International Conference

ON

ADVANCES IN NANOMATERIALS AND NANOTECHNOLOGY (ICANN-2025)

05-06 March 2025

Department of Physics
Rajdhani College,
University of Delhi
New Delhi -110015

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Proceedings of
International Conference on

"ADVANCES IN NANOMATERIALS AND NANOTECHNOLOGY" (ICANN – 2025)

Organized by

Department of Physics

Rajdhani College

University of Delhi

New Delhi - 110015

Scope of Conference

The conference aims to articulate metallurgical and technological advancement in ancient India along with the latest advances in this field. The conference is centered on the interdisciplinary research on processing, structure and various properties of nanomaterials along with their scope in various fields. This forum will open new horizons for discussing basic studies and applications related to nanomaterials. It will address topics of novel issues, difficulties, and breakthroughs in the field of nanomaterials. In the wake of enormous advancement and potential use in different applications of nanomaterials, this conference has been structured to assemble together scientists, researchers, faculty and experts to discuss the recent advancements in this field. The discussion will encompass basic studies and applications and also address the topics of novel issues, difficulties, and breakthroughs in the field of nanomaterials. The “Advanced Nanomaterials and Nanotechnology” conference brings out together the innovations in advanced materials and nanotechnology through expected scientific presentations, networking as well as engagement of companies developing innovations in tools and technologies in this space. The conference organizing committee is providing a podium for all the budding young researchers, enthusiastic and curious investigators to showcase their research and innovation. Our participants will gather together to achieve collective priorities, including the dissemination of knowledge generated through research studies and strengthening the community of Theoretical and Applied Nanotechnology. Each session has been meticulously designed to help participants achieve these goals and enrich them scientifically. The conference provides an excellent opportunity for expert career guidance and research project advice.

Sub-themes

- · Advancement and Emerging Research in Nanomaterial and Nanotechnology in Defence sector
- · Advanced Smart and Sustainable Nanostructured Materials
- · Environmental Nanotechnology and Sustainable energy storage
- · Nanobiotechnology: Nanomedicine, Environment Nanobiotechnology
- · Nanomedicine and Healthcare applications
- · Commercialization and Industrial Perspectives
- · Nano Satellites, Nanosensors
- · Advanced Material for Nanodevice Fabrication
- · Nano Antenna
- · Nanophotovoltaics and Nanoelectronics
- · Metallurgical and technological Advancement in Ancient India
- · Materials and Technologies for Sustainable Environment
- · Advanced Materials Devices
- · Nanotechnology: Insights and challenges
- · Emerging Areas of Materials Science
- · Polymers Science & Nano Engineering
- · Carbon Nanostructures and Graphene
- · Nuclear Radiation, Radiation Dosimetry
- · Radiation Detection

राजधानी कॉलेज
(दिल्ली विश्वविद्यालय)
RAJDHANI COLLEGE
(UNIVERSITY OF DELHI)

Chairman of the Conference's Message

Since its establishment in 1964, Rajdhani College has remained steadfast in its commitment to fostering the holistic development of its academic community. The institution takes immense pride in the accomplishments of its alumni, who have excelled across diverse fields, including academics, administrative services, judiciary, armed forces, politics, fine arts, theatre, research and development, sports, mass media, and beyond. Upholding the values of diligence, dedication, cooperation, tolerance, and social responsibility, the College continually endeavors to instill these principles in its students.

Each year, a multitude of students join Rajdhani College with the aspiration of realizing their potential and exploring opportunities for academic and extracurricular growth. The institution offers a wide array of platforms for both individual and collective development, ensuring students have ample opportunities to excel. Through departmental societies, students engage in lectures, seminars, workshops, conferences, and competitions, fostering critical thinking and active participation in academic pursuits. It is a matter of immense pride that our college continues to make remarkable strides in the realm of academic excellence and research. The Department of Political Science successfully organized a prestigious two-day National Conference on the Uniform Civil Code, sponsored by ICSSR, which provided a platform to explore and acknowledge the diverse societal dimensions of this important subject. Adding to this legacy of scholarship, the Department of Chemistry hosted an insightful two-day National Conference on the Use of Chemistry in Forensic Research, fostering innovative discussions and advancing knowledge in this crucial field. Yet another feather in our cap was the college's initiative to send a dedicated team of teachers and students to the Mahakumbh Mela to study its socio-economic and cultural implications. This remarkable field study culminated in a one-day seminar where the team presented their findings, unveiling the rich and multifaceted dimensions of their research. These endeavors reflect our unwavering commitment to nurturing intellectual curiosity and contributing meaningfully to society. Additionally, various co-curricular and extracurricular committees—including the Cultural Committee, Debating Society, Creative Writing Society, Entrepreneurship Cell, NCC, NSS, WDC, Enactus, Yoga and Meditation Committee, and Yuva—contribute to a well-rounded educational experience, nurturing students as both scholars and socially responsible individuals.

Rajdhani College is distinguished by its student-centric infrastructure and dynamic academic environment, which encourage engagement and foster a strong sense of belonging. Renowned for their dedication, professionalism, and efficiency, the faculty prioritize critical thinking and cognitive skill development through student-centered pedagogical approaches. The collective efforts of the staff and all stakeholders in addressing the diverse needs of students have played a crucial role in strengthening the institution's unwavering commitment to academic excellence.

On behalf of the Rajdhani College community, I extend a warm welcome to all participants of the International Conference on "ADVANCES IN NANOMATERIALS AND NANOTECHNOLOGY" (ICANN – 2025). This conference aligns with the vision of Viksit Bharat 2047, and I sincerely extend my best wishes for its success and for all your future endeavors.

Best regards,
Prof. Rajesh Giri
Principal

राजधानी कॉलेज
(दिल्ली विश्वविद्यालय)
RAJDHANI COLLEGE
(UNIVERSITY OF DELHI)

Convener's Message

The field of Materials Science, through the manipulation of matter at atomic, molecular, and supramolecular scales, has significantly contributed to the development of innovative materials and their unconventional applications. Nanotechnology, encompassing the study and utilization of matter within the 1-100 nm size range, is distinguished by the predominance of quantum mechanical effects, which impart properties vastly different from those of bulk materials. Given its broad scope, nanotechnology intersects with various scientific and technological disciplines, necessitating a continuous exchange of knowledge and ideas among researchers and experts.

Conferences serve as essential platforms for facilitating such intellectual exchanges, enabling discussions on current advancements and future directions in research and development. In this regard, it is my privilege to announce the International Conference on "Advances in Nanomaterials and Nanotechnology" (ICANN – 2025), organized by the Department of Physics, Rajdhani College, University of Delhi, scheduled to be held on March 5th – 6th, 2025.

I extend a cordial invitation to all participants and look forward to insightful discussions that will contribute to the enhancement of scientific knowledge. Additionally, this conference will provide an excellent opportunity to foster meaningful collaborations for the advancement of the research community.

Best regards,
Dr. Jasvir
Convener, ICANN 2025

राजधानी कॉलेज
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A Report on ANN 2024

On 20th-21st March, 2024 the Department of Physics, Rajdhani college has organized a Two Day “National Conference on Advances In Nanomaterials and Nanotechnology” which comes under the vision of “Viksit Bharat @2047” . The chief Patron of this conference was Prof.Rajesh Giri, Principal, Rajdhani college, University of Delhi. The program was filled with the involvement of significant people and research scholars who have presented their papers on the topic of Nanomaterials etc. Prof. Rajesh Giri has guided and enlightened all the present audience and Chief Guests with his golden and knowledge filled words. The Chief Guest of the conference was Prof. Tankeshwar Kumar, Vice Chancellor, Central University of Haryana. The keynote speaker of the conference was Dr. Laishram Radhapiyari scientist F, SSPL, DRDO, New Delhi. The conference was filled with so much of Themes like “Effect of Post annealing on Third Order Nonlinear optical properties of ZnO Thin Films, Study of Dielectric, Piezoelectric and Ferroelectric properties of the ZnO nanoparticles synthesized by the co-precipitation method, Utilizing Carica Papaya Leaf Extract for the Synthesis of Zinc Oxide Nanoparticles: Photocatalytic Degradation of Congo Red Dye, Development in materials and device design of Halide Perovskite Semiconductor lasers, Ytterbium fibre laser with Diamond: A new approach to Laser Threshold Magnetometry etc. On the second day of the conference many research scholars have presented the poster presentations on the various dimensions of the topic of Nanomaterials and Nanotechnology. The chief guest of valedictory session was Dr. D.S. Rawal, scientist H,SSPL, DRDO , New Delhi. In the end the vote of thanks is given to all the participants including speakers presenters and all. The Conference was filled with so much of learning about the Advances in Science and its various dimensions.

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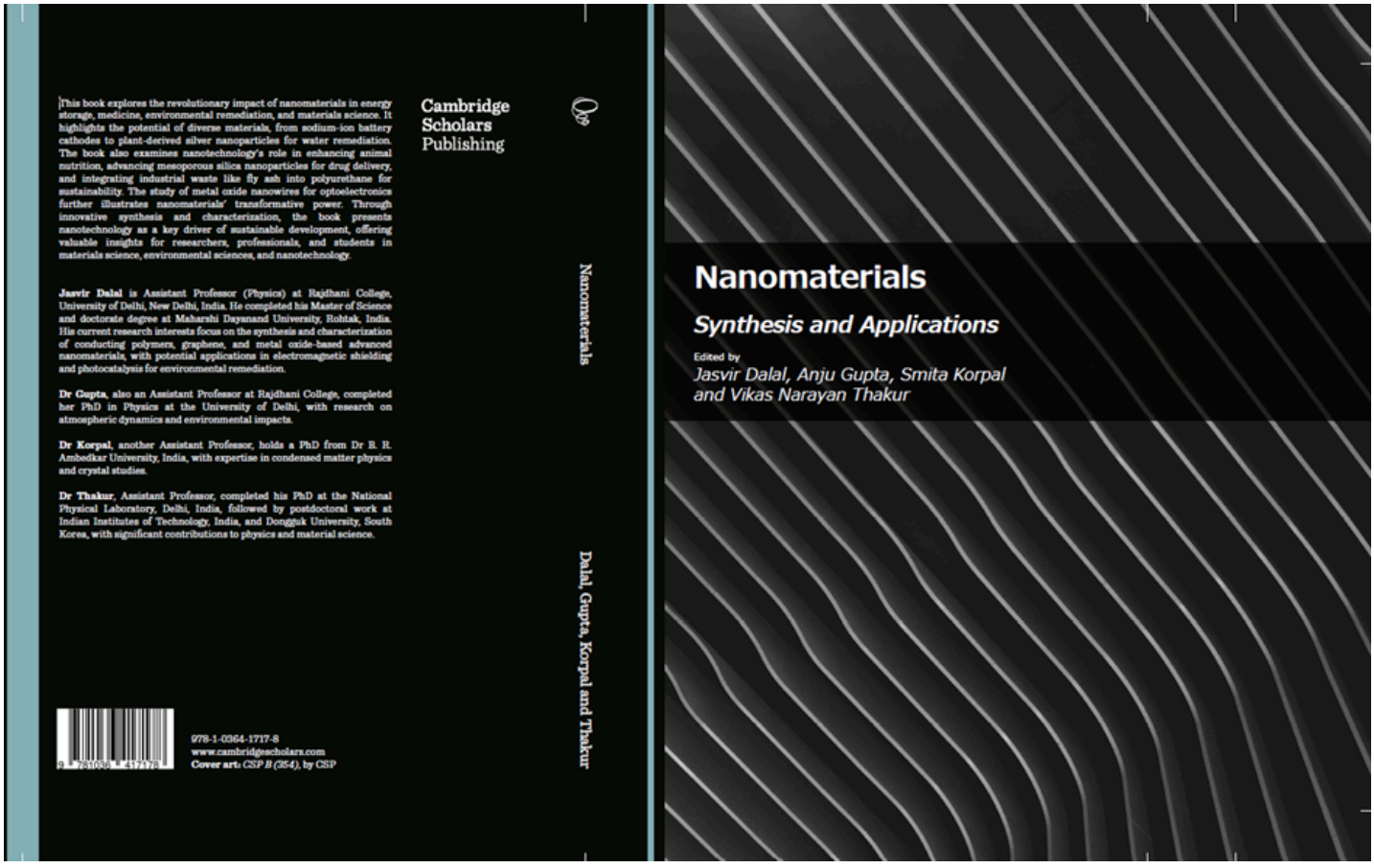

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[1] **EFFECT OF INDIUM TIN OXIDE NANOPARTICLES ON THE ALIGNMENT OF NEMATIC LIQUID CRYSTALS**

Saifa Tafseer, Jai Prakash

Physics Department, Aligarh Muslim University

Abstract: The tunable dual alignment could be utilized to make improved and high-performance tunable LC-based devices used in the purpose of sensing, displays, photonics, photovoltaics, memory devices. Therefore, for that we need to align Liquid Crystal (LC) materials on different substrate surface in various configurations. Several techniques such as rubbing, groove formation, photo-alignment, irradiation etc. are used to align LC materials in the desired way. But these techniques are not that much cost effective and induce several impurities in the LC system. Therefore, nanoparticles (NPs) based alignment is not only useful for achieving specific alignment but also, they are able to tune other display parameters in the desired way. This work covers the achievement of various alignments (homogeneous and homeotropic) of a Nematic liquid crystal (NLC, 5CB) material in ITO sample cell devoid of alignment layer by dispersion of indium tin oxide (ITO) NPs (0.25 wt% and 1 wt%). Various LC alignments are observed with the help of polarizing optical micrographs in presence of external DC biasing voltage. POM depicts the various domains of 5CB in pristine form while uniform vertical (homeotropic) monodomain was achieved through the dispersion of 0.25 wt% ITO NPs that, interestingly, again tuned to the planar (homogeneous) alignment when ITO concentration was increased up to 1 wt%. To further confirm POM observations, the frequency-bias dependent dielectric parameters (dielectric permittivity, dielectric loss and loss factor) were also examined.

Keywords: photovoltaics, Nanomaterials, indium tin oxide

[2] **Study of Shape and Size dependence of thermophysical properties of Nanomaterials**

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Abstract: A simple model named as Bond energy model has been proposed in terms of melting temperature to explain the shape and size effect on Debye temperature (ΘDn) and Einstein temperature (ΘEn) of nanomaterials. It is found that Debye temperature and Einstein temperature are reduced in nanomaterials as their size is reduced. The variation in these physical properties is calculated for various shapes i.e., sphere, thin film, and nanowire. The computed results are compared with the available experimental results and it is found that there is a good agreement between them. The results obtained for the bulk materials are also depicted in the graphs to judge the stability of this work.

Keywords: Debye temperature; Einstein temperature; size; shape

[3] **Deep Wet Etched Silicon Cavities for Scalable Microfabricated Alkali Vapor Cells in Quantum Sensing**

Neeharika Shree Pareek[1,2], Pintu Das[1], Preeti V. Shah[2], Poornendu Chaturvedi[2]
1.Indian Institute of Technology Delhi, 2. Solid State Physics Laboratory, DRDO

Abstract: Microfabricated Alkali Vapor Cells (MAVCs) are at the heart of several quantum sensing devices, such as atomic clocks, magnetometers and gyroscopes. These miniaturized vapor cells offer advantages in terms of significant reduction in size, weight, cost and power consumption making them highly attractive for portable and scalable quantum systems. In this work, we demonstrate the double-sided wet etching technique for Amardeep Bajwar through cavity fabrication in 1.4 mm thick silicon for the development of MAVCs. Photolithography is employed to define the cavity patterns. Selection of an appropriate mask that can withstand extended etching durations is a critical step, and low-pressure chemical vapor deposition (LPCVD)-grown Silicon nitride masks have been optimized in this work. The etching process is thoroughly characterized using Dektak profilometry and Scanning Electron Microscopy (SEM) to assess the etch rate, surface morphology, etch depth uniformity, and sidewall quality—critical factors influencing MAVC performance. The etch rate is found to be ~ 0.6 μm/min. Additionally, a comparative assessment with alternative fabrication techniques such as water jet drilling, DRIE, laser drilling, etc., is presented. These results pave the way for the scalable and reproducible fabrication of MAVCs, offering improved performance for next-generation quantum sensing applications.
Keywords: Nanomaterial, SEM and LPCVD

[4] **Thickness dependent digital-to-threshold resistive switching behaviour in polymer composite based memristive devices**

Farhana Yasmin, Rajesh Deb, Asim Roy, Avijit Chowdhury, Saumya R. Mohapatra
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Abstract:Green electronics play a crucial role in minimizing environmental impact and enabling implantable devices. Organic, non-toxic materials are prime candidates for sustainable electronics, with polymer-based devices gaining significant attention due to their flexibility and biocompatibility. This study investigates the influence of switching layer thickness on the performance of copper (II) sulfide nanoparticle (CuS NPs) based polymer composite (PC) memristive devices. A two terminal, vertically structured memristor (Cu/CuS NPs-PC/ITO) is fabricated, where copper serves as the top electrode (TE) and ITO as the bottom electrode (BE). The switching layer, composed of CuS NPs-PC, is spin coated onto the BE at different speeds (3000, 4000, and 5000 rpm), resulting in varying film thicknesses. The devices exhibit both volatile and non-volatile switching characteristics, revealing a strong dependence of switching behavior on the thickness of the switching layer. While previous studies have focused on compliance current dependent switching, thickness dependent switching remains unexplored in polymer composite based memristive field. The switching mechanism is explained by the electrochemical metallization (ECM) process, where copper nano-filaments form and rupture due to electrochemical redox reactions at the interface. The non-volatile/digital switching behavior arises from the formation of stable copper filaments, whereas volatile/threshold

switching occurs due to weak and unstable filaments. This study highlights the critical role of thickness in

determining switching characteristics and suggests that integrating non-volatile bipolar and volatile memristive devices could advance neuromorphic computing.

Keywords: Polymer composite (PC), memristive device, volatile and non-volatile resistive switching, electrochemical metallization (ECM).

[5] SYNTHESIS OF QUANTUM DOTS FROM CLITORIA TERNATEA EXTRACT AND STUDY OF ITS USAGE IN INTELLIGENT PACKAGING

Pandala Neha, Ms. K. Suman
St. Francis college for women

Abstract: Food spoilage is a natural process caused by microorganism growth, chemical change and enzymatic reaction which leads to quality and safety deterioration. Indicators are the tools in intelligent packaging which provide real time visual cue to assess food freshness and prevent consumption of spoiled product. pH indicators are particularly effective in monitoring food quality as they respond to biochemical change during spoilage. The current study includes extraction of floral compound of *Clitoria ternatea* and enumeration of its properties in intelligent packing. *Clitoria ternatea* (CT) commonly known as butterfly pea flower contain anthocyanins which change color in response to pH variation during spoilage making it a good natural indicator. The flowers were collected, dried, powdered, and macerated in methanol for 15 days to produce CT extract. The CT extract was optimized and a natural pH indicator was prepared and used for further studies. Green synthesis was employed to produce Quantum dots (QDs) using CT extract. The CT extract solution was subjected to continuous stirring conditions followed by holding at high temperature to produce QDs. The structural characterization of QDs was analyzed by UV-Vis spectroscopy, FTIR, XRD, SEM. The indicator films with CT extract and QDs were made using PVC and sodium alginate and used to investigate its application in intelligent packing of different food products as an alternative in the detection of food spoilage by rapid visual method.

Key words: *Clitoria ternatea*, pH indicator, Quantum dots, characterization, intelligent packaging.

[6] Analysis of Structural Parameters of rare earth doped metal oxide via Hydrothermal Route

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Abstract: In this present work, rare earth doped transition metal oxides have been synthesized using hydrothermal route. This route possesses not only uniform incorporation of dopant ions into the metal oxide structure but also improving its optical and photo catalytic properties. Doping improves light absorption and emission capabilities, making it more effective. The hydrothermal method is an efficient, cost-effective approach for producing high-quality sample

with improved performance and potential for advanced technological applications. Various structural parameters like crystallite size, strain, dislocation density, lattice parameters etc. have been calculated via X-ray Diffraction technique (XRD).

Keywords: Transition metal, Dopant, Hydrothermal Route, Structural parameters.

[7] Targeting cAMP Receptor Protein (CRP) in *Gardnerella vaginalis* Using Phytochemicals from *Camellia sinensis*: An In-Silico Approach for Nanomedicine Applications

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Abstract: Bacterial vaginosis (BV), primarily caused by *Gardnerella vaginalis*, is still a severe clinical issue due to recurrence and the emergence of antibiotic resistance. The cAMP Receptor Protein (CRP) is a key regulator of bacterial gene expression and metabolic adaptation and a potential target for new therapeutic strategies. An in-silico strategy was used in this investigation to screen phytochemicals from *Camellia sinensis* as potential CRP inhibitors, highlighting their applications in nanomedicine for targeted therapies. The three-dimensional structure of CRP (PDB ID: 7ETS) was optimized with Discovery Studio, and the most significant phytochemicals were selected based on ADME profiling for drug-likeness determination and nanocarrier system compatibility. Molecular docking was conducted using AutoDock Vina, with Apigenin demonstrating a binding affinity of -7.3 kcal/mol, indicating a strong and stable interaction with the protein. Binding interaction analysis confirmed the formation of stable hydrogen bonds with SER (A:81) and ARG (A:144), which were complemented by π-π stacking and π-cation interactions between ARG (A:174) and LEU (A:197). These stable interactions not only define the binding ability of the ligand but also its potential to be incorporated into nanocarriers, such as liposomes or chitosan-based nanogels, that can enhance bioavailability, stability, and targeted delivery. Incorporation of these phytochemicals into nanomedicine formulations can lead to controlled release, thereby ensuring localized therapeutic action at the infection site and minimizing systemic side effects. Incorporation of naturally occurring bioactive molecules and nanotechnology offers a promising platform for the development of precision-targeted therapies against BV. Future research will involve performing molecular dynamics simulations and nanocarrier optimization to enable and complement these findings towards potential clinical applications.

Keywords: Bacterial vaginosis, cAMP Receptor Protein, Camellia sinensis, Molecular Docking, Nanomedicine.

[8] **Optimization of firing temperature of Lithium Ferrite synthesized wet combustion method**

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Abstract: Lithium ferrite ($Li_{0.5}Fe_{2.5}O_4$) belongs to the class of soft magnetic materials having ferrimagnetic ordering. In the present studies lithium has been prepared by combustion technique. As Lithium is volatile in nature so firing temperature is optimized at 600℃. That's why wet chemical combustion route has been choosing for the synthesis of lithium ferrite. XRD pattern reveal the ordered (P4132/P4332 space symmetry) and disordered phase (Fd3m space symmetry). The site preference of the $Li^{+}$and Fe^{3+} has been calculated by cation distribution method. The results are well matched with the Riteveld refinement. The crystallite size has been calculated with the Scherer formula of cubic symmetry. As lithium ferrite is promising material for microwave devices due to its square hysteresis loop. So, for the further studies of substituted lithium ferrite with divalent, trivalent transition metal cations decided to substitute at optimum firing temperature 600℃. The applications of lithium ferrites in energy storage devices, in medical used in drug delivery, cancer treatment, stealth technology etc.

Keywords: Ferrimagnetic ordering, wet chemical, space symmetry, cation distribution

[9] **Electrochemical immunosensor Based on NiO for CA 15-3 detection and agent based modelling and treatment optimization**

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Abstract: Diagnosis of breast cancer at its onset is crucial for the therapeutics so as to make the condition treatable, thereby increasing the patient survival rate. We report herein a simple and efficient electrochemical method using NiO thin film-based immunoelectrode to detect the proteins released by cancerous cells in human plasma (CA 15–3 polyclonal antibody). The raised polyclonal antibody is confirmed by Scanning Electron Microscope (SEM), Western blot and ouchterlony techniques. The developed immunoelectrode (CA 15–3/NiO/ITO/glass) has a low

detection limit of 5 U/mL, sensitivity of 0.18 mA/(UmL-1) and fast response time of 2 s, which is comparable to that obtained with commercial ELISA kit. The testing of real samples of breast cancer was carried out using both the prepared immunoelectrode and CA 15–3 ELISA kit and the outcomes show strong correlation with one another. Interference studies with other diseases such as ovary cancer, lung cancer, asthma and tuberculosis were also analyzed by both techniques. The prepared immunoelectrode (CA 15–3/NiO/ITO/glass) was found to be highly sensitive and selective towards breast cancer detection and pave the way for the development of a simple, cost-effective and fast detection technique for breast cancer detection. We used an agent-based simulation model to evaluate the effects of targeting distinct cancer cell populations in breast cancer. Results showed that targeting cancer stem cells (CSCs) prevents tumor regrowth but harms other living cells, while targeting migratory cancer stem cells reduces metastasis with minimal impact on tumor mass. Targeting transitory cells lowered tumor burden without affecting metastasis. These findings suggest that a combined approach targeting CSCs, migratory stem cells, and transitory cells is crucial for effectively managing tumor growth and metastasis, offering a comprehensive strategy for breast cancer treatment.

Keywords: Breast Cancer Biomarker, Thin film, Immunosensor, Agent Based modelling

[10] **Solvothermally Synthesized Zn-Doped MgO Nanocomposites for the Efficient Photodegradation of Congo Red Dye**

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Abstract: This study shows the improved photocatalytic activity of zinc (Zn)-doped manganese oxide (MnO) nanocomposites prepared using a solvothermal method. The prepared compounds were thoroughly analyzed using X-ray Diffraction (XRD), UV-Visible Spectroscopy (UV-Vis), and Scanning Electron Microscopy (SEM). XRD analysis verified crystallite dimensions between 18–25 nm, and UV-Vis spectroscopy evidenced a significant decrease in the energy band gap from 3.18 eV to 2.88 eV after Zn doping, reflecting enhanced visible-light absorption. SEM imaging showed multifarious morphologies of spherical, oval, and hexagonal nanoparticles, proposing a unique nanostructural organization affected by the doping process. The photocatalytic efficacy of the Zn-doped MnO nanocomposites was assessed using Congo red dye under visible-light irradiation, achieving a remarkable degradation efficiency of 85%. These findings underscore the potential of Zn-doped MnO nanocomposites for environmental remediation, particularly in the degradation of hazardous organic dyes.

Keywords: Manganese oxide MgO, Zinc Zn, Photocatalysis, Congo red dye, Nanocomposites

[11] Metamaterial-Based Optical Devices for Novel Applications

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Abstract: Using the numerical method, we plot the transmission features of a ternary photonic crystal (PC) consisting of metamaterial and dielectric layers. Photonic crystals consist of alternative layers of different materials with periodicity. When the transmission curves of such ternary photonic crystals are plotted and compared, we find that the transmission properties are tunable by changing the thickness of the metamaterial. Due to the unlike behaviour of metamaterial, they show a wide variety of applications in tunable optical devices and wideband absorbers, and sensors.
Keywords: metamaterial, ternary, periodic, transmission, matrix method, sensors

[12] Advanced Materials and Development Techniques for Solar Cell Devices

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Abstract: This review explores the rapidly growing field of polymer and organic solar cells, focusing on materials, processes, and devices that diverge from the conventional approach. The standard method typically involves rigid glass substrates, indium-tin-oxide electrodes, spin-coated layers of conjugated polymer/fullerene blends, and evaporated metal electrodes arranged in a flat multilayer structure. It is believed that significant breakthroughs could emerge from further exploring these innovative ideas. The goal of this review is to highlight these emerging studies and inspire renewed interest in materials and techniques that, while currently underperforming compared to the state-of-the-art, may have the potential to surpass existing technologies with further development and investment.

Keywords: Spin- Coated layers, Silicon , Solar cells , polymer, Hetro junction device .

[13] Structural and Mechanical Properties of Hot Cathode Arc Discharged TiNx Thin Films

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Abstract: Titanium nitride (Ti_xN) exhibits various important applications in technological fields, including mechanical properties like hardness, wear and corrosion resistance. This material is also used in semiconductor devices for diffusion barriers, adhesion layers and contact layers due to their high conductivity. In the present work, we have deposited Titanium thin films using pulsed plasma deposition technique on Si substrate. We have established a hot cathode arc

discharge system for treating Titanium thin films. In this system, we can independently monitor the plasma parameters and optimize the nitriding parameters of work piece. A mixture of H_2 and N_2 gases in the ratio of 80:20 respectively was fed into the plasma chamber and the treatment time and substrate temperature were optimized for treating Ti films. To investigate the effect of nitriding time and hydrogen gas on the structural, morphological and mechanical properties of Ti_xN thin films, the films were characterized by various physical techniques. For structural analysis, the pristine and nitride films were characterized using XRD whereas morphological and roughness of the films were estimated from SEM. Further, hardness of these films was calculated using AFM in nanoindentation mode.

Keywords: Titanium nitride (Ti_xN), XRD.

[14] **To Investigate The Redox-Active Electrolyte For Supercapacitor Application**

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Abstract: Due to the rising demand for renewable sources, researchers are interested in electrochemical energy storage devices. Various types of energy storage devices are supercapacitors, batteries, and fuel cells. Supercapacitors are gaining much attention due to their characteristics of high-power density, quick charging/discharge processes, and long-life cycle stability. The electrolyte is one of the key components of the supercapacitor affecting it's overall performance. The focus is to choose an effective redox-active material to enhance the energy density and specific capacitance of the supercapacitor cell. This study focusses on the role of redox-active compounds in enhancing the parameters of supercapacitors. Sunflower seed-activated carbon-based supercapacitor cells containing Hydroquinone (HQ) as a redox-active electrolyte were studied and electrolyte characterization such as Fourier Transform Infrared Spectroscopy and Impedance Spectroscopy was performed wherein the presence of various functional groups and ionic conductivity respectively was found to increase. The electrochemical characterization such as Cyclic voltammetry, Electrochemical Impedance Spectroscopy, and Galvanostatic Charge-Discharge were conducted for HQ doped supercapacitor cell, and various parameters like specific capacitance, energy density, and power density were calculated and were found to be increased from the supercapacitor cell with no additive. The specific capacitance of 399.8 Fg^{-1}, energy density of 18.315 $Whkg^{-1}$ and a power density of 549.45 kW kg^{-1} was achieved. The main advantage of this innovative technique lies in its straightforward, safe, and cost-effective preparation method.

Keywords: *Supercapacitors, redox-active, ionic conductivity, power density*

[15] **Hyperbolic Metamaterials for Potential Applications in Light Manipulation through Layered Media**

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Abstract: Metamaterials are artificially created media having frequency dependent refractive index that becomes negative in certain frequency ranges. Hyperbolic metamaterials are new

generation of materials that allow manipulation of light transmission through them. They control light propagation and manipulation of EM waves at nano scale allowing hyperbolic dispersion. Owing to such transcendental control of light, they are widely used in spontaneous emission, nano lithography and other optical devices, which may revolutionize the optical communication. In this paper, we analyzed the propagation characteristics with a nano composite material in a periodic structure as the layers to study its optical characteristics that may work as super lattice. It is found that hyperbolic metamaterials play a vital role as good absorbers. Therefore, such high absorbing materials may open the door of advanced solar cell technology, enhanced emission control and other potential applications.

Keywords: nanocomposite, metamaterial, optical property, abnormal dispersion, absorber.

[16] **Tunable Angle Dependent Transmission Spectra in a Quaternary Photonic Crystal**

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Abstract: In this study, we consider a quaternary photonic crystal (QPC) structure, with each unit cell composed of three semiconductor layers and a layer of metal. The transfer matrix method is used to plot the transmission spectra in the terahertz range for this QPC structure while varying the angle of incidence. As the incident angle is varied, a shift of the transmission peaks toward higher frequencies is observed. We have studied the variation of the incident angle from 0° to 60°, and it is observed that increasing the angle results in the peak shifting towards higher frequency regions. This tunable behavior of the proposed QPC structure holds potential for applications in the design of optical filters and optical devices.

Keywords: transfer matrix method (TMM), quaternary, semiconductor, optical filters, optical devices.

[17] **Application of copper and Zinc nanoparticles in the photocatalytic degradation of dye from wastewater**

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Abstract: The current study illustrates the use of *Punica granatum* peel extract to manufacture copper and Zinc nanoparticles. To analyze the produced nanoparticles, a variety of methods were used, including UV-visible, Zeta sizer, Fourier transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM) with energy dispersive X-ray analysis. UV-visible and FTIR measurements were used to identify bioactive compounds responsible for nanoparticle reduction and stabilization. The SEM and zeta investigation verified that the average crystallite size was 10-50 nm and had tubular and flakes-like structures respectively. Moreover, the

degradation of methylene blue dye under solar irradiation was studied using the photocatalytic potential of green-produced Cu NPs and ZnO NPs. The decolorization efficiency for the removal of methylene blue dye was about 98% after 180 minutes of reaction for CuNPs and 95% for ZnO NPs. Future studies are needed to examine how the peel extract concentration affects the physical, chemical, and optical characteristics of the Cu NPs and ZnO NPs that are produced.

Keywords: Copper nanoparticles, Zinc oxide nanoparticles *Punica granatum*, Methylene blue dye, Decolorization

[18] SYNTHESIS OF ACTIVATED CARBON FROM WALNUT SHELL USING KOH AND EXPLORING ITS APPLICATIONS

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Abstract: Activated carbon, also known as activated charcoal, is a very adaptable substance that is made from carbon-rich materials including wood, coconut shells, and walnut shells. Activated carbon gains a large surface area and a complex network of pores by a process called activation, which entails heating the carbonaceous material to high temperatures in the presence of an activating chemical like potassium hydroxide (KOH). Because of its special structure, activated carbon is able to efficiently absorb a variety of toxins and impurities from wounds resulting in faster wound healing. It is used in various wound dressings to treat chronic and infected wounds. This study focuses on the chemical activation method that creates activated carbon from walnut shells using KOH. 170 grams of walnut shell were impregnated at a ratio of 1:1 with KOH in the experimental setup. A yield of 30 grams of activated carbon is obtained during the activation carbon process. After undergoing XRD characterization, the resulting activated carbon was shown to have exciting potential in wound care applications through its incorporation into wound dressings and topical ointments.

KEYWORDS: Activated carbon, Walnut shells, Chemical activation, Adsorption

[19] Use of Platinum based nanoparticles in fuel cells.

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Abstract: Platinum-based nanoparticles are critical electrocatalysts in proton exchange membrane fuel cells (PEMFCs), offering high catalytic activity for oxygen reduction reactions. However, their carcity and cost limit widespread fuel cell adoption. This research investigates strategies to enhance the efficiency and durability of platinum nanoparticles while minimizing platinum usage. Specifically, we aim to address the gap in understanding the structure-activity relationship of tailored platinum alloy nanoparticles, exploring how controlled synthesis and surface modification impact their electrochemical performance. Utilizing electrochemical

characterization, transmission electron microscopy, and X-ray diffraction, we analyze synthesized nanoparticles to correlate their structural properties with catalytic activity. Our approach focuses on developing robust and cost-effective platinum-based catalysts, ultimately promoting the commercial viability of fuel cell technology.

KEYWORDS: PEMFCs, durability of platinum nanoparticles.

[20] Synthesis and Characterization of Rutile TiO_2 and g-C_3N_4 nanocomposite: An Experimental and DFT studies

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Abstract: In present study we synthesized rutile-TiO_2 and g-C_3N_4 nanocomposite by hydrolysis route. The XRD analysis confirmed the successful formation of a rutile-TiO_2 and g-C_3N_4 nanocomposite. SEM technique is used to analyze the morphology of nanocomposite. To analyze structural information Raman spectroscopy was performed and UV-Visible Spectroscopy results showed that nanocomposite of TiO_2 and g-C_3N_4 having the band gap of approximately 3 eV. In this process, Titanium (IV)-isopropoxide (TTIP) and g-C_3N_4 are mixed with water and suitable solvent then giving heating treatment and annealing. This result in formation of nanocomposite with controlled size and morphology. Where theoretical calculation is done on individual system on bulk rutile-TiO_2 and C_3N_4 by DFT where bands structure is reproduced by GGA+U approximation showing 3.1 eV and 2.7 band gap. Projected density of state is used to describe actual orbital contribution of TiO_2 and C_3N_4 system. As research in this field continues to advance, we can expect to see even more exciting bioapplication of this nanocomposite in the near future.

Keyword: Rutile Phase, Nanocomposite, Hydrolysis, g-C_3N_4, Bioapplication.

[21] Unlocking the Potential of Alkali-Cation-Based Perovskite Solar Cells: A Route to Enhanced Efficiency

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Abstract: With outstanding optoelectronic properties, Tin-based $ASnI_3$ type of inorganic perovskites is a promising candidate as lead-free visible light absorbers in perovskite solar cells (PSCs). However, their performance is significantly limited by severe non-radiative recombination losses resulting from interfacial defects and the energy band offsets at the interfaces. These issues need to be addressed for designing high-performance solar cells. This study has investigated alkali-based perovskite materials $ASnI_3$ for their potential use as a perovskite absorber layer (PAL) in PSCs using SCAPS-1D software. The device architecture FTO/ETL/PAL/HTL/Carbon has been investigated with different hole transport layers (HTLs) namely CFTS, CUSCN, CuI, and Spiro-OMeTAD to examine the best HTL to boost the device

performance with CdZnS as electron transport layer (ETL). Carbon has been incorporated as a back electrode with the proposed structure owing to its good chemical stability, and electrical and thermal conductivity. Further, the impact of thickness variation, interface defects, temperature, and energy band offset on the photovoltaic parameters has been investigated in detail. After a series of optimizations, the proposed device results in an optimized PCE of over 22% with CuI as HTL and CdZnS as ETL. The results of the present investigation are anticipated to design and develop alkali-cation-based PSCs with decent efficiency and stability.

Keywords: Mixed-cation perovskites, carbon electrode, copper-based hole transport layers, Energy band offsets, perovskite solar cells.

[22] Structural, Magnetic properties, Dielectric properties, AC conductivity and EMI shielding properties of Co-Sr nanoferrite

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Abstract: $Co_{0.5}Sr_{0.5}Fe_2O_4$ ferrite nanoparticles were prepared by solution combustion technique. Co-Sr nanoferrites were characterized by X-ray diffraction analysis, Fourier transform-infrared spectroscopy, Scanning electron microscopy and Vibrating sample magnetometer Studies. Co0.5Sr0.5Fe2O4 ferrite nanoparticles were prepared by solution combustion technique. The Co-Sr nanoferrites were characterized by X-ray diffraction analysis, Fourier transform infrared spectroscopy, scanning electron microscopy, and vibrating sample magnetometer studies. Current nanoferrites exhibit ferromagnetic behaviour at room temperature. Frequency dependence of Dielectric constant AC conductivity and Electromagnetic Interference. The EMI shielding effectiveness characteristics in the frequency range of 50 Hz to 5 MHz at room temperature were studied. t is found that the dielectric constant decreases with increasing frequency. It is found that the AC conductivity increases with increasing frequency. The electrical conduction mechanism of as prepared nano ferrite is found to be in accordance with the electron hopping model. The EMI shielding effectiveness characteristics of the nano-ferrite decrease as the frequency increases.

Key words: Ferrites, Magnetic properties, Dielectric properties, Conductivity, Hysteresis, EMI shielding

[23] Analytical Study of Self-Phase Modulation in Nonlinear Photonic Crystal Fibers

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Abstract: Self-phase modulation (SPM) is a fundamental nonlinear optical effect that plays a crucial role in pulse propagation in photonic crystal fibers (PCFs). This paper presents a rigorous theoretical analysis of SPM in nonlinear PCFs, focusing on the mathematical derivation of nonlinear phase shift and spectral broadening. Using the nonlinear Schrödinger equation (NLSE), we derive analytical expressions for intensity-dependent phase modulation and investigate its dependence on fiber parameters such as core diameter, effective mode area, and nonlinear coefficient. The impact of pulse shape on nonlinear phase evolution is explored through Gaussian and hyperbolic secant (sech) pulses. Additionally, the conditions for soliton formation in nonlinear PCFs are examined based on the interplay between self-phase modulation and dispersion. Theoretical results indicate that smaller core diameters enhance nonlinear interactions, leading to stronger spectral broadening. The findings provide insights into optimizing photonic crystal fiber designs for high-nonlinearity applications such as supercontinuum generation and optical pulse compression.

Keywords: Self-Phase Modulation (SPM), Nonlinear Optics, Spectral Broadening, Nonlinear Phase Shift, Optical Pulse Propagation

[24] **Applications of Photonic Crystal Fibers in Modern Optical Technologies**

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Abstract: Photonic crystal fibers (PCFs) have revolutionized optical technologies due to their unique guiding properties and tunable dispersion characteristics. These fibers, designed with a periodic microstructured cladding, enable enhanced light confinement, leading to numerous applications across various domains. This paper explores key applications of PCFs, including supercontinuum generation, high-power laser delivery, optical sensing, and telecommunications. Their ability to support endlessly single-mode propagation and high nonlinear interactions makes them ideal for nonlinear optics and biomedical imaging. Additionally, PCFs are widely employed in gas and chemical sensing due to their high sensitivity and customizable dispersion properties. Emerging applications in quantum optics and ultrafast pulse generation further highlight the transformative role of PCFs in modern photonics.

Keywords: Photonic crystal fiber, supercontinuum generation, optical sensing, nonlinear optics, high-power lasers, optical communication, biomedical imaging, quantum optics, ultrafast pulse generation.

[25] **Biomedical Applications of Various Carbon-Based**

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Abstract: The field of healthcare relies significantly on sensors. In biomedical applications, carbon sensors are essential, especially when analysing clinical samples. This study examines the use of carbon sensors in clinical sample analysis, emphasising their importance in contemporary

medical diagnosis. Applications for carbon sensors are numerous, ranging from tracking important metrics to identifying biomolecules in clinical samples. Monitoring blood sugar, pregnancy testing, identifying infectious diseases, identifying cancer biomarkers, and more are a few typical uses. Herein, several carbon sensors types, highlighting their contribution to real time analysis and the development of diagnostic capabilities is explained. It also covers the latest advancements in sensors based on nanocarbon and how they might be combined with other technologies to improve clinical diagnostics.

Keywords: Carbon sensors, blood sugar, biomedical applications, diagnosis

[26] **Synthesis and characterization of $SmFeO_S$ nanoparticles**

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Abstract: Samarium Ferrite ($SmFeO_3$) is a perovskite type material with applications in optoelectronic due to its unique optical properties. In this study, $SmFeO_3$ was synthesized by co-precipitation method. The as prepared powders were characterized by Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), Thermogravimetric Analysis (TGA). XRD confirmed the formation of pure – phase orthorhombic perovskite structure. FTIR confirmed the presence of characteristic Fe-O vibrations while UV-vis spectroscopy revealed a direct band gap of which is useful for visible light driven applications. TGA analysis indicates its high thermal stability, which enhances its applications. These findings tell us that $SmFeO_3$ is promising material for future generation optical and energy related devices.

Keywords: $SmFeO_3$, X-ray Diffraction, Perovskite, UV-vis

[27] **Advancement in Immunosensing Based on Gold Nanoparticles**

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Abstract: Immunosensing is an emerging technology in the field of material sciences based on nanomaterials. It has attracted high interest because of its low cost, high sensitivity and miniaturization. There are significant applications because of unmatched optical properties as well as electromagnetic and chemical qualities. Immunosensing has been widely used in clinic procedures which includes protein detection, calorimetric detection and antibodies modifications. Nowadays AuNPs have versatile shapes and morphologies such as nanorods, nanoclusters, nanoflowers, nanostars, nanobipyramids and nanowires which can be employed to design biosensors. AuNPs have marked effects because of their extraordinary high extinction coefficient, with inherent plasmonic properties and can be easily as biosensor to induce particles modified with single-stranded DNA. These NPs are used for the detection of Alzheimer's tau protein. AuNPs allows enhanced analytical detection and on functionalized with Raman

molecules their aggregation can change interparticle distance which results in induced surface-enhanced Raman scattering that can be employed for highly sensitive detection. Studies also showed that AuNPs was efficient in preserving the activity and orientation of the antibody serves a good platform for electrochemical sensors because of the ability to provide a stable immobilization of biomolecules. In aspect to immunoassays gold nanoparticles-based biosensors serves an excellent platform for fields in clinical analysis, environmental monitoring and detection of food contaminants.

Keywords: AuNPs, nanorods, nanoclusters, nanoflowers, nanostars, nanobipyramids and nanowires

[28] **Modulation Instability in Cubic-Quintic Nonlinear AlGaAs-Doped Photonic Crystal Fiber.**

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Abstract: Modulation instability (MI) is a fundamental nonlinear phenomenon that plays a crucial role in optical systems, enabling applications such as supercontinuum generation and optical frequency comb production. In this work, we analyze MI in a photonic crystal fiber (PCF) with cubic-quintic nonlinearity, modeled using the cubic-quintic nonlinear Schrödinger equation (NLSE). We perform a linear stability analysis to derive the dispersion relation and identify the conditions under which MI occurs. The influence of quintic nonlinearity on the instability gain spectrum is examined, revealing that a focusing quintic term enhances MI, while a defocusing quintic term suppresses it. Additionally, we explore the impact of input power, dispersion regimes, and higher-order nonlinearities on MI dynamics. Our results provide a deeper understanding of nonlinear wave propagation in photonic crystal fibers, offering valuable insights for optical communication and pulse generation technologies.

Keywords: Modulation instability, cubic-quintic nonlinearity, nonlinear Schrödinger equation, photonic crystal fiber, optical wave propagation, dispersion relation, supercontinuum generation, nonlinear optics.

[29] **Theoretical investigation of acene-bridge materials for photovoltaic applications**

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Abstract: This study examines the electronic, chemical reactivity, and photovoltaic aspects of newly designed series of acene-based organic compounds with [D–π–A]-type (donor - π - acceptor) structural models for photovoltaic applications. All the under-studied compounds are optimized utilizing the density functional theory (DFT) framework with the B3LYP hybrid functional and 6-31G (d, p) basis set using Gaussian 9W software. The impact of acene units and different electron donor replacements on the electrical, chemical, and photovoltaic properties of acene-modified compounds are presented. Theoretical recognition of the frontier molecular orbitals (HOMO and LUMO energy levels) of a compound is essential in the exploration of organic solar cells characteristics, so the HOMO, LUMO, Gap energy (ELUMO - EHOMO), change in free energy of electron injection, and Voc (open circuit voltage) of the studied compounds were determined and addressed. The findings reveal that gap energy ranges from 2 - 3 eV of all the under-studied organic compounds. The energy gap between HOMO and LUMO is reduced and becomes softer as the conjugation length of acenes (from anthracene to pentacene) increases. As a result, the stability of acenes decreases while the mobility of charge carriers increases. All the under-studied organic compounds show negative values of change in free energy of electron injection, which confirms that charge injection into the conduction level of the semiconducting material would be beneficial. The obtained results suggest that these compounds can be utilized in organic photovoltaic systems.

Keywords: Conjugated organic materials; DFT calculations; HOMO/LUMO; Photovoltaic applications.

[30] Structural correlation of Transport properties of Li_2O containing zinc bismuth borate glasses

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Abstract: Ion-conducting oxide glasses have been investigated vastly owing to their potential technological applications, such as solid-state rechargeable batteries, electrolytes in fuel cells, chemical sensors, thin-film batteries integrated circuits, and several electrochemical devices. B_2O_3 glass comprises corner-shared trigonal BO_3 units; a significant portion of these unite to create three-membered boroxol rings. Contrary to silicate glasses, the addition of alkali modifiers (Li_2O, Na_2O, K_2O, etc.) to B_2O_3-based glasses not only creates non-bridging oxygens (NBOs) but also leads to charge stabilization by changing boron coordination number from 3 to 4 (i.e. conversion of trigonal BO_3 structural units to tetrahedral BO_4^- units), which enhances connectivity in glass matrix, or create NBOs by rupturing the linkage between two trigonal BO_3 units. Lithium ions, due to their highly electropositive character, lighter weight, and smaller size, give rise to high operational voltage windows and high energy density in micro-batteries. In Bismuth oxide-based glasses, Li_2O acts as a feasible solid-state electrolyte, intensifying electrical conductivity and making them the appropriate applicants in high energy density batteries and sensors. So, to fully comprehend the ionic conductivity in the vitreous network, it is necessary to examine a broad range of compositions and combine structural studies and electrical conductivity measurements to learn more about how the composition and temperature of the glass network alter it.

Keywords: NBOs, electrochemical devices.

[31] A review of wide band gap II-VI semiconducting nanomaterials for use in optoelectronic and photovoltaic devices

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Abstract: Wide bandgap II-VI semiconductors are excellent materials for many advanced and competent energy applications due to their suitable band gap with tunable carrier concentration, elevated optical transparency, and favorable electrical conductivity. Mostly, II-VI group materials have a direct band gap with high optical absorption coefficients; therefore, absorption of around 99% of the impinged photon having energy higher than the band gap energy was observed for a small layer thickness of ~1.0 μm. Nowadays, these versatile semiconductor materials are applied extensively to electronic, optical, and photovoltaic devices, including light-emitting diodes, thin-film transistors, optical waveguides, photodetectors, and solar cells. The cadmium and zinc-based groups of II-VI semiconductors (CdS, CdTe, CdSe, ZnS, ZnSe, ZnTe) have two main phases (i) zincblende and (ii) wurtzite in the bulk form. In addition to the distinct *n*- and *p*-type conductivity of each material, both types of conductivity for some II-VI compound semiconductors were also noticed. The ZnO, CdS, CdSe, and ZnS are of the *n*-type binary, ZnTe is *p*-type, while CdTe and ZnSe exhibit both *n*- and *p*-type characteristics. On the other hand, the CdS and CdSe absorption edge emissions are excitonic, while ZnS shows the lasing possibility in the UV region. Therefore, these II-VI group semiconductors revealed the huge and competitive potential to be applied in further advanced optoelectronic and photovoltaic devices.

Keywords: II-VI group materials.

[32] Enhanced Syphilis Detection using a Microstructured Fiber SPR Sensor with Optimized Wavelength Sensitivity

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Abstract: This paper introduces a cutting-edge method for detection syphilis through the use of a surface plasmon resonance (SPR)-based microstructured fiber sensor. The sensor demonstrates exceptional sensitivity, making it an ideal tool for the early diagnosis and management of syphilis, crucial for preventing transmission and ensuring effective treatment. The sensor employs a silver (Ag) coating to enable SPR excitation, which efficiently detects minute changes in the refractive index (RI) of blood plasma samples. Numerical simulations suggest that the sensor operates most effectively within an RI range of 1.29 to 1.40, closely aligning with the refractive index of blood plasma (1.36 at 1550 nm). With a remarkable wavelength sensitivity of 8000 nm/RIU, this sensor offers a high level of precision, which is essential for reliable syphilis detection. Unlike traditional diagnostic methods, this SPR-based sensor stands out with its

compact form factor, fast response time, and improved sensitivity thanks to its microstructured fiber design. The enhanced light-matter interaction increases the accuracy of results, providing an innovative and efficient diagnostic solution. This research lays the groundwork for the development of portable, high-performance syphilis detection tools that could revolutionize diagnostics, ensuring quicker treatment and better health outcomes for patients.

Keywords: Surface plasmon resonance, refractive index, microstructured fiber, wavelength sensitivity, syphilis detection.

[33] **Elliptical Holes Photonic Crystal Fiber-Based SPR Biosensor for Malaria Detection**

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Abstract: This study investigates an innovative approach for malaria detection using a surface plasmon resonance (SPR) biosensor based on an elliptical-shaped photonic crystal fiber (PCF). The sensor is designed to detect the presence of the *Plasmodium falciparum* parasite in human red blood cells (RBCs) by analyzing the refractive index (RI) variations at different stages of infection. Healthy RBCs exhibit uniform RI distribution, while infected RBCs display altered, uneven RI patterns due to parasite development. To enhance sensor performance, the PCF-SPR biosensor incorporates gold nanowires and strategically arranged holes to focus the evanescent field, improving detection sensitivity. The sensor's performance is evaluated across various stages of infection, including the ring, trophozoite, and schizont phases, with measured wavelength sensitivities for the x-polarized mode of 12857 nm/RIU, 9473 nm/RIU, and 7931 nm/RIU, respectively, and for the y-polarized mode, 14285 nm/RIU, 10000 nm/RIU, and 8275 nm/RIU. The sensor's ability to differentiate healthy RBCs from infected ones, based on their distinct RI signatures, demonstrates its potential for the early diagnosis of malaria. This SPR-based biosensor provides a promising solution for rapid and accurate malaria detection, particularly beneficial for resource-limited regions.

Keywords: Malaria, *Plasmodium falciparum*, Photonic Crystal Fiber, Surface Plasmon Resonance, Refractive Index, Biosensor.

[34] **Optimized Fe_2O_3/TUD-1 Nanocomposites for Humidity Sensing Applications**

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Abstract: This study presents the synthesis and performance enhancement of tailored nanoporous x-Fe_2O_3/TUD-1 (x = 0, 1, 5, 10, 15%) nanocomposites, developed to achieve effective and dependable humidity sensing. Using a hydrothermal synthesis technique, the characterization of the composite material reveals a mesoporous structure, a substantial surface

area of 681 m^2g^{-1}, and well-defined porous channels, demonstrating its suitability for humidity detection through physisorption. The sensing mechanism is explained by analysing the interaction between Fe_2O_3/TUD-1 and water vapor molecules, which causes variations in electrical resistance. The sample with 10% Fe_2O_3 demonstrates superior performance, exhibiting a rapid response time of 4 seconds and a recovery time of 6 seconds over a relative humidity range of 11–98%. Additionally, the sensor exhibits a 4-fold of magnitude change in resistance over multiple cycles reflecting excellent durability and consistent stability over a 12-day period. These findings support progress in humidity sensing technology, encouraging the creation of sensors that are efficient, long-lasting, and cost-effective.

Keywords: Sensor, Mesoporous, Hydrothermal, Nanocomposite

[35] GREEN SYNTHESIS OF TITANIUM DIOXIDE USING FOENICULUM VULGARE EXTRACT, CHARACTERIZATION STUDIES, ANTI-MICROBIAL ACTIVITY AND COSMETIC APPLICATIONS

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Abstract: Nanoparticles have a wide range of applications in various fields like medicine, physics, technology due to their properties like high surface to volume ratio, enhanced reactivity, quantum confinement etc. As a result, the synthesis of nanoparticles has increased significantly. However, conventional synthesis methods generate a substantial amount of toxic chemical waste, making green synthesis a crucial and sustainable alternative. Green synthesis refers to the environmentally friendly and sustainable production of substances using biological or non-toxic chemical methods. It aims to reduce hazardous substances, minimize waste, and use renewable resources. Therefore, the current work focuses on synthesis of Titanium Dioxide nanoparticles through a green method, using the extract of Foeniculum vulgare (fennel) seeds, which is widely available, economical and has several therapeutic benefits. Titanium Dioxide can absorb light with wavelengths between 275 to 405 nanometers and is stable in sunlight, hence acts as a protector against UV-Rays, so synthesized nanoparticles have been used to prepare a sample of Talcum Powder. The synthesized particles have been characterized using UV-Visible Spectrophotometry, Scanning Electron Microscopy (SEM) and X-Ray Diffraction (XRD), and the results were consistent with previous findings. The extract of Fennel was also analysed by FT-IR studies. The synthesized nanoparticles were evaluated for Anti-Microbial studies against E-Coli, Staphylococcus aureus and Propionibacterium acnes.

Keyword: Green Synthesis, Titanium Dioxide Nanoparticles, Fennel Extract, Talcum Powder, UV-Visible Spectroscopy, SEM, XRD, Biological Activity.

[36] Hydrothermal Synthesis and Structural Characterization of $BaTiO_3$ Nanocrystals: Effect of Reaction Time on different Properties

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Abstract: $BaTiO_3$ nanocrystals were synthesized via the hydrothermal method at different reaction times (12h, 18h, and 24h) to investigate the impact of synthesis duration on their structural and morphological properties. X-ray diffraction (XRD) analysis confirmed the formation of the tetragonal phase of $BaTiO_3$. Scanning electron microscopy (SEM) revealed particle size and morphology variations, while transmission electron microscopy (TEM) provided insights into the nanocrystalline structure and lattice fringes. The study demonstrates how reaction time influences the phase purity, grain growth, and microstructural evolution of $BaTiO_3$ nanocrystals, offering valuable insights for their application in electronic and energy-harvesting devices.

Keyword: X-ray diffraction, $BaTiO_3$ nanocrystals, Scanning electron microscopy (SEM), transmission electron microscopy (TEM)

[37] **Anionic defect engineering of fluorite oxide for heterogeneous catalysis**

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Abstract: This work reports a facile solution combustion synthesis of divalent doped and tetravalent metal ion stabilized fluorite oxide (δ-Bi_2O_3) and its application as a heterogeneous catalyst in Knoevenagel condensation reaction and photocatalytic disintegration of Eosin Yellow dye from aqueous solutions. The samples were extensively characterized by various physicochemical techniques such as powder X-ray diffraction, electron microscopy measurements, Raman, diffuse reflectance, and photoluminescence spectroscopy measurements, along with Brunauer-Emmett-Teller analysis. The oxides' catalytic activity was probed in the Knoevenagel condensation reaction of various substituted aldehydes coupled with malononitrile, resulting in excellent yields after optimization of various reaction parameters such as temperature, catalyst dosage, amount of aldehyde, and malononitrile. The oxides' high surface area was also exploited for photocatalytic disintegration of Eosin Yellow (toxic xanthene dye). The presence of anionic defects and the generated superoxide radicals play a dominant role in enhancing photocatalytic activity. The electrical efficiency for practical utility, electrical energy per order (E_{EO}) was assessed for all the samples. The divalent doped oxides' catalytic and photocatalytic efficiencies were higher than the tetravalent stabilized fluorite oxide elucidating the synergistic effect of anionic defects and lewis acid-base interaction in enhancing the catalytic activity and in suppressing the recombination of photogenerated holes and electrons. Excellent

recycling efficiency and stability exhibited by an optimally doped fluorite oxide demonstrated it to be a promising and efficient catalyst.

Keywords: X-ray diffraction, Knoevenagel condensation, Photocatalysis

[38] **Effect of Indium Sulfide as Buffer Layer on improving Photovoltaic Efficiency**

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Abstract : A photovoltaic (PV) cell with the Al/ZnO/In_2S_3/CdTe/Cu_2O/Ni configuration was simulated using SCAPS-1D software. The device comprises multiple layers: a 100 nm zinc oxide (ZnO) layer serving as the transparent conductive oxide (TCO) window, a 40 nm indium sulfide (In_2S_3) buffer layer, and a 5000 nm cadmium telluride (CdTe) absorber layer. To enhance charge transport, a 50 nm cuprous oxide (Cu_2O) electron-reflecting hole transport layer (ER-HTL) is positioned between the absorber and the back contact. Aluminum (Al) functions as the top contact, while Nickel (Ni) serves as the back contact, ensuring proper electrical interconnection. The optimized model achieves a module efficiency of 23.0369% and a short-circuit current density (JSC) of 28.796238 mA/cm² under the AM 1.5G spectrum. Furthermore, it exhibits nearly 100% quantum efficiency in the visible wavelength range.

Keywords: Thin-film solar cell, Buffer layer, Thickness, Efficiency, SCAPS-1D.

[39] **Sodium-Ion and Sodium-Glass Batteries: A Sustainable Alternative to Lithium-Ion**

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Abstract: The growing demand for sustainable and cost-effective energy storage solutions has accelerated the search for alternatives to lithium-ion batteries (LIBs). Among the most promising candidates, sodium-ion (SIBs) and sodium-glass batteries have emerged due to their low cost, resource abundance, and enhanced safety profile. Sodium-ion batteries operate through a similar intercalation mechanism as LIBs but utilize widely available sodium-based cathodes and anodes, mitigating concerns related to lithium scarcity and supply chain instability. Sodium-glass batteries, an innovative class of solid-state batteries, leverage a glass electrolyte that enables higher ionic conductivity, improved thermal stability, and dendrite suppression, potentially outperforming both SIBs and LIBs in safety and longevity. This review presents a comprehensive evaluation of sodium-based battery technologies, focusing on recent advancements in electrode materials, electrolyte development, and electrochemical performance improvements. While LIBs currently maintain an advantage in commercialization readiness and

energy density, sodium-based alternatives offer superior sustainability, lower raw material costs, and greater safety, making them attractive for grid storage, electric mobility, and large-scale energy applications. Despite their potential, sodium-ion and sodium-glass batteries face significant challenges, including lower energy density, electrode degradation, and industrial scalability. To address these limitations, ongoing research is focused on nanostructured cathodes, hybrid electrolytes, and optimized solid-state interfaces. Several industry players, including CATL, Faradion, and Toyota, are actively developing sodium-based battery technologies, bringing them closer to real-world deployment. By addressing current technical barriers and leveraging advances in material engineering, sodium-based batteries have the potential to become a transformative solution for sustainable and scalable energy storage in the coming decade.

Keywords: Sodium-ion batteries (SIBs), Sodium-glass batteries, Lithium-ion alternatives, Solid-state electrolytes, Energy storage sustainability, Battery commercialization.

[40] **NEW AGE ENERGY SCIENCES: Phase Change Nanomaterials**

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Abstract: Phase Change Materials (PCMs) are revolutionizing thermal energy storage by efficiently storing and releasing heat during phase transitions. This ability makes them ideal for applications like solar energy storage, cooling electronic devices, and improving energy efficiency in buildings. However, one major drawback of PCMs is their low thermal conductivity, which slows down heat transfer and limits their effectiveness. To overcome this, researchers have started incorporating nanoparticles into PCMs, creating what is known as Nanoparticle-Enhanced PCMs (NePCMs). By adding materials like metal oxides, carbon-based particles, or metallic nanoparticles, the thermal conductivity of PCMs can be significantly improved. This means heat can move through the material more quickly, allowing for faster energy storage and release without sacrificing the material's heat-storing capability. NePCMs are already being explored for various real-world applications, from improving the efficiency of solar panels to maintaining stable temperatures in smart buildings and even regulating heat in medical devices. As the world pushes toward cleaner and more sustainable energy solutions, these advanced materials play a crucial role in reducing energy waste and enhancing performance in thermal management systems. While challenges like optimizing nanoparticle concentration and ensuring long-term stability remain, ongoing research is steadily addressing these issues. With continued advancements, NePCMs have the potential to transform the way of storage and use thermal energy, making renewable energy systems more efficient and contributing to a greener, more sustainable future.

Keywords: PCM, Energy Storage, Nanoparticles, Thermal Energy.

[41] Nano-Antenna-Based Solar Harvesting: Advancements and Future Prospects

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Abstract: The increasing global demand for renewable energy has driven research into novel methods for high-efficiency solar energy harvesting. Nano-antenna has emerged as a promising technology for capturing and converting sunlight into usable energy with superior efficiency compared to conventional photovoltaic cells. These nanoscale antennas operate by resonantly absorbing electromagnetic radiation in the optical and infrared spectrum, enabling enhanced light harvesting and conversion. This paper explores the design, fabrication, and performance analysis of nano-antenna for solar energy applications. Various nano-antenna geometries, materials, and patch configurations are investigated to optimize absorption efficiency and minimize energy losses. Simulation and experimental results demonstrate that carefully engineered nano-antenna can achieve high absorption efficiency, broad spectral response, and improved thermal stability. The integration of nano-antenna with rectification circuits for direct current (DC) power generation is also discussed, highlighting the challenges and potential solutions for practical implementation Finally, we computationally demonstrate that the reflecting mirror allows for nearly full cancellation of light dispersed by the receiving antennas. The end result is a polarization-insensitive reception theoretical efficiency more than 85% over the whole 300-3000 nm spectral range, with less than 20% energy wasted owing to back-scattering of sunlight. This research contributes to the advancement of next-generation solar energy technologies by providing insights into the design and optimization of nano-antenna-based solar harvesting systems.

Key words: nano-antenna, solar energy. Microstrip patch antenna, HFSS.

[42] Tailoring 2D-MoS_2 and MoS_2@r-GO Nanocomposites via Hydrothermal Synthesis and Liquid Exfoliation for Electronic Applications

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Abstract: 2-D MoS_2 and its nanocomposites with reduced graphene oxide, MoS_2@r-GO were successfully synthesized by the conventional hydrothermal method at high temperature (240^0C) and pressure conditions. The structural and optical properties of as synthesized samples were analyzed using various characterization techniques including XRD, UV-Vis Spectroscopy, FTIR spectroscopy, PL spectroscopy and I-V characteristics, which providing valuable insights into the successful formation, crystalline structure, optical band-gap (E_g) and other significant optical and electrical characteristics of the synthesized samples. Thin films of the synthesized samples

were grown using drop-casting method for the fabrication of the electronic device. To enhance the Adaptability of the device, synthesized MoS_2 and its nano-composites, MoS_2@r-GO were further subjected to liquid-phase-exfoliation using a high power (~100W) ultra-sonication bath utilizing Acetone, N-Methyl-2-Pyrrolidone (NMP) and isopropyl alcohol (IPA) as solvents. The exfoliated dispersions of the synthesized samples with different solvents shows improved uniform deposition of thin films, making them compelling choice for various electronic device applications including photo-detectors and other optoelectronic devices. The result will be discussed during the presentation.

Keywords: 2D-MoS_2, XRD, PL, Liquid Exfoliation, Photodetectors, Optoelectronic Devices.

[43] EFFECT OF NANOPARTICLES AND NANOCOMPOSITES ON GROWTH OF CHILLI PLANTS

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Abstract: Nanotechnology has the potential to revolutionize agriculture by offering sustainable solutions to control plant diseases and reduce dependence on harmful pesticides. This study explores eco-friendly nanomaterials for agriculture by assessing their antimicrobial and growth-promoting effects on chili crop. Mangenese oxide (MnO_2), Copper oxide (CuO), Zinc oxide (ZnO) and Iron oxide (Fe_3O_4) nanoparticles were prepared using the green synthesis method, utilizing natural extracts from *Brassica oleracea*, *Mentha piperita*, *Calotropis gigantea* and *Azadirachta indica*. These nanoparticles were then combined in various ratios to prepare nanocomposites. The synthesized nanomaterials were characterized using UV-Vis spectroscopy, Fourier transform infrared spectroscopy, scanning electron microscopy, and energy-dispersive X-ray analysis. Antimicrobial tests of nanoparticles & nanocomposites revealed significant antibacterial effect against *Pseudomonas syringae* and strong antifungal activity against *Fusarium oxysporum*. MnO_2 Nps exhibit maximum antibacterial activity & CuO Nps, highest antifungal activity. The binary nanocomposite ZnO:MnO_2 (1:3) and ternary nanocomposite ZnO:CuO:MnO_2 (1:1:2) showed strong antibacterial property, while ZnO: CuO (1:3) and ZnO:Fe_3O_4:CuO (1:1:2) displayed a remarkable antifungal effect. The enhanced antimicrobial effects were attributed to the nanoparticles high surface area and reactivity, which promoted stronger interactions with microbial membranes.

These treatments suppressed pathogenic activity and boosted height of the plant, leaf length, leaf breadth & chlorophyll content. The chilli plants were infected with *Pseudomonas syringae* and further treated with various nanoparticles and nanocomposites. ZnO:CuO:MnO_2 nanocomposite treatment enhanced the height of chilli plant upto 60%, leaf length by 70%, leaf breadth by 86% and chlorophyll content by 92.67%. The chiilli plants infected with *Fusarium oxysporum* and treated with ZnO:Fe_3O_4:CuO nanocomposite, have shown a height difference of 69%. A considerable difference of 78% in leaf length and 82% in leaf breadth with ZnO: CuO & ZnO:Fe_3O_4: CuO treatments was observed. The chlorophyll content has hiked by 61% in ZnO:CuO treatment. Higher nanoparticle concentrations (0.2 to 1.0 mg/ml) led to better pathogen inhibition and improved plant vitality. These findings emphasize the potential of green-synthesized nanomaterials as sustainable alternatives to chemical pesticides, contributing to enhanced crop health and environmental safety.

Keywords: Green synthesis, CuO Nps, MnO Nps, ZnO Nps, Fe_3O_4 Nps, Nanocomposites, Antibacterial activity, Antifungal activity.

[44] **Radially Polarized Femtosecond Laser Interaction with an Unmagnetized Plasma Slab: Symmetric Modes and Enhanced Terahertz Generation**

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Abstract: This study delves into the polarization dynamics of amplitude-modulated lasers interacting with plasmas characterized by non-uniform density gradients. A comprehensive examination of electric field behavior across diverse electron density profiles elucidates its pivotal role in laser-plasma interactions. The findings reveal a pronounced dependence of normalized power density on modulation frequency, dictated by the electron density scale length. Steeper density gradients amplify energy absorption, resulting in a significant surge in power density at lower modulation frequencies. Distinct variations in electric field amplitudes along the xxx- and zzz-axes emerge across different density profiles, with linear and quadratic profiles exhibiting substantial amplitude shifts and crossovers, whereas cosine-squared and complex exponential profiles manifest intricate phase effects. The electric field phasor angle further delineates polarization state transitions, showcasing predictable trends for linear, quadratic, and cosine-squared profiles, while complex exponential profiles exhibit multiple polarization reversals. These results align with experimental observations, reinforcing the significance of polarization and field amplitude dynamics in laser-plasma interactions. This work underscores the critical role of electron density gradient control and modulation parameters in optimizing energy transfer, with far-reaching implications for plasma-based particle acceleration, fusion energy research, and high-power laser applications.

Keywords: Density gradient, Ponderomotive potential, Modulated laser, Power density, normalized frequency, Phasor angle.

[45] Titania-CdS composite heterojunctions for efficient solar photocatalytic hydrogen evolution

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Abstract: Titania is considered to be the chief semiconducting photocatalyst for both environmental remediation as well as green energy production. The co-existence of two or more polymorphs of Titania (Anatase, Rutile and Brookite) has reported to further improve their photocatalytic performance due to the difference in carrier life time. However, the wide bandgap of Titania (3.0 – 3.2 eV), make it relatively inactive under visible range of solar spectrum. This works aims to overcome the challenges within Titania through integration of a visible active photocatalyst (CdS) with biphasic Titania. Biphasic Titania (Anatase and Rutile) – CdS nanocomposite (TARC) was synthesized through facile hydrothermal route. The structural and

morphological analyses confirm the presence of biphasic Titania and CdS in the nanocomposite. The optical and XPS analyses further confirm the improvement in photon absorption range and change in electron density of the composite, confirming the successful formation of heterojunction. Photoelectrochemical studies were carried out to study the change in charge carrier dynamics. TARC was found to have superior charge separation efficiency as well as carrier life time. The photocatalytic water splitting for pristine (CdS (C) and biphasic Titania (TAR)) and TARC was conducted under sunlight. The composite produces 11.70 mmol/g/h hydrogen gas with an apparent quantum yield (AQY) of 1.38% which is found to be 23 times and10 times superior than the AQY of TAR and CdS under similar conditions. This enhanced performance can be attributed to the improved photon absorption ability as well as carrier separation efficiency achieved through the heterojunction. This study opens up a new area of research to develop triphasic composite heterojunctions as a sustainable solution for efficient solar hydrogen evolution.

Keywords: Photocatalytic Hydrogen evolution, biphasic Titania-CdS, heterojuction

[46] Structural Study of Polymer Electrolyte Film for Sustainable Lithium-ion Batteries

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Abstract: With the growing demand for energy and the need for safer, high performance energy storage solutions, polymer-based electrolytes are gaining significant attention for next generation Li-ion batteries (LIBs). In this study, a polymer electrolyte film has been prepared using a solution casting method with polyvinyl alcohol (PVA) as the polymer matrix. Lithium nitrate is incorporated to ensure uniform dispersion, while formamide acts as a plasticizer to enhance flexibility and ionic conductivity. The structural characterizations of synthesized polymer film are performed to determine its nature which is crucial for efficient lithium-ion transport. The findings can contribute to the development of new efficient polymer electrolytes and offer potential improvements in the safety, performance and sustainability of lithium ion batteries.

Keywords: Electrolyte, PVA, $LiNO_3$, Structural study, Lithium-ion battery.

[47] Investigating the Impact of Halide Alloying on all-inorganic $Cs_3Bi_2I_9$ Perovskite: Structural and Optical Studies

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Abstract: All-inorganic halide perovskites (HP) have attained significant attention in the field of optoelectronics due to its structural stability, excellent optical properties and advantages over its organic-inorganic counterparts. Recent studies have demonstrated the advantage of halide mixing in tuning the bandgap of different HPs and enhancement of its optical and electronic

properties. $Cs_3Bi_2I_9$, a lead free all inorganic halide perovskite, has proven to be a promising material in optoelectronics like solar cells, LEDs, etc. In this work, chlorine (Cl) is alloyed with $Cs_3Bi_2I_9$ HP and its effects on the structural and optical properties of pristine HP is studied. The pristine and the Cl-alloyed $Cs_3Bi_2I_{9-x}Cl_x$ HPs are synthesized using one-step solution processed method with different Cl/I ratio. The XRD pattern of the pristine as well as Cl-mixed samples reveals the hexagonal structure of $Cs_3Bi_2I_9$ HP, with changes in the average crystallite size and peak intensity for the halide mixed samples. UV-VIS absorption and Photoluminescence (PL) study is conducted to analyse the optical properties. The pristine sample shows an absorption edge in the visible region with a peak at around 436 nm and a bandgap of 2.31 eV, which shifts with increase in Cl concentration. Enhancement of PL peak intensity and blue shift in the PL peak position are observed for the halide mixed samples with increasing Cl/I ratio. These structural analyses and enhanced optical properties of the halide mixed samples show their potential in different optoelectronic applications with optimized halide concentration.

Keywords: its organic-inorganic counterparts, Cl-alloyed $Cs_3Bi_2I_{9-x}Cl_x$ HPs, UV-VIS absorption and Photoluminescence (PL).

[48] **Energy Storage and Conversion Devices for Sustainable Solutions**

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Abstract: The need for sustainable energy solutions is driving innovation in energy storage and conversion devices, which play a vital role in balancing the intermittency of renewable energy sources like solar and wind. This paper explores key technologies, including lithium-ion batteries, supercapacitors, and hydrogen fuel cells, and their potential to meet global energy demands. Lithium-ion batteries, commonly used in electric vehicles and portable electronics, remain the dominant energy storage solution due to their efficiency and high energy density. However, newer alternatives such as solid-state batteries, sodium-ion batteries, and other advanced materials are being developed to address challenges in safety, cost, and resource scarcity. Supercapacitors, with their ability to charge quickly and handle numerous charge-discharge cycles, are gaining interest for applications requiring high power output. Hydrogen fuel cells, which offer clean energy conversion with zero emissions, are increasingly seen as a solution for large-scale energy needs, particularly in sectors like transportation and industrial energy. The integration of these storage and conversion devices into renewable energy systems is essential for achieving a reliable, sustainable energy grid. This paper also examines the ongoing challenges, such as environmental impacts of materials and production processes, scalability, and energy efficiency. Continued research and development of new technologies and materials are crucial to improving performance, reducing costs, and enabling the widespread adoption of sustainable energy solutions, paving the way for a low-carbon future.

Keywords: - Sustainable energy, energy storage, energy conversion, lithium-ion batteries, supercapacitors, hydrogen fuel cells, renewable energy, smart grids, energy efficiency, clean energy, low-carbon solutions, environmental sustainability.

[49] **Optical properties of Nickel ferrite and Magnesium composite Nickel ferrite.**

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Abstract: Nickel ferrite ($NiFe_2O_4$) and magnesium-composited nickel ferrite ($Mg_{0.5}Ni_{0.5}Fe_2O_4$) nanoparticles are prepared by the citric precursor method a cost and time-effective method, using nickel nitrate, ferric nitrate and citric acid. The average size of particles was found to be nearly 10 nm. Characterizations like Zeta potential and DRS show good results in the prepared sample. An inverse spinel structure was formed by $NiFe_2O_4$ and $Mg_{0.5}Ni_{0.5}Fe_2O_4$ nanoparticles.

Keywords: Ferrites, Nanoparticles, Spinel, Composite etc.

[50] Precursor-Engineered g-C_3N_4 for Superior Visible-Light-Driven Methylene Blue Degradation

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Abstract: The rising contamination of water bodies poses a major threat to aquatic life and human health. This necessitates the synthesis of a low cost photocatalyst that can degrade toxins in the presence of visible light while also being reusable. g-CN, a nonmetal-based photocatalyst with a low band gap (≈ 2.7 eV), uses solar light as a clean fuel to function without emitting secondary pollutants, making it a feasible solution to current concerns. This paper examines how g-CN is synthesized from melamine, thiourea, and combinations of the two precursors in 5:5 and 7:3 ratios by a simple thermal polymerization procedure at 550°C for two hours. The largest amount of g-CN is synthesized using melamine and the amount synthesized by different precursors is only 10% of the original quantity, which is relatively small. The graphitic in-plane structure and stacking of g-CN sheets are supported by XRD. Both the functional groups and the level of condensation are identified using FTIR. To ascertain the band gap, visible light absorption, and dye degradation efficiency, UV visible spectroscopy is utilized. The degradation of MB dye is clearly visible, with the g-CN produced using a 7:3 precursor ratio showing the greatest amount of degradation in comparison to the others. In addition to this, the impact of catalyst dosage on dye removal rate under visible light is also investigated. Finally, it is concluded that g-CN derived from melamine and thiourea has good potential for wastewater treatment under visible light.

Keywords: g-CN, Photocatalysis, MB Degradation, Precursors, Visible Light.

[51] On the structural analysis of $NaNi_{0.85}Co_{0.10}Mn_{0.05}O_2$ cathode material for sodium-ion batteries synthesized via sol-gel method with ethylene glycol as a gelation facilitator

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Abstract: The quantity and affordability of sodium make sodium-ion batteries (SIBs) as a possible substitute for lithium-ion batteries. The cathode material plays a major role in SIB performance and the ternary combinations of nickel, cobalt, and manganese (NCM) are promising options. In order to examine the impact of a gelation facilitator on structural characteristics, the bulk samples of $NaNi_{0.85}Co_{0.10}Mn_{0.05}O_2$ are prepared using sol-gel process with ethylene glycol as a gelation facilitator and the other without any gelation facilitator. The nature of these materials, crystalline size, dislocation density, and microstrain are deduced using X-ray diffraction (XRD) analysis. The results help in the optimization of cathode materials based on NCM for high-performance sodium-ion batteries. Furthermore, avoiding the adverse impacts on the environment and promoting the widespread use of sodium-ion technology as a green energy storage solution depend on developing economical and sustainable synthesis routes for SIB cathodes.

Keywords: Energy storage, sodium ion batteries, cathode materials, structural properties.

[52] Sustainable Synthesis of Magnetite Nanoparticles Using Cucurbita pepo Leaves: A Step towards Green Nanotechnology

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Abstract: In this study, Cucurbita pepo leaf extract is used as a natural reducing and stabilizing agent to demonstrate the environmentally friendly, green synthesis of magnetite nanoparticles (MNPs). To produce ecologically acceptable nanomaterials, the synthesis approach uses bio-nanotechnology, which is a combination of biotechnology and nanotechnology. Fourier Transform Infrared Spectroscopy (FTIR) and UV-Visible Spectroscopy (UV-Vis) were used to analyze the synthesized MNPs. FTIR analysis verified the existence of functional groups in charge of their reduction and stabilization. The successful production and optical characteristics of the MNPs were further confirmed by UV-Vis spectroscopy, demonstrating their applicability for a range of uses. The produced MNPs are excellent candidates for a variety of applications due to their special qualities. These microscopic particles can be used in systems to deliver drugs in the biomedical industry, allowing for tailored therapy with fewer adverse effects. They are used as contrast agents in magnetic resonance imaging (MRI) because to their magnetic properties, which increase the precision of diagnosis. They are also positioned as prospective medicines for the treatment of cancer hyperthermia due to their capacity to produce heat in reaction in a magnetic field outside. The MNPs can be utilized in environmental applications to

purify water by efficiently adsorbing pollutants such colors, poisons, and heavy metals. Their magnetic qualities make it simple to separate them from water, which improves process sustainability and efficiency. All things considered, the environmentally friendly production of MNPs using Cucurbita pepo leaves offers an economical and environmentally friendly way to create nanoparticles with a wide range of potential uses in industry, medicine, and the environment.

Keywords: Cucurbita pepo leaf extract, magnetite nanoparticles, green synthesis

[53] **Synthesis And Characterization Of Cu And Zn Doped Vanadium Oxide Nanomaterials For Photocatalytic Degradation Of Dye Under Visible Light**

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Abstract: This study explores the synthesis of Zn and Cu doped vanadium oxide nanomaterials , aimed at enhancing the photocatalytic degradation of dye under visible light. The doped vanadium oxides were synthesized using co-precipitation method resulting in incorporation of copper and zinc ions into vanadium oxide lattice. The structural and optical properties of synthesized materials were analyzed through characterization such as X-ray diffraction (XRD) and UV Vis absorption spectroscopy. UV-vis spectroscopy showed that the degradation percentage of Cu doped vanadium oxide is greater than Zn doped vanadium oxide under lesser time. Cu doping can cause shifts in the diffraction peaks in the XRD spectrum due to changes in lattice parameters. Zn doping usually results in smaller shifts in diffraction peaks compared to Cu doping. The photocatalytic performance of dye degradation was evaluated using methylene blue as model dye under visible light. Cu doped vanadium oxide often exhibits superior photocatalytic activity compared to Zn doped vanadium oxide due to more significant extension of absorption into visible light region. This study highlights the distinct effects of Cu and Zn doping on structural, optical and photocatalytic properties of vanadium oxide, providing valuable insights into design of efficient photocatalysts for environmental remediation under visible light.

Keywords: vanadium oxide nanomaterials, UV-vis spectroscopy, photocatalytic.

[54] Structural Analysis of Metal oxides doped with rare earth elements via Hydrothermal Route

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Abstract: Pure transition metal oxides have widely been studied due to its excellent photo catalytic, optical, and electronic properties. When metal oxides doped with some rare earth elements, its photo catalytic activity is adorned and optical properties are modified. Hydrothermal method is used to synthesize samples. Various characterization techniques have been used to analyze the structural properties of prepared samples. The polycrystalline phase and the integrated dopants into pure oxide were completely verified by X-ray diffraction. The results represent that doping remarkably impact the crystal structure polycrystalline phase and photo catalytic performance of metal oxide.

Keywords: Transition metal, rare earth, Hydrothermal Route, Structural parameters**.**

[55] Synthesis and structural analysis La doped nickel oxide nanoparticles

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Abstract: Nickel oxide (NiO) nanoparticles gain a significant interest of researchers and industries due to its wide range of properties and application. Metals doped nickel oxide nanoparticles have drawn a lot of attention mostly because of their unique properties. It is a semiconductor with a wide band-gap. The lanthanum (La) doped nickel oxide nanoparticles were successfully synthesis by sol gel auto combustion method. The structural properties of undoped and La doped Nickel oxides were further studied using X-ray diffractometer (XRD). The XRD peaks positions appearing at as (111), (200), (220), (311), and (222) crystal planes. The peaks position of the samples exhibited single phase of NiO nanoparticles and are in a good agreements with reported research work. The average particle size, specific surface area, crystallinity index is estimated from XRD analysis.

Keywords: Nanoparticles, nickel oxide, structural properties

[56] Synthesis and Characterization of SnS_2 Nanosheets by Sol-Gel Method for Multifunctional Applications

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Abstract: Tin disulfide (SnS_2) is a promising material for applications in hydroelectric cell, photovoltaics, photodetectors, and energy storage owing to its layered structure, excellent optical

properties, electrical and high chemical stability. In this study, SnS_2 nanosheets were fabricated using the sol-gel technique, a method known for its efficiency in producing high-purity nanostructures on a large scale at a reasonable cost. To produce the final SnS_2 nanosheets, a precursor solution consisting of Sn and sulfur sources were prepared. This was followed by careful hydrolysis of Tin (IV) chloride pentahydrate with thiourea, forming a gel, which was dried and annealed to obtain crystalline SnS_2 nanosheets. X-ray diffraction (XRD), field-emission scanning electron microscopy (FESEM), Fourier transform infrared spectroscopy (FTIR), UV-Vis spectroscopy, and Photoluminescence spectroscopy (PL) were used to investigate the structural, morphological, chemical bonds, optical and electrical characteristics of the produced SnS_2. While FESEM showed a layered and distinct nanostructure, the XRD investigation verified the production of a pure hexagonal SnS_2 phase. UV-Vis spectroscopy estimates a band gap of 2.37 eV. PL spectra showed a prominent emission peak at 700 nm, suggesting a direct bandgap transition suitable for optoelectronic devices. FTIR analysis of sol-gel-synthesized SnS_2 confirmed the presence of Sn-S bonds, indicating successful compound formation. According to these estimations, the optical band gap falls within the range appropriate for optoelectronic applications. The results show that the sol-gel process is a productive way to create high-quality SnS_2 with adjustable characteristics, making it a good option for next-generation energy harvesting and electronic devices.

Keywords: Hydroelectric cell, SnS_2 nanosheets, field-emission scanning electron microscopy (FESEM),

[57] **Structural Analysis of PVA Added Barium Hexaferrite**

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Abstract: Barium hexaferrite ($BaFe_{12}O_{19}$) is a widely studied material due to its excellent magnetic properties and potential applications in data storage, microwave devices, and permanent magnets. In this study, $BaFe_{12}O_{19}$ was synthesized using the solution auto-combustion method with and without polyvinyl alcohol (PVA) as a fuel additive. The structural parameters of both samples were investigated using X-ray diffraction (XRD). The XRD results confirmed the successful formation of the hexagonal magnetoplumbite phase in both cases, with variations in peak intensity and broadening attributed to the presence of PVA. The incorporation of PVA influenced the structural parameters, indicating its role in modifying the combustion process and crystal growth. The findings contribute to the advancement of ferrite-based materials for high-performance applications.

Keywords: Barium hexaferrite, PVA, Auto combustion, Structural parameters, XRD.

[58] **Plastic Waste Management: Challenges and Opportunities**

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Abstract: Nowadays, the efficient handling of city municipal plastic solid waste (PSW) is currently facing a worldwide challenge. Modern life is tightly linked to the use of plastics. Communities have both opportunities and challenges due to PSW, regardless of technological improvements and sustainability awareness. This paper examines recent advancements in the recycling and recovery of PSW. Special focus is paid to waste from polyolefinic sources, which make up a large percentage of the single-life plastic products we use every day. There is a comprehensive examination and debate of the four PSW treatment routes: primary (re-extrusion), secondary (mechanical), tertiary (chemical), and quaternary (energy recovery) techniques and technology. Because recycling materials rarely have the required quality, recyclers rarely use primary recycling, even if it is commonly used in the processing line itself. The technologies used for the chemical recycling of different plastic waste materials using thermocatalytic pathways, such as polyethylene terephthalate, polyolefins, polystyrene, and polyamide, were examined and described in this review paper. It is also explored how to value the chemicals that is recycled from plastic garbage. In light of the current problems, the research and prospects for thermocatalytic upcycling of solid waste plastic are also discussed.

Keywords : *Plastic solid waste (PSW), polyolefinic sources thermocatalytic pathway*

[59] **Nanoformulation based Topical Creams to treat Skin Infections**

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Abstract: The opportunistic human pathogens such as *Staphylococcus epidermidis*, *Staphylococcus aureus* and *Propionibacterium acnes* have become the most important cause of skin infections in recent years. Its pathogenicity is mainly due to the ability to form biofilms. These organisms are protected against attacks from the immune system and against antibiotic treatment, making these infections difficult to eradicate and this drives the search for alternative treatments with more than one active component that has potential antimicrobial activity. Sweet orange (*Citrus sinensis)* is potential antibacterial agent and it is widely used in face wash, face creams and face scrubs. Orange peel contains essential oils and compounds that can inhibit bacterial growth. Phytochemical analysis and HPLC of the plant extracts revealed the presence of bioactive compounds with therapeutic properties. Zinc oxide nanoparticles was synthesized by sol-gel method and was subsequently characterized. Nanoparticles based creams for topical applications were prepared using calamine base and stearyl based creams integrated with orange peel extract and zinc oxide nanoparticle. The antimicrobial activity was tested by Agar well diffusion and MIC was determined by the tube method against *S.epidermidis* (MTCC 435), *P.acnes* (MTCC 1951) and *S.aureus* (MTCC 96).The present study concludes that the nanobased formulations can be used as an affective treatment for skin infections.

Keywords: Skin infections, orange peel extract, ZnO nanoparticles, Antimicrobial activity, Nanobased formulations.

[60] **Structural Analysis of PVA/ Manganese Ferrite Nanoparticles**

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Abstract:Manganese ferrite ($MnFe_2O_4$) nanoparticles were successfully synthesized using the auto-combustion method with citric acid as a fuel along with ferric nitrate and manganese nitrate as precursors. To investigate the effect of polymer-assisted synthesis, polyvinyl alcohol (PVA) was added in one sample while another was synthesized without PVA. X-ray diffraction (XRD) analysis confirmed the formation of a single-phase spinel structure in both samples. Crystallite size, lattice parameters, and micro strain were calculated using Debye Scherrer's equation and Williamson-Hall analysis. A comparative study revealed that PVA incorporation influenced the crystallite size, strain, and peak broadening, suggesting modifications in the structural properties. These findings provide insights into the role of polymer-assisted synthesis in tailoring microstructural characteristics of $MnFe_2O_4$ for potential applications in magnetic and electronic devices.

Keywords: Manganese ferrite, auto-combustion, XRD analysis, crystallite size, structural properties.

[61] **Structural Investigations of Ni:ZnO Nanoparticles Synthesized by Solution Auto Combustion Method**

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Abstract: Transition metal ions doping may significantly alter the favorable structural modifications in metal oxide nanoparticles. ZnO nanoparticles have recently attracted a lot of attention of researchers and investigators due to broad area of applications. Here, undoped and nickel doped zinc-oxide nanoparticles were successfully synthesized by the solution auto combustion method. The structural and optical properties of Ni:ZnO samples were examined. A well-arranged crystallite structure was confirmed by X-ray diffraction patterns. XRD peaks observed corresponding to (1 0 0), (0 0 2), (1 0 1), (1 1 1), (1 0 2), (1 1 0), (2 0 0), (1 0 3), (1 1 2), and (2 0 1) planes. The crystallite size for pure and doped ZnO observed by the Scherrer formula. The average crystallites size was also calculated based on the Williamson–Hall equation. Tau's plots from UV-visible spectroscopy analysis revealed that the band gap decrease with doping of nickel ion.

Keywords: Nanoparticles, synthesis method, structural parameters

[62] **Study of the Enhancement of the Efficiency of the GaP/Si heterojunction Solar Cell by Optimizing Effective Parameters Using PC1D Simulation**

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Abstract: The efficiency of conventional diffused homojunction silicon solar cells is limited by emitter recombination and high thermal budget processes. To overcome these limitations, alternative approach is to develop hetero-junction solar cells employing low-thermal budget processes. GaP/p-Si heterojunction solar cells offer a promising alternative due to better lattice matching, a wider bandgap, and high charge carrier mobility. n-GaP provides a high valence band offset (ΔEv = 1.05 eV) and low conduction band offset (ΔEc = 0.09 eV), forming an electron-selective interface with silicon. This reduces tunnelling and thermionic emission losses, enhancing overall device performance. This study investigates the performance of n-GaP/p-Si single heterojunction solar cells using PC1D simulation software. The effects of GaP doping concentration, absorber layer thickness, and temperature on device efficiency were analysed. Optimized parameters for emitter thickness (0.1 μm), base thickness (200 μm), emitter doping (1.94×10^{19} cm^{-3}), and base doping (6.23×10^{16} cm^{-3}) were identified. Simulation results were compared with experimental data to highlight design improvements. The findings confirm that PC1D provides reliable benchmarks for optimizing high-efficiency GaP/Si heterojunction solar cells.

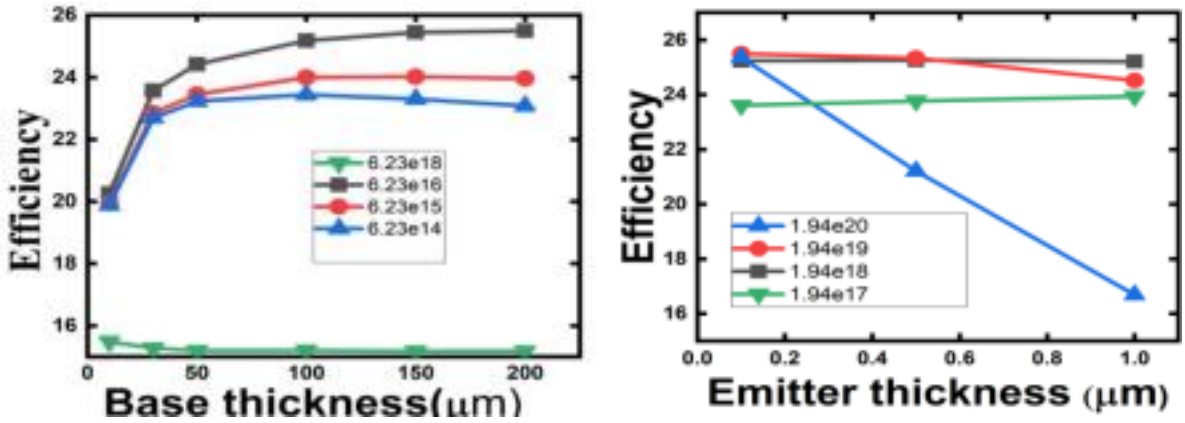

Figure. 1 (a) Shows the variation of efficiency with base thickness at different doping concentration of base region (b) Shows the variation of efficiency with emitter thickness at different doping concentration of emitter region.

Keywords: Hetero-junction solar cells, PC1D, tunnelling and thermionic emission.

[63] Advances in Ionic Liquid based Polymeric Smart Material: A Spectroscopic Investigation

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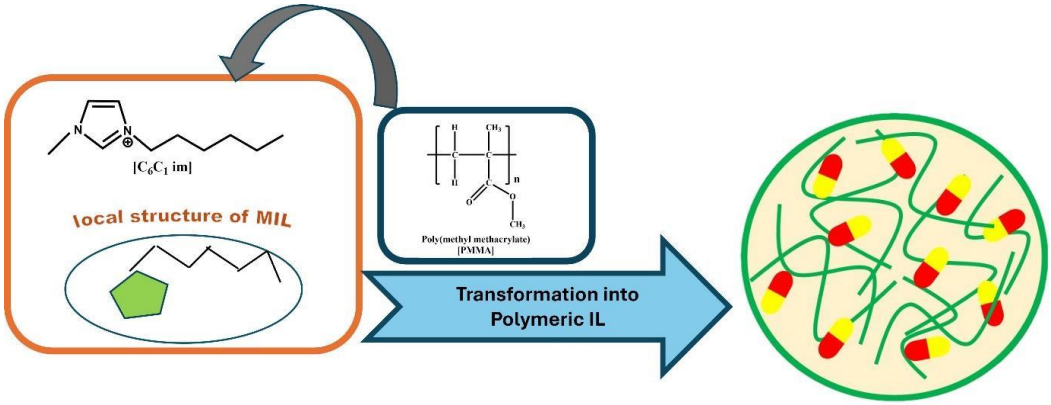
Abstract: Over the years with the development of Ionic Liquids (IL), IL based gel polymeric smart material have emerged wherein the ILs are trapped inside the polymeric hosts. The popularity of this material stems from the fact that IL based gel polymers have high thermal stability. However, designing of a proper IL based gel polymeric material can only be possible when the physiochemical as well as spectroscopic properties are well understood. With an aim to achieve this objective, a method has been developed to prepare a IL based gel polymeric system. For this study, 1-hexyl-3-methyl-imidazolium bis(trifluoromethylsulfonyl)imide, [C_6mim] [Tf_2N] has been first synthesised and later polymethyl methacrylate (PMMA) has been infused in the IL matrix. To monitor the proper distribution of polymer in the IL matrix, infra red method (IR spectroscopy) has been used. Steady state fluorescence measurements have been performed to reveal the heterogeneity in this material. Further, time-resolved fluorescence measurements have been carried out have a comprehensive understanding on the rotational dynamics of the polymeric system. The outcome of the present investigation focuses on the nanostructural organisation of the polymeric IL system.



Keywords: Ionic Liquids (IL), polymethyl methacrylate (PMMA) , nanostructural organisation of the polymeric IL system.

[64] **Unlocking the Potential of Rutile TiO_2 Nanoparticles: An Experimental and DFT Studies**

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Abstract: Water dispersible Rutile Titanium dioxide nanoparticles (TiO_2) were synthesized via hydrolysis method, involving the mixing of titanium precursor with water and ethanol, followed by heating and annealing. This results in the formation of water dispersible TiO_2 nanoparticles. Different characterization techniques were used to identify phase, crystallinity and morphology of the material. X-Ray Diffraction (XRD) confirmed the rutile phase. Zeta potential analysis provides information about surface properties of molecules or particles. The morphological study was performed by scanning electron microscopy (SEM). UV-Vis spectroscopy reveled optical

properties of the sample. Where theoretical calculation is done by DFT where bands structure is reproduced by GGA+U approximation showing 3.1 eV band gap. Projected density of state is used to describe actual orbital contribution of Ti and O in TiO_2 system. Biomedical application of rutile TiO_2 nanoparticles is still in progress.

Keyword: Rutile Phase, Water Dispersible , Hydrolysis , Zeta potential , UV-Visible

[65] **Electronic properties of Graphene and Twisted Bilayer Graphene** ***Jema Sudan*, Nivedita Deo.***

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Abstract: The project works on the aspect of theoretical studies of the electronic properties of Graphene, Bilayer Graphene and Twisted Bilayer Graphene. The introduction to graphene has been given in this poster along with the preliminaries of the study of 2D systems are discussed which includes topics of Hybridization, Linear Combination of Atomic Orbital, and the Tight Binding Model. These concepts are used throughout the poster to obtain results. The Density function theory calculations has not been done in this project but approximate results of values taken from several review papers have been used which were obtained using this method. The electronic properties of the single layer Graphene are discussed which forms the basic framework of all the calculations of the text. The results regarding band structures have been obtained analytically and using MATHEMATICA throughout the project. The poster extends the topic of Graphene to the Bilayer and to its dispersion relation and low energy approximation. Also, a new lattice Twisted Bilayer Graphene whose tight binding model and low energy approximation for dispersion relation has been discussed and hence future work will be done upon its effect in superconductivity using new substrate.

Keywords: Tight binding approach, Graphene, Twisted bilayer graphene, Dispersion relation.

[66] **Al doped CdS quantum dots for thermoelectric energy conversion: An experimental and first principles study**

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Abstract: CdS quantum dots (QDs) have received a lot of interest in past few years as viable candidates for thermoelectric applications owing to their unique electrical and thermal properties at the nanoscale. Herein, we synthesized Al doped CdS QDs by facile wet chemical approach at room temperature. The synthesized materials are characterized by techniques such as XRD

indicate that the Al doped CdS QDs have the cubic structure, doping could not have changed the lattice structure. UV-Vis-abs spectra shows a that first absorption peak is seen at 435 and 455 nm for CdS and Al doped CdS QDs, respectively. PL spectroscopy reveals the CdS QDs have a broadband surface trapped defect emission centered at 490 nm while doped QDs shows a broad Al-emission centered at 492 nm indicates that the suppression of nonradiative recombination and the successful doping of Al in the lattice of CdS QDs. HRTEM and EDS of CdS QDs shows particle size about 3-4 nm with chemical composition of Cd, S and Al without any impurities. Theoretical study performed by first principles calculations with density functional theory (DFT) for the bulk CdS and Al doped CdS. Thermoelectric energy conversion study examined through the transport properties by solving Boltzmann transport equation as well as lattice transport calculated by elastic constant. CdS QDs shows impressive transport properties to be considered as a potential thermoelectric material but lack of mobility charge carriers hence Al is doped in QDs.

Keywords: UV-Vis-abs spectra, HRTEM and EDS of CdS QDs, Boltzmann transport equation.

[67] *Computational Analysis of Anticonvulsant Potential of Bioactive Compound from Indigofera tirunelvelica*

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Abstract: Epilepsy, a neurological disorder defined as perennial seizures, importantly accords the tone of life of sick individuals. The seek for efficient and innocuous anticonvulsant agents has impelled involvement in plant-derived bioactive compounds. This study, engaged computational techniques to analyze the anticonvulsant potential of bioactive compounds infused from *Indigofera tirunelvelica*. Molecular docking introspection was executed to evaluate the constricting affinities of these compounds against primal molecular targets associated with seizure modulation, $GABA_{AT}$ (1OHW) and $GABA_A$ (4COF) receptors. The findings revealed that a specific bioactive compound with IUPAC name (3R,4R,6S)-3,4-dihydroxy-6-((1R,3aS,3bR,7S,9aR,9bS)-7-hydroxy-6-(hydroxymethyl)-3a,3b,6,9a-tetramethyl-7(((2S,3R,4S,5S,6R)-3,4,5-trihydroxy-6-hydroxymethyl)tetrahydro-2H-pyran-2-)oxy)hexadecahydro-1H-indolo[7,6-h]quinolin-1-yl)-2-methyltetrahydro-2H-pyran-2,6-dicarboxylic acid from *Indigofera tirunelvelica* exhibited strong binding affinity with the active sites of the target proteins, suggesting its potential role in modulating neuronal excitability and seizure activity. The docking scores and interaction profiles presented affirmative binding energies and significant hydrogen bond interactions, supporting the hypothesis of its anticonvulsant activity.

Further computational studies, foretold the compound to possess delectable pharmacokinetic properties with negligible toxicity risks, deepening its candidacy potentiality as a therapeutic agent. These collections aid the latent use of the phytocompound for being a natural curative agent with anticonvulsant activity, highlighting the potency of *Indigofera tirunelvelica* as a valuable source of natural compounds for the development of novel anticonvulsant therapies with countenance of further investigation through experimental validation.

Keywords: Pharmacokinetic, $GABA_A$, $GABA_{AT}$, Diazepam, anticonvulsive.

[68] **Effect of Calcium Doping on the Structural, Morphological, and Dielectric Properties of Manganese Ferrite**

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Abstract: This study investigates the synthesis and characterization of calcium-doped manganese ferrite $Ca_xMn_{1-x}Fe_2O_4$ (x = 0.0, 0.2, 0.4, 0.6, 0.8, and 1.0) nanoparticles using a facile hydrothermal method. In this work, we systematically varied the calcium concentration (x) to explore its influence on the structural, morphological, and dielectric characteristics of the resulting nanoparticles. According to the XRD pattern, every composition had a rhombohedral single spinel phase structure without any impurities. The average crystallite sizes, as determined by Williamson-Hall (W-H) graphs, were found to be between 48 and 79 nm. SEM images show some agglomeration of particles, and EDX helps to confirm the presence of all the desired elements. As a function of frequency and composition, the dielectric constant (Ɛ′ and Ɛ") values varies in the range of 8680.02 to 2306.08 and 22331.1 to 6697.63 at 1.15MHz frequency respectively, and dielectric loss (tanδ) were also examined, and this behaviour was described by Maxwell-Wagner Model. It was shown that when frequency increases, dielectric loss decreases. The synthesized material may be used in radio frequency applications, sensors, and transformers.

Keywords: Ferrites, Hydrothermal method, Structural properties, Dielectric

[69] **Electro-optical properties of BT2/BT4 nanocomposites doped 8CB liquid crystals for storage applications**

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Abstract: Science has always been the basis of advancement for society since time immemorial. One of the problems that was faced by human beings earlier was related to development of

devices to store valuable data related to their professional work, their health profiles or even their valuable personal moments. One important candidate that exhibits the potential to form memory devices in near future is liquid crystals (LCs). LCs are anisotropic materials having properties intermediate between a crystalline solid and anisotropic liquid. Memory effect in LCs can be visualized as the property of the material to withhold or preserve any particular switching state in it for a specific period of time. The memory effect and other electro-optical properties can be exponentially improved by the incorporation of nanoparticles onto these LCs. Here, we report the effect of Bismuth titanate ($Bi_2Ti_2O_7/Bi_4Ti_3O_{12}$) (also known as BT2/BT4 NCs) on the dielectric and electro-optical properties of a nematic and smectic-A liquid crystal, 4'- octyl-4-biphenylcarbonitrile (also referred to as 8CB) at the room temperature using the dielectric spectroscopy and the polarizing optical microscopic techniques. The incorporation of NCs also causes a random type of disordering in the material under investigation, thereby inducing a non-volatile memory of a few hours in it. These results will pave the way to fabricate various memory devices in LCs with the desired dielectric and electro-optical parameters by tuning the doping amount and type of nanoparticles.

Keywords: Liquid crystals (LCs),C,rystalline solid and anisotropic liquid, Memory effect in LCs.

[70] STRUCTURAL AND OPTICAL ANALYSICS OF Ag-Co_3O_4/rGO NANOCOMPOSITE

VIA HYDROTHERMAL ROUTE

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Abstract: Metal oxide semiconductors have attracted great interest in research because of their tunable band gap and its diverse applications in electrochromic devices, gas sensors and photocatalytic activities etc. Cobalt trioxide Co_3O_4, Ag-Co_3O_4 nanoparticles and Ag- Co_3O_4/rGO nanocomposites through a facile, one-step and cost-effective hydrothermal route; and thoroughly analyzed these materials using a variety of complementary techniques, including XRD, SEM/TEM, XPS, FTIR, VSM, UV–Vis, PL, photocatalytic and electrochemical measurements. The formation of cubic spinel structure in Ag- Co_3O_4/rGO nanocomposite was investigated by X-ray diffraction. As a comparison to Co_3O_4 and Ag- Co_3O_4 nanoparticles, the absorption edge of Ag- Co_3O_4/rGO nanocomposite was significantly shifted towards the visible region, and hence the band gap is narrowed due to highly conducting Ag and rGO incorporation. Also examined the electrochemical activity of as-obtained Ag- Co_3O_4/rGO nanocomposite using cyclic voltammetry and galvanostatic charge-discharge cycle analysis, demonstrating its employability in supercapacitors as it possessed excellent specific capacitance.

Keywords: Cobalt trioxide, nanocomposite, hydrothermal route, electrochemical activity, supercapacitors.

[71] Ammonia gas induced dielectric relaxation dynamics in Dodecyl Benzene Sulfonic Acid Doped Polyaniline Thin Film

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Abstract: Dielectric spectroscopy (20 Hz to 100 MHz) has been performed on dodecyl-benzene-sulphonic acid (DBSA) doped polyaniline (PANI) nano-composite polymer thin film to analyze their electrical properties in the absence and presence of ammonia (NH_3) gas. In the absence of NH_3 gas, a negative relative dielectric constant has been observed at very low frequency indicating the conducting nature of deposited PANI-DBSA films. On exposing the film to NH_3, the low frequency relaxation process has been observed which shows the time dependent behavior of relaxation process. The dipolar relaxation process has been found shifting towards the high frequency with time. This shift suggests a continuous increase in dielectric strength which is attributed as the increment in the density of dipoles in the composite film. The removal of NH_3 gas from PANI-DBSA allows the system to retain its previous state which is significant for sensing application.

Keywords: Dielectric spectroscopy, Conducting Polymers, Polyaniline (PANI), Dodecyl Benzene Sulfonic Acid (DBSA), Ammonia.

[72] A New Signal Conditioning Circuit for Sensitivity and performance enhancement for Nanostructured Gas Sensors

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Abstract: This project explores the performance enhancement of a nanomaterial-based Nitrogen Oxide (NO) gas sensor using a chaotic system. A simple and low-cost chaotic circuit is implemented as a signal conditioning circuit for the sensor. By leveraging the Sensitive Dependence on Initial Conditions (SDIC) phenomenon of chaotic systems, the sensitivity and overall performance of the NO sensor can be improved. This approach aims to provide a simple and effective signal conditioning technique.

Keywords: nanomaterial - Nitrogen Oxide - chaotic circuit - Sensitive Dependence on Initial Conditions (SDIC) - Signal Conditioning.

[73] High- Sensitive and Performance NO Gas Sensor Based on Reduced Graphene Oxide/Nickel Oxide Nanocomposite

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Abstract: This study reports the synthesis and gas sensing properties of reduced graphene oxide/nickel oxide (rGO/NiO) nanocomposites synthesized via a facile wet impregnation method. The structural, morphological, and electrical properties of the synthesized nanomaterials were characterized. The gas sensing performance of the rGO/NiO nanocomposite sensor towards nitrogen monoxide (NO) was investigated, focusing on sensitivity, response and recovery times, and selectivity. The results demonstrate the potential of the rGO/NiO nanocomposite as a highly sensitive and reliable NO sensor, offering improved performance compared to traditional sensing materials. This work paves the way for the development of advanced NO sensors with potential applications in environmental monitoring, industrial safety, and other related fields.

Keywords: Reduced graphene oxide/nickel oxide – nanocomposites - wet impregnation - nitrogen monoxide (NO) - Sensitivity.

[74] $CuFe_2O_4$ Nanoparticles as Potential Electrode Material for Asymmetric Supercapacitor Applications

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Abstract: The study demonstrates the synthesis of $CuFe_2O_4$ (CFO) nanoparticles via co-precipitation for supercapacitor applications, focusing on the impact of annealing temperature. High-resolution X-ray diffraction pattern confirms the formation of a tetragonal spinel phase, with crystallite size increasing with annealing temperature due to Ostwald ripening. Raman spectra further confirms the formation of tetragonal CFO NPs. FESEM and HR-TEM confirm particle agglomeration and an average particle size of ~71.66 nm. Fourier transform infrared spectroscopy identifies functional groups, while XPS and EDAX confirm the presence of Cu, Fe and O atoms in their Cu^{2+}, Fe^{2+}, Fe^{3+} and O^{2-} oxidation states at CFO's surface. Magnetic measurements from vibrating sample magnetometry indicate CFO's ferromagnetic nature. The BET analysis indicates the highest specific surface area for the sample annealed at 800 °C which enhances electrochemical properties by providing more number of active sites. Electrochemical tests, including CV, GCD and EIS assess redox activity and ion diffusion. CFO annealed at 800 °C achieves optimal performance with a specific capacitance of 911.1 F/g at current density of 1 A/g in 3 M KOH electrolyte. An asymmetric supercapacitor was constructed using CFO-800 serving as the positive electrode paired with activated carbon function as the negative electrode yields a specific capacitance of 44.42 F/g, 12.97 Wh/kg energy density, and 3.92 kW/kg power density, with 77.26 % cycling retention over 5000 charge/discharge cycles. These results highlight CFO's potential in next-generation energy storage.

Keywords: $CuFe_2O_4$, co-precipitation method, HR-XRD, Electrochemical study, Supercapacitor.

[75] **Advancements in Nanotechnology for Enhancing Veterinary Medicine: Revolutionizing Animal Health and Care**

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Abstract :The integration of nanotechnology in veterinary science is revolutionizing the way we approach animal health, diagnostics, and treatment. Nanomaterials, nanocarriers, and nanosensors offer novel solutions for enhancing drug delivery, improving diagnostic accuracy, and providing targeted therapies for various veterinary applications. These abstract reviews recent advancements in the application of nanotechnology within veterinary medicine, including its use in developing smart drug delivery systems, enhancing vaccines, and enabling precise detection of pathogens at the molecular level. Additionally, the potential of nanotechnology in tissue engineering, wound healing, and imaging is explored, emphasizing its ability to address challenges associated with traditional veterinary approaches. The presentation will highlight current research trends, potential benefits, and the regulatory considerations necessary for the safe application of nanotechnology in veterinary practice. The evolving role of nanotechnology in veterinary science promises to bring forth more effective, efficient, and personalized care for animals, opening new frontiers for clinical treatment and diagnostic methodologies.

Keywords: Nanotechnology, veterinary science, drug delivery, diagnostics, targeted therapies, veterinary applications.

[76] **Bio-waste based composite for wastewater remediation**

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Abstract:Climate change, urbanization, and population growth will make water scarcity worse. The development of economical and energy-efficient water purification technologies is necessary to address this problem. Utilizing biomass to create bio-based materials (BBMs) with desirable properties is one strategy. This is in line with the objectives of waste management and environmental preservation. Utilizing biomass is also beneficial due to its affordability, ease of availability, and low secondary environmental impact. Because they are plentiful and contain significant functional groups like hydroxyl, carboxyl, and amino groups, biomass materials are perfect for purifying water. In order to alter and absorb pollutants in water, functional groups are crucial. Limitations of single-sourced biomass include chemical instability, limited adsorption capacity, and poor mechanical strength. Research and development expenditures are essential for creating effective processes for producing BBMs and creating appropriate models for water purification applications. The creation, alteration, functionalization, and uses of BBM in wastewater treatment are all covered in this review. Oil-water separation, membrane filtration, organic pollutant removal, and micropollutant removal are some of these uses. This review

highlights the potential of BBMs for water treatment applications by examining their properties and production processes from biopolymers. The future opportunities and difficulties of creating BBMs for water treatment and use are also covered in this review. Lastly, this review emphasizes how crucial BBMs are to resolving issues with water purification and promotes creative approaches in this area.

Keywords: Bio-based materials (BBMs).

[77] **Nanoencapsulated Curcumin Micelles as Photo-protectants and Antioxidants in Milk**

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Abstract: India has a rich history of spice production and global exportation, with turmeric being one of the most valued spices due to its medicinal and therapeutic properties. The primary bioactive compound in turmeric, curcumin (diferuloylmethane), is a natural polyphenol extracted from *Curcuma longa* rhizomes. It is widely used in food, skincare, and pharmaceuticals for its potent antioxidant, anti-inflammatory, and photoprotective properties. However, the practical applications of curcumin are significantly limited due to its poor solubility, low stability, and rapid degradation under environmental conditions. To overcome these challenges, nanoencapsulation has emerged as an effective strategy to enhance curcumin's bioavailability and stability. This study compares the efficacy of curcumin loaded sodium dodecyl sulphate (SDS) micelles synthesized by chemical method and saponin micelles by green synthesis method. The nano-micelles were characterized using Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM), and X-Ray Diffraction (XRD) to determine their structural, morphological, crystalline properties and size determination respectively. Their antioxidant potential of the nano-micelles was evaluated using the 2,2-Diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay. The photoprotective activity of the synthesized micelles was analysed by UV-Vis absorption spectrophotometric studies. The findings suggest that green-synthesized saponin micelles offer a sustainable and biocompatible nanoencapsulation system for curcumin over chemical synthesis, demonstrating their superior photoprotective and antioxidant potential in milk and enabling an eco-friendly approach for improved shelf-life.

Keywords: Curcumin, SDS micelles, saponin micelles, antioxidant, photo-protectant.

[78] **Comparative Assessment of Anti-Microbial Activity of *Tinospora cordifolia*, *Glycyrrhiza glabra* Plant extracts and Zinc Nanoparticles derived from these extracts against Opportunistic Microbes of Skin**

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Abstract: The evaluation of the antimicrobial properties of *Tinospora cordifolia*, *Glycyrrhiza glabra* plant extracts and the zinc nanoparticles synthesized from them against opportunistic skin infection-causing pathogens was conducted. The plant extracts were obtained through solvent extraction using aqueous ethanol, chosen for its high antimicrobial activity. Zinc nanoparticles (Zn NPs) were synthesized using these plant extracts and were subsequently characterized. Skin swabs were collected from multiple sites, and the isolates were identified as *Staphylococcus*, *Micrococcus*, and *Pseudomonas* species and confirmed using Vitek 2. Phytochemical analysis of the plant extracts revealed the presence of bioactive compounds with therapeutic properties. This study aims to address the need for effective, sustainable treatments for managing skin infections caused by opportunistic pathogens. The antimicrobial assays revealed that *Glycyrrhiza glabra* extract demonstrated the highest activity overall, outperforming its nanoparticle form as well as *Tinospora cordifolia* and its nanoparticle form. While *Tinospora cordifolia* extract did not exhibit notable antimicrobial effects, its synthesized ZnO NPs showed measurable activity, highlighting the enhancement of antimicrobial properties through nanoparticle synthesis. These findings emphasize the potential of *Glycyrrhiza glabra* and the innovative application of nanoparticles in developing natural treatments for opportunistic skin infections. The Minimum Inhibitory Concentration (MIC) was determined. Conductivity experiments revealed a positive correlation between the conductivity and antioxidant capacity of the extracts. Given the rising threat of antibiotic resistance, investigations into plant-based alternatives hold significant potential for addressing the need for effective and sustainable treatment options.

Keywords: *Tinospora cordifolia*, *Glycyrrhiza glabra*, Opportunistic pathogens, Zinc Nanoparticles, Skin Infections, Antimicrobial Activity.

[79] **Investigation of Polar Phase Content and Energy Harvesting Performance of Electrospun PVDF Nanofibers under Varying Processing Conditions.**

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Abstract: Polyvinylidene fluoride (PVDF) stands out for its flexibility, stability, ease of processing, low cost, and high dielectric and piezoelectric constant value. However, like other piezoelectric polymers, it requires a post synthesis electrical poling to transfer nonpolar α phase to polar β phase for better piezoresponse. Therefore, self-polarization of the material during synthesis is highly crucial for its commercial viability. This work aims to polarise the molecular dipoles present in PVDF through electrospinning process by applying a strong electric field during its synthesis. Additionally, the morphology, fiber orientation, β phase nucleation in PVDF nanofibers are thoroughly investigated by varying the electrospinning parameters. Among all the electrospinning parameters, processing parameters adversely affect the β phase percentage in PVDF. In this study, the effects of two key processing parameters such as applied voltage and tip-to-collector distance on the polar phase content and fiber morphology of PVDF are explored. The content of the β phase and the morphological analysis of deposited fibers are studied through FTIR and FESEM analysis. Keeping all the parameters constant, the electric field variation (12kV to 18kV) promotes the phase content from 73.44% to 80%. The same process is repeated

further with optimized field value and varying the spinning distance (10cm to 14 cm), which further increases the β phase content from 80% to 82.68%. The results are validated by examining the energy harvesting performance of different PVDF nanofiber-based devices. The PVDF nanofiber-based device, exhibiting the highest polar phase, achieves an impressive average peak-to-peak open-circuit voltage of 9.27 V.

Keywords: Electrospinning, nanofiber, polar phase, nanogenerator.

[80] **Nano-Vet Revolution: Transforming Animal Health with Nanotechnology**

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Abstract: Nanotechnology is a fast-growing technology that plays an important great impact on various fields of therapeutic applications. It is capable for solving several problems related to animal health and production. There are different nano-systems such as liposomes, metallic nanoparticles, polymeric micelles, polymeric nanospheres, functionalized fullerenes, carbon nanotubes, dendrimers, polymer-coated nanocrystals and nanoshells. Nanoparticles are characterized by many features include their minimal size, colossal surface zone to mass extent. The development of antimicrobials in nanoparticle systems is considered an excellent alternative delivery system for antimicrobials for the treatment of microbial diseases by increasing therapeutic effect and overcoming the side effects. Nanotechnology has a significant effect for veterinary prescription in numerous fields incorporates therapeutics, diagnostics, tissue building, immunization generation and disinfectants. The Nano-applications are as of now being used inside the region of creature wellbeing, rearing, proliferation and sustenance of creature. It is concluded that, before making nano-products available for animal use, extensive risk evaluations should be carried out to ensure their safety. So, the overview of existing and promising nano applications in veterinary research that may lead to increased efficiency and production.

Keywords: Animal health, Nanoformulations, Nanomedicines, Nanobiotechnology, Veterinary Science

[81] **MICROBIAL – IRON NANOCOMPOSITE IN LEAD METAL REMOVAL AND IMPACT ON PLANT GROWTH**

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Abstract: Industrialization has revolutionized the global growth at a faster rate and at the same time led to an increase in the accumulation of industrial waste. There are different sources for waste accumulation and major industrial waste contains many toxic compounds like heavy metals and hazardous chemicals. These compounds leach into the soil and pose a major threat to

the flora and fauna and persist in soil for longer periods without being degraded. Among the toxic heavy metals released from different waste the most important toxic compound which is highly toxic even at low concentrations to all the living cells and has a major impact on the physiology of plant growth is Lead metal. So, the present study focusses on an ecofriendly micro remediation approach to reduce the metal toxicity in soil and facilitate the plant growth. The biosorption ability towards Lead metal of the bacterial isolate *Bacillus licheniformis* isolated from electronic waste soil was 10000 ppm. To recover the bacterial isolate from the soil after application and enhance the metal removal capability of the bacterial isolate magnetite nanocomposites were synthesized by Co-precipitation method and the metal adsorption was studied. The metal concentrations were determined by atomic absorption spectrophotometer. In vitro studies on the role of Microbial-Iron nanocomposites in reducing metal toxicity and enhancing plant growth was studied in chilli and tomato plants for a period of 45 days and 21 days respectively. It was observed that in sterilized soil containing Pb (1000ppm) inoculated with the bacterial isolate metal concentration was reduced by 53% when compared to the magnetite nanoparticles which reduced by 40% and microbial-iron nanocomposites with a reduction of 44%. In tomato plants the amount of metal removed was 28.78% by bacterial isolate, 41.76 % by Magnetite nanoparticles and 23.60 % by Microbial-Iron nanocomposites.

Key words: Biosorption, Magnetite nanoparticles, Biosorbent, Nanocomposites, Microbial nanocomposites

[82] **Green Synthesized cobalt ferrite nanostructures using *Azadirachta indica* leaf extract**

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Abstract: Green synthesis of cobalt ferrite ($CoFe_2O_4$) nanoferrites using *Azadirachta indica* (Neem) leaf extract by sol- gel techniques offers an eco-friendly and sustainable approach to nanoparticle fabrication. In this study, neem leaf extract served as a natural reducing and stabilizing agent for the synthesis of $CoFe_2O_4$ nanostructures. The structural, morphological, and surface charge properties of the synthesized nanoparticles were characterized using X-ray diffraction (XRD), Dynamic Light Scattering (DLS), and Zeta potential analysis. XRD analysis confirmed the spinel cubic phase of cobalt ferrite with an average crystallite size of about 31 nm. Average hydrodynamic radius of the ferrite nanoparticles were found to be 402 nm. Surface charge of the nanoparticles were calculated to be -4 mV. The green synthesis approach not only eliminates the need for toxic chemicals but also enhances the biocompatibility of the nanoparticles, making them promising candidates for photocatalytic and antibacterial applications.
Keywords: Green synthesis, ferrites, sol-gel, X-ray diffraction (XRD), Dynamic Light Scattering (DLS), Zeta potential

[83] **Investigation of Structural and Dielectric Properties of Mg Ferrite for High-Frequency Applications**

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Abstract: Magnesium ferrite nanoparticles were synthesized using the co-precipitation method and the structural and electrical properties were investigated. X-ray diffraction (XRD) confirms the formation of a pure cubic spinel phase of the composition with a lattice constant of 8.4017 Å. The average crystallite size was determined to be approximately 24.03 nm and calculated magnetic hopping lengths, L_a & L_b were 4.057 and 2.686 Å. The Williamson–Hall (W–H) method was employed to evaluate the crystal structure and lattice strain, further validating the spinel phase through X-ray analysis. Dielectric studies were conducted at room temperature in the frequency range from 1 kHz to 120 MHz. The material exhibited typical spinel ferrite behavior, where the dielectric constant was highest at lower frequencies and decreased with increasing frequency due to electron hopping, demonstrating dielectric dispersion. Impedance analysis revealed that the real component shifted from 26227 MΩ to 48 MΩ, while the imaginary component varied from -70731 MΩ to 38.48 MΩ. The material displayed a high resistivity of 2.7×10^4 $(\Omega m)^{-1}$ at low frequencies, whereas at higher frequencies it exhibited significant conductivity, reaching 1.5×10^4 $\Omega^{-1}m^{-1}$. These electrical characteristics make magnesium ferrite a suitable candidate for high-frequency applications.

Keywords: Nanoferrites; Co-precipitation; X-ray Diffraction; Dielectric Constant; Impedance Analysis.

[84] Study the structural and dielectric behaviour of Sr1-xMoxSiO3 (x = 0, 0.05, 0.10) synthesized by the solid-state reaction method

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Abstract: The molybdenum (Mo)-doped Sr1-xMoxSiO3 (x= 0, 0.05, 0.10) perovskite materials were synthesized using the conventional solid-state reaction method. The precursor powders were thoroughly mixed in appropriate ratios and finely ground, followed by calcination at 1200°C for 12 hours and sintering at 1000°C for 6 hours. The prepared samples were characterized using X-ray diffraction (XRD), Energy Dispersive spectroscopy (EDS), and field emission scanning electron microscopy (FESEM). The XRD pattern confirmed the formation of the SrSiO3 phase. Significant variations in the lattice parameters were observed due to the incorporation of molybdenum (Mo) at the lattice sites of strontium atoms in the synthesized powder. The EDS confirms the Mo doping and stoichiometry of the resultant samples. FESEM has revealed the notable impact of doping on the grain size, which is consistent with the XRD results. The electrical properties such as dielectric constant (εr), dielectric loss (tan δ), capacitance, and conductivity (σ) of the synthesized material were studied using capacitance resistance (LCR) meter over various range frequencies and temperatures. The

Mo-doped Sr1-xMoxSiO3 (x=0.05) has shown an increase in dielectric constant in the temperature range (300°C – 700°C) when studied at different frequency ranges (1KHz, 10KHz, 100KHz) in comparison with pure SrSiO3. Also, a drastic increase in the dielectric constant is observed with Mo (x=0.10) doping in the temperature range (550°C -800°C) at frequencies (1KHz, 10KHz, 100KHz). The variation in the dielectric losses (tan δ) is also studied with different dopant concentrations. These materials can provide new insights and possibilities for engineering dielectric materials for high-temperature and advanced power device applications.

Keywords: Perovskite material, Dielectric constant, solid-state reaction

[85] **Green Synthesized Metal Oxide Nanoparticles for Photocatalytic Degradation**

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Abstract: For Photocatalytic applications, green-synthesized Metal-Oxide Nanoparticles (MONPs) have shown great promise as sustainable and environmentally acceptable materials, especially when it comes to decomposing organic contaminants. Green synthesis uses natural materials including plant extracts, microorganisms, and biopolymers, which ensures environmental compatibility and lower toxicity than conventional chemical and physical synthesis procedures, which frequently rely on hazardous reagents and demand significant energy input. The synthesis, characterisation, and Photocatalytic characteristics of green-synthesized MONPs are the main topics of this study, with particular attention paid to their optical, morphological, and structural characteristics. To improve Photocatalytic performance in both visible and ultraviolet (UV) light, the effects of synthesis conditions on variables such particle size, surface area, and band gap energy are studied. The degradation kinetics of different organic pollutants such as dyes and medicinal compounds are also examined. In order to appraise these Nanomaterials' potential uses in wastewater treatment, the study also looks at their long-term stability and recyclability. In the end, our work demonstrates how green-synthesized MONPs can be effective and affordable Photocatalysts, advancing sustainable Nanotechnology for pollution reduction and environmental remediation.

Keywords: Photocatalysts, Metal-Oxide Nanoparticles (MNOPs), Degradation, Green Synthesis.

[86] **CaV_2O_6-glass composite for ultra low temperature co-fired ceramic (ULTCC) technology**

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Abstract: Herein, we synthesized Ultra-low-temperature Co-firing ceramics (ULTCC) based on calcium metavanadate (CaV_2O_6) ceramic using the conventional solid-state reaction route. The synthesized material is characterized by advanced techniques to know about the phase purity, crystal structure and microstructural characteristics using X-ray diffraction (XRD), Raman spectroscopy, and Field Emission Scanning Electron Microscopy (FE-SEM). The analysis revealed that the pure phase monoclinic CaV_2O_6 is obtained. The CaV_2O_6 -glass-ceramic has been prepared by adding glass in CaV_2O_6 with different weight ratios. The ceramic-glass powder was compacted into pellets and sintered at a temperature of 670°C. Furthermore, CaV_2O_6 -glass ceramics has been tested for microwave dielectric properties. For the ratio 70:30, the dielectric constant and Qf oblation εr = 11.1, Q X f = 5500 GHz. The overall results suggest that the CaV_2O_6 -glass ceramics could be promising materials for Ultra-low-temperature-cofired ceramic technology.

Keywords: Ultra-low-temperature Co-firing ceramics (ULTCC), solid-state reaction, CaV_2O_6 -glass-ceramic, microstructural, dielectric

[87] Green route harvesting of hydrogen energy using B-PbBr2 and S-PbBr2 under electrochemical water splitting

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Abstract: For enhanced electrochemical water splitting, to produce clean and green hydrogen, which is fuel for sustainable energy conversion and storage, high-efficiency and reasonably priced catalysts for the hydrogen evolution reaction (HER) in basic electrolytes are essential. The primary difficulty in producing green hydrogen is achieving continuous and efficient hydrogen evolution at high current densities, which is impossible since prolonged large-current operation quickly degrades efficiency. In this work, B-PbBr2 and S-PbBr2 nano composites were prepared using simple hydrothermal method with the objective of improving electrocatalytic green hydrogen production at industrial current densities. X-ray diffraction (XRD), scanning electron microscopy (SEM), and X-ray photoelectron spectroscopy (XPS) were used to analyse the crystalline structure, morphology, and chemical composition of the synthesised nanocomposites. The prepared B-PbBr2 and S-PbBr2 catalysts exhibit excellent electrochemical water-splitting activity, a low overpotential, a high current density, and extended stability lasting more than 12 hours. Our work has been developed a new electrocatalysis which is one of the earth abundant, stable, and highly effective catalysts for water electrolysis. S-PbBr2/NF improves conductivity, and its nanosheet structure, which offers a large surface area for catalytic activity is one of the most promising electrocatalysts for HER

than B-PbBr2/NF, especially in an alkaline medium, because of its outstanding catalytic activity, excellent stability, and simple production method.

Keyword: B doping; S doping; Water Splitting; Electrochemical Analysis; HER

[88] Hybrid reflective metasurface for linear to circular polarization conversion

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Abstract: This paper presents a single-layered linear to circular polarization conversion metasurface achieving great polarization conversion efficiency in reflection mode. The simulated results shows that the metasurface cell converts linearly polarized EM wave to a circularly polarized reflective wave when operated in the sub-terahertz and terahertz regime (0.1THz to 10THz). The structure is a hybrid structure incorporating graphene along with the conventional gold. The structure also provides a wide angular stability up to 40°. The structure has applied relevance in the design of polarization manipulation devices such as satellite systems and radar technology.

Keywords: Metasurface; Polarization Converter; Hybrid Structure; Graphene

[89] **Assessment of the Antimicrobial activity of *Camellia sinensis* Extracts and Silver Nanoparticles synthesized from *Camellia sinensis* against oral Biofilm Formers**

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Abstract: Dental caries is considered one of the most existing and worldwide common diseases related to the oral cavity affecting both children and adults. Natural herbal plants like *Camellia sinensis* (green tea) was found to have less side effects. Green tea is a globally popular beverage, widely consumed across the world. Numerous studies have suggested about the beneficial effects of green tea on oral conditions such as dental caries, periodontal diseases. 14 Dental samples were isolated from the patients suffering from dental caries and characterized by Vitek-2. The strains were identified as *Pseudomonas fluorescens*, *Enterobacter cloacae complex*, *Pseudomonas aeruginosa* respectively. Standard strains of *Streptococcus salivarius* (MTCC13009) and *Candida albicans* (MTCC227) were procured from IMTECH Chandigarh were used in the current study. Solvent extraction is done using methanol and hexane. Phytochemical analysis of the green tea extractsshowed the presence of bioactive components such as alkaloids, phenols, reducing sugars and carbohydrates. Silver nanoparticles were synthesized using *Camellia sinensis* and characterized by UV-Vis Spectroscopy. Comparative analysis of anti-microbial activity was carried out using various green tea extracts and Silver

nanoparticles syntesied from green tea extracts on the isolates. The green tea methanolic extract showed higher activity on all the isolates in comparison to hexane. The synergistic effects of AgNPs and green tea were also studied against organisms. The MTT cytotoxicity assay of green tea extract on HOK (Human Oral Keratinocytes) cell lines showed IC50 as ND (not detected) at the highest dose of 100 µg/ml. Conductivity studies were performed to elucidate the role of electrical impedance in inhibiting microbial growth, with a focus on disrupting cell membrane function and its implications for antimicrobial applications.Even though the current study demonstrates the beneficial role of green tea, more clinical and biological studies are required for the treatment of oral diseases. Our study proposes a novel approach of use of Green tea extract to help reduce the bacterial activity in the oral cavity.

Key words: *Camellia sinensis*, Dental caries, Phytochemical analysis, Comparative analysis, Synergistic effect, Conductivity studies.

[90] **Optimizing electrochemical performance of graphene-PAni composites for high-performance supercapacitors**

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Abstract:The combination of graphene and conducting polymers has emerged as a highly promising strategy for designing high-performance supercapacitor electrodes. The integration of Reduced Graphene Oxide (rGO) and Polyaniline (PAni) in nanocomposites enables rapid charge transfer, improved cycle stability, and increased specific capacitance. This study aims to contribute to the development of high-performance graphene-PAni composites for supercapacitor applications. In the present work, we reported the synthesis, characterization and electrochemical performance of the composites of reduced graphene oxide with polyaniline. Three samples were prepared via in-situ chemical polymerization method with rGO to PAni in certain weight ratios. To evaluate the structural properties of the synthesized materials, samples were characterized using X-ray diffraction (XRD), Fourier Transform Infrared spectroscopy (FTIR) and Raman spectroscopy. Further, electrochemical measurements were carried out with cyclic voltammetry (CV). The results will be discussed for the performance of synthesized materials for the potential supercapacitor application.

Keywords: Polyaniline, Reduced Graphene Oxide, Supercapacitor

[91] **"Optimizing SeTeSn Alloys with Zn for Better Phase Change Memory and High Energy Radiation Shielding"**

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Abstract:This study provides an in-depth analysis of how zinc (Zn) as an additive influences the kinetic parameters of glass transition and crystallization in $Se_{78}Te_{20}Sn_2$ alloys. Through non-isothermal calorimetric techniques, the research examines the role of Zn incorporation in modifying key thermal properties, including the glass transition temperature (T_g), activation energy (E_g), thermal stability (S), and the glass-forming ability of the material. Additionally, the study investigates the suitability of these quaternary alloys for shielding against high-energy radiation, such as X-rays and gamma rays. The examined chalcogenide-based alloy belongs to the Se-Te-Sn-Zn system, with their radiation attenuation characteristics assessed using the online Phy-X/PSD tool. Notably, the results indicate that the attenuation coefficients of these materials exceed those of several conventional and commercial glasses, demonstrating their effectiveness as shielding materials. Furthermore, the study explores how substituting selenium (Se) with zinc affects the radiation protection properties of the base Se-Te-Sn glass. By integrating thermal analysis with radiation shielding performance, this work offers significant insights into the dual functionality of these quaternary ChGs, making them promising candidates for applications in both phase-change technology and radiation shielding.

Keywords: Activation energy, thermal stability, radiation shielding

[92] Photonic Crystal Biosensor and their Applications

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Abstract: A sensor is a device that converts light into an electrical signal. Examples of sensors include thermometers, glucometers, and photonic sensors, which evaluate changes in one physical parameter in terms of the magnitude of another parameter that can be measured more easily or precisely. After measuring the physical amount of light, it converts it into a format that an instrument can read. Numerous essential benefits of photonic sensors are their compact size, low weight, immunity to electromagnetic interference, environmental stability, precision, quick sensing speed, and long-range data transmission capability. Photonic sensors are frequently used in many different fields because of these peculiarities. We talk about photonic sensors in agriculture and aircraft in this paper.

Keywords: Photonic sensors, environmental stability, data transmission capability, compact size.

[93] Nanomedicine in Veterinary Medicine: Advancing Diagnosis, Treatment, and Prevention

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Abstract: Nanomedicine has emerged as a transformative field in healthcare, offering significant potential in veterinary medicine for the diagnosis, treatment, and prevention of various diseases in animals. The application of nanotechnology in veterinary care enables the development of novel drug delivery systems, targeted therapies, diagnostic imaging, and disease monitoring, all while minimizing side effects and enhancing treatment efficacy. This abstract explores the role of nanomedicine in veterinary medicine, focusing on its applications in companion animals, livestock, and wildlife. Key advancements in nano-based drug formulations, vaccines, diagnostic devices, and tissue engineering will be discussed, highlighting their ability to address challenges such as drug resistance, long-term treatment regimens, and the need for more precise interventions. The integration of nanomedicine in veterinary practice holds promise not only for improving animal health but also for ensuring public health safety by enhancing zoonotic disease management. Challenges regarding safety, regulation, and ethical concerns will also be examined, providing a comprehensive overview of the current landscape and future directions in this promising field.

Keywords: Nanomedicine, Veterinary medicine, drug resistance.

[94] **A Study of Photocatalytic Nanomaterials for Environmental Remediation**

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Abstract: The rapid advancement of technology and industry has significantly accelerated the depletion of natural resources, posing a serious threat to our ecosystem and ecological balance. Presently, one of the major environmental challenges is industrial effluents released into water and air have been treated using physical and chemical methods. However, in recent years, photocatalytic technology has emerged as a powerful and sustainable approach to mitigate environmental degradation. Photocatalysis utilizes solar energy efficiently, making it a promising alternative for addressing energy demands and reformative techniques for environmental sustainability. A variety of materials, including metal oxides, chalcogenides, and semiconductors, have exhibited excellent remarkable photocatalytic properties due to their eco-friendliness, affordability, chemical stability, non-toxicity, and high photocatalytic efficiency. These materials can effectively absorb both UV and visible light, further intensifying their performance. Nanomaterials possess numerous advantages such as high surface area, improved light absorption, and enhanced charge separation, making them highly efficient and stable for photocatalytic applications. Their versatility extends to critical areas such as environmental remediation, air purification, water splitting for hydrogen production, and solar energy conversion, pollutant degradation. Majorly reported photocatalysts include TiO_2, ZnO, CuO, Fe_2O_3, ZnS, MOFs, COFs, graphene, g-C_3N_4, CNTs, and bismuth oxides. Structural modifications of these materials using metals, nonmetals, metal ions, and other semiconductors have been found to reduce band gap energy, prevent agglomeration, and enhance their affinity toward organic compounds, thereby expanding their industrial applicability. These modifications improve light absorption of the material and hence significantly enhance photocatalytic efficiency. This article explores critical factors that influence photocatalytic performance,

including size, structure, surface area, morphology, and band gap energy. Furthermore, it examines various synthesis methods offering a comprehensive review of their potential for industrial-scale applications.

Keywords: Photocatalysis, Metal oxides, Chalcogenides, Semiconductors, Environmental remediation, Pollutant degradation.

[95] Graphene-Based Oxide Interface Engineered FET (GCOTE-FET) Biosensor for Early Breast Cancer Detection

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Abstract: Graphene-based field-effect transistors (GFETs) have emerged as promising platforms for biomolecular detection, leveraging their exceptional electrical properties and high surface-to-volume ratios. This study presents the design and simulation of a novel Graphene Channel with HfO_2 Interface Engineered Field-Effect Transistor (GCOTE-FET) biosensor, specifically engineered to enhance sensitivity for biomedical applications. The proposed sensor integrates hafnium oxide (HfO_2) as a high-k dielectric material to improve gate control, reduce leakage currents, and enhance interface stability, thereby optimizing device performance. The sensor's response was analyzed for biomolecules with varying dielectric constants—MCF-10A (K = 4.5), Hs578T (K = 22), and T47D (K = 32)—demonstrating a significant increase in ON-state current (I_ON) while maintaining a low OFF-state current (I_OFF). The results highlight the substantial impact of dielectric modulation on device characteristics, establishing the GCOTE-FET as a strong candidate for real-time, ultra-sensitive biosensing. This advancement paves the way for next-generation graphene-based biosensors with potential applications in early disease detection and precision medical diagnostics, reinforcing their transformative role in modern healthcare technologies.

Keywords: Graphene-based field-effect transistors, Graphene Channel with HfO_2 Interface Engineered Field-Effect Transistor, ultra-sensitive biosensing, biomolecular detection

[96] Environmental applications of novel Glutaraldehyde crosslinked Chitosan/GMA/Nickel oxide nanoparticles for wastewater treatment

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Abstract: Emerging micro-pollutants and the resistant bacteria in the water samples related to antibiotic pollution has raised concerns in the scientific community. To tackle this, either the problem should be targeted at the source, or the solution should be top-notch. Thus, we developed biopolymer-based composite using chitosan, glycidyl methacrylate, and nickel oxide to remediate two antibiotics, Tetracycline and Ofloxacin and one heavy metal ion, Lead from their aqueous solution. Batch method was used to optimise the synthesized composite against different parameters which affects the rate of adsorption. The results indicated upto 100%

removal of tetracycline and 95% removal of ofloxacin under normal conditions. The material was well-characterized using various spectroscopic techniques like FTIR, SEM-EDX, TEM, XRD, and TGA-DTA. The adsorption isotherm study indicated that the process follows multilayer adsorption governed by Freundlich isotherm model and reaction kinetics followed pseudo-second order rate. Thermodynamic study also revealed the process to be spontaneous, endothermic and favourable at all temperatures. The maximum adsorption capacity was achieved as 394.2, 277.5 and 113.8 mg/g for tetracycline, ofloxacin and lead ions, respectively. This composite showcased outstanding performance while being regenerated upto 6 adsorption-desorption cycles. The novelty and efficacy of this composite makes it a potential candidate as a solution to this existing problem.

Keywords: Chitosan, nickel oxide, nanocomposite, antibiotic, adsorption.

[97] **Upconversion investigation from rare-earth doped double perovskite K_3InF_6**

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Abstract: There has been a gradual transition in research activity from discovering newer mixed metal fluorides, oxyfluorides to investigate their intricate and interesting properties. Especially the variation properties such as temperature, pressure, electric or magnetic fields have given raise to many interesting observations such as newer ferroelectric or ferroelastic materials. It is well known that composition, structure and property are highly correlated in these materials.

Compounds with the general formula A_3BF_6 can be considered as a double perovskite form of A_2ABF_6 and from this elpasolite $A_2B'B''X_6$ and cryolite $A_3B'X_6$ structure types are derived from the perovskite by a cationic ordering and are based on a double perovskite cell but with a lower symmetry, where, all the B^{3+} ion is 6-fold coordinated with X anion and out of three A^+ ions the two A^+-ions are 12-fold coordinated and one A^+ is 6-fold coordinated with X anion, structure is presented in Figure 1 .[4] Indium containing fluorides exhibit polymorphism resulting from structural distortions and show superstructure. The present work has been undertaken to synthesize K_3InF_6 in a manner involving less hazardous chemicals. K_3InF_6 was investigate its role as a host matrix with the evaluation of their optical properties including energy upconversion by doping with rare-earth ions such as Er^{3+} and co doped with sensitizer Yb^{3+}.

Keywords: Metal fluorides, oxyfluorides, Synthesize $K_3InF_{6,.}$

[98] **Room-Temperature Water Splitting and Power Production via Fe-Doped $SrTiO_3$ based Hydroelectric Cells**

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Abstract: The current work aims to establish hydroelectric cells based on strontium iron (0.1) titanate ($Sr_{0.9}Fe_{0.1}TiO_3$) and strontium titanate iron (0.1) oxide ($SrTi_{0.9}Fe_{0.1}O_3$) and to emphasize their potential as effective and environmentally conscious energy conversion devices. At room

temperature $Sr_{0.9}Fe_{0.1}TiO_3$ and $SrTi_{0.9}Fe_{0.1}O_3$-based hydroelectric cells generate electricity through a water-splitting process. Utilizing the solid-state technique, the oxygen-deficient materials $Sr_{0.9}Fe_{0.1}TiO_3$ and $SrTi_{0.9}Fe_{0.1}O_3$ are processed. These high-temperature treated oxide compounds produce structural defects, pores, and oxygen vacancies. Crystal structure and phase identification of synthesized compounds $Sr_{0.9}Fe_{0.1}TiO_3$ and $SrTi_{0.9}Fe_{0.1}O_3$ were studied using X-ray diffraction while scanning electron microscopy was used to examine the surface features and morphology of the compounds. Raman spectroscopy was utilized to analyze the structural flaws induced in the engineered oxygen-deficient materials. To fabricate HEC, one side of each pellet had a zinc electrode attached, and the other was coated with silver. Water is added to the pellet's surface, which undergoes chemidissociation to produce hydroxide and hydronium ions before physidissociation. Current travels across an external circuit due to a redox reaction that happened at both electrodes to produce voltage. The result will be discussed during the presentation.

Keywords: Hydroelectric cell, Water splitting, Strontium titanate, Iron, XRD, Raman, V-I measurements, SEM, EIS.

[99] Conjugating ammonia gas with functionalized multi-wall carbon nanotubes doped polyaniline dodecyl benzene sulphonic acid composite for sensing applications

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Abstract: Functionalized multiwall carbon nanotubes (*f*-MWCNT) offers the greatenhanced sensing of ammonia (NH_3) gas when doped indodecyl benzene sulphonic acid (DBSA) and polyaniline (PANI) composites polymer nanoparticles(*f*-MWCNT-PANI-DBSA). The thin film of *f*-MWCNT-PANI-DBSA compositeis characterized for sensing by depositingit on the glass substrate having interdigitatedplatinum electrodes. The enlarged surface area of offered by the *f*-MWCNT-PANI-DBSA to the NH_3 is the basis of enhanced sensing response and reduced response time. The low concentration 100ppb of NH_3 is significantly detected with due to the availability of in-plane and out-planes π-π stacking of side chain of DBSA and PANI molecules around *f*-MWCNT which offers the largersurface area to exposure and the same is confirmed by the rough and porous surface morphology of the composite.

Keywords: Carbon nanotubes, Doped indodecyl benzene sulphonic acid (DBSA) and polyaniline (PANI).

[100] Dodecyl Benzene Sulfonic Acid Doped Polyaniline Thin Film Based Chemo-Resistive Ammonia Gas Sensor

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Abstract: Polyaniline (PANI) doped with dodecyl benzene sulfonic acid (DBSA) has been synthesized by *ex-situ* doping in emeraldine base (EB). The optical and functional properties of as synthesized DBSA doped PANI (PANIDBSA) have been studied by UV-Visible and FTIR spectroscopy, respectively. A chemo-resistive gas sensor was prepared using spin coated PANI-DBSA thin film for quantitative detection of ammonia (NH_3) under ambient conditions (27^0C, 50% RH). The sensing characteristics of fabricated sensor were recorded using the dynamic resistance measurement, that revealed high sensitivity in relative response (~4.5), response time (~55 sec) and rapid recovery (~100 sec). The PANI-DBSA thin film sensor shows good linearity (R = 0.996) and repeatability over a wide concentration range of NH3 from 5 to 250 ppm.
Keywords: Conducting Polymers, Polyaniline, Dodecyl Benzene Sulfonic Acid (DBSA), Ammonia.

[101] Effect of ion beam irradiation on optical, structural and surface morphological properties of WO_3 thin films grown by RF sputtering method

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Abstract: Among the various metal oxides, WO_3 is considered to be a promising oxide material due to its low cost, wide band gap and high solubility in aqueous solutions. Highly energetic radiations like gamma rays and ion beam provide significant modifications in the morphology and physio-chemical properties of the nanomaterial's that further modify their sensing, structural, electrical and optical properties. In the present study, WO_3 thin films of 200 nm were deposited by the RF magnetron sputtering method. After the deposition of WO_3 thin films on glass and silicon substrate, thin films were exposed to ion beam irradiation at different fluences. A comparative study on morphological, optical and structural properties of pristine and irradiated WO_3 thin films at various doses was observed by several techniques such as AFM, UV–Visible spectroscopy, Photoluminescence Spectroscopy and Raman spectroscopy. The results will be discussed during the presentation.

Keywords: WO_3, RF sputtering, Thin Films, PL, XPS

[102] **Study the structural and dielectric behaviour of Sr1-xMoxSiO3 (x=0,0.05,0.10) synthesized by the solid-state reaction method**

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Abstract: The molybdenum (Mo)-doped Sr1-xMoxSiO3 (x= 0, 0.05, 0.10) perovskite materials were synthesized using the conventional solid-state reaction method. The precursor powders were thoroughly mixed in appropriate ratios and finely ground, followed by calcination at 1200°C for 12 hours and sintering at 1000°C for 6 hours. The prepared samples were characterized using X-ray diffraction (XRD), Energy Dispersive spectroscopy (EDS), and field emission scanning electron microscopy (FESEM). The XRD pattern confirmed the formation of the SrSiO3 phase. Significant variations in the lattice parameters were observed due to the incorporation of molybdenum (Mo) at the lattice sites of strontium atoms in the synthesized powder. The EDS confirms the Mo doping and stoichiometry of the resultant samples. FESEM has revealed the notable impact of doping on the grain size, which is consistent with the XRD results. The electrical properties such as dielectric constant (εr), dielectric loss (tan δ), capacitance, and conductivity (σ) of the synthesized material were studied using capacitance resistance (LCR) meter over various range frequencies and temperatures. The Mo-doped Sr1-xMoxSiO3 (x=0.05) has shown an increase in dielectric constant in the temperature range (300°C – 700°C) when studied at different frequency ranges (1KHz, 10KHz, 100KHz) in comparison with pure SrSiO3. Also, a drastic increase in the dielectric constant is observed with Mo (x=0.10) doping in the temperature range (550°C -800°C) at frequencies (1KHz, 10KHz, 100KHz). The variation in the dielectric losses (tan δ) is also studied with different dopant concentrations. These materials can provide new insights and possibilities for engineering dielectric materials for high-temperature and advanced power device applications.
Keywords: Perovskite material, Dielectric constant, solid-state reaction

[103] Analytical studies of radioactivity Concentration Levels in Soil Samples of Eastern Haryana

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Abstract: This study focuses on presence of Radon (^{222}Rn) and Thoron (^{220}Rn) in soil samples from diversified locations in Eastern Haryana. Smart Rn Duo instrument was used to take precise measurement to analyse variability. Soil structure, moisture level and geological structure have been analysed to identify their impact on release of Radon and Thoron. Radiation dose was estimated and compared to global safety limits to identify potential human health risks. Results revealed noticeable variability in the region highlighting periodic checks to monitor radiation in the region. This work provides insightful results on natural radiation in soil and assists in Environmental safety assessments.

Keywords: Radon (^{222}Rn) and Thoron (^{220}Rn), Natural radiation in soil.

[104] **Advanced Smart Nanomaterials for Wound healing applications**

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Abstract: Wound healing is a natural process characterized by various biochemical mechanisms that maintain the cellular integrity of bodily tissues. The global market for wound-care products has experienced substantial growth, exceeding fifteen billion US dollars, with an additional twelve billion U.S. dollars allocated to the treatment of wound scars. The usage of advanced technologies, such as nanotechnology, electrospinning etc. is essential for enhancing wound prevention strategies. Advanced smart materials are revolutionizing wound healing applications by integrating innovative technologies that enhance therapeutic outcomes. Recent advancements in smart materials for wound healing applications are engineered to dynamically respond to the physiological conditions of wounds. These advanced smart nanomaterials can replicate the extracellular matrix (ECM) microenvironment of the injured wound site, facilitating healing through the four overlapping phases: haemostasis, inflammation, proliferation, and remodelling. Traditional wound care methods often fall short due to their passive nature, failing to adapt to the complex and variable healing environment. In contrast, smart materials utilize stimuli-responsive mechanisms such as pH, temperature, and enzymatic activity—to facilitate real-time monitoring and targeted drug delivery, thereby promoting optimal healing conditions. However, various types of smart materials, including hydrogels, nanocomposites, electrospun nanofibrous films can be explored along with their multifunctional properties such as antibacterial activity, moisture retention, and enhanced biocompatibility to healing applications. Smart nanomaterials for wound healing are formulated using diverse synthetic and natural compounds. Different nanocarriers (chitosan, PCL, PLGA etc.) can offer sustained release and enhanced stability of therapeutic agents. So, the combination of biocompatible polymers and synthetic/bioactive compounds could be utilized as a promising avenue for advanced wound care.

Keywords: Nanotechnology, electrospinning, extracellular matrix (ECM) microenvironment.

[105] **Advanced Nanocarriers: Surface-Modified Clay Polymer Nanocomposites for Revolutionizing Oral Insulin Delivery Systems**

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Abstract: In the present work surface-modified clay polymer nanocomposites have been designed as promising carriers for the oral delivery of insulin, addressing the challenges of its poor bioavailability and degradation in the gastrointestinal (GI) tract. This study explores the synthesis and characterization of nanocomposites combining biocompatible polymers with surface-modified clay nanoparticles to protect insulin and enhance its transport across

the intestinal barrier. The surface modification of clay enhances drug encapsulation efficiency and ensures its sustained in vitro release profile, with gastoretentive and mucoadhesive capabilities. Whereas the polymer matrix supposed to protect insulin from enzymatic degradation in the GI tract. The *In vitro* evaluations demonstrated the improved stability and sustained release profile in simulated gastrointestinal fluids, highlighting the potential of these nanocomposites as a non-invasive alternative to traditional insulin administration methods. The findings pave the way for developing advanced nanocarrier systems for effective oral delivery of peptide-based therapeutics.

Keywords: *Clay polymer nanocomposites, insulin, oral drug delivery,*

[106] **Investigation of Structural and Dielectric Properties of Mg Ferrite for High-Frequency Applications**

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Abstract: Magnesium ferrite nanoparticles were synthesized using the co-precipitation method and the structural and electrical properties were investigated. X-ray diffraction (XRD) confirms the formation of a pure cubic spinel phase of the composition with a lattice constant of 8.4017 Å. The average crystallite size was determined to be approximately 24.03 nm and calculated magnetic hopping lengths, L_a & L_b were 4.057 and 2.686 Å. The Williamson–Hall (W–H) method was employed to evaluate the crystal structure and lattice strain, further validating the spinel phase through X-ray analysis. Dielectric studies were conducted at room temperature in the frequency range from 1 kHz to 120 MHz. The material exhibited typical spinel ferrite behavior, where the dielectric constant was highest at lower frequencies and decreased with increasing frequency due to electron hopping, demonstrating dielectric dispersion. Impedance analysis revealed that the real component shifted from 26227 MΩ to 48 MΩ, while the imaginary component varied from -70731 MΩ to 38.48 MΩ. The material displayed a high resistivity of 2.7×10^4 $(\Omega m)^{-1}$ at low frequencies, whereas at higher frequencies it exhibited significant conductivity, reaching 1.5×10^4 $\Omega^{-1}m^{-1}$. These electrical characteristics make magnesium ferrite a suitable candidate for high-frequency applications.

Keywords: Nanoferrites; Co-precipitation; X-ray Diffraction; Dielectric Constant; Impedance Analysis.

[107] **Clofazimine Nanoformulations in Mannosylated Gelatin Microparticles: A Dry Powder Inhalation Strategy for Tuberculosis Therapy**

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Abstract: This study investigates the therapeutic potential of gelatin nanoparticles (GNPs) as carriers for clofazimine (CLF) delivery to treat *Mycobacterium tuberculosis*. CLF, a second-line antitubercular drug, exhibits potent antimycobacterial and anti-inflammatory properties but is limited by poor solubility and low bioavailability. Clofazimine-loaded mannosylated gelatin nanoparticles (CLF-Mn-GNPs) were developed using a double desolvation technique for targeted delivery to alveolar macrophages. The nanoparticles were further processed into microparticles via spray-drying and freeze-drying to optimize pulmonary delivery. The formulation was characterized for particle size, polydispersity index (PDI), zeta potential, drug entrapment efficiency, and in-vitro drug release kinetics. Cellular uptake studies were conducted to evaluate macrophage targeting efficiency. The optimized CLF-Mn-GNP formulation exhibited a mean particle size of 244.2 ± 3.52 nm, a PDI of 0.181 ± 0.04, and a zeta potential of 14.6 ± 0.55 mV. Drug entrapment efficiency was 54.28 ± 1.82 %, with sustained in-vitro drug release confirmed by kinetic studies. Cellular uptake studies demonstrated enhanced internalization of the mannosylated formulation. The particulate engineering approach combined microparticles (~5 µm) for optimal pulmonary deposition and nanoparticles (~300 nm) for improved drug dissolution. The inhalable CLF-Mn-GNP formulation offers a promising strategy for tuberculosis therapy, enabling targeted alveolar macrophage delivery, reduced dosage, lower dosing frequency, and minimized toxicity. This approach enhances patient compliance and highlights its potential as an effective antitubercular treatment.

Keywords: Clofazimine, gelatin nanoparticles, mannosylation, pulmonary delivery, tuberculosis, alveolar macrophages.

[108] **Impact of Sm insertion on microstructural and magnetic properties of $PrCo_5$ particles with high energy product**

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Abstract: $PrCo_5$ particles exhibit promising application potentials in fabricating high-performance permanent magnets and nanocomposite magnets. In view of this, we employ a bottom-up strategy to fabricate highly anisotropic $Pr_{1-x}Sm_xCo_5$ (x= 0 - 0.5) particles. The synthesis process involved mainly two steps, (i) preparation of precursor that contains a mixture of amorphous $Pr(OH)_3$ & $Sm(OH)_3$ and crystalline $Co(OH)_2$ and (ii) Using a calciothermic-reduction, the precursor mixture has converted into $Pr_{1-x}Sm_xCo_5$ particles, which are similar to the traditionally prepared $SmCo_5$ particles. The obtained particles mostly single crystal with an average size from 200nm to 800nm. The single crystal particles assembly show a strong magnetic anisotropy and excellent magnetic properties at room temperature. Consequentially, the best results obtained for x=0.2 are 11.08kOe of H_c, 9.35kG of M_r and 10.82kG of M_s leading to a larger maximum energy product about 18.88MGOe. This enhancement can be instrumental for advanced permanent magnets high storage density applications.

Keywords: Single crystal particles, Anisotropy, Maximum energy product, Energy storage devices, Sensors.

[109] Nanothermites: Applications, Limitations, Safety Considerations, and Future Prospects

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Abstract: The continuous advancement of energetic materials is critical for modern defense, aerospace propulsion, space exploration, and high-performance pyrotechnic applications. Among these, nanothermites—thermite compositions containing at least one nanoscale component—exhibit superior energy density, rapid reaction kinetics, and high combustion temperatures, making them highly attractive for next-generation energetic systems. Their unique properties, including high linear burning rates, tunable reaction heats, and the ability to form hybrid energetic compositions, enable their use in diverse applications such as propellant formulations, micro-thrusters, and reactive materials. However, their widespread adoption faces several challenges. Issues such as the formation of condensed combustion products, which contribute to two-phase flow losses in propulsion systems, and their heightened sensitivity to electrostatic discharge (ESD) pose significant safety risks. Additionally, storage stability and scalability remain major concerns. This study explores the opportunities presented by nanothermites, critically examines their limitations, and discusses key safety considerations. Finally, future research directions are outlined to address existing challenges and enhance the applicability of nanothermites in both civilian and military domains.

Keywords: Nanothermites, Energetic Materials, Propellants, Safety Concerns, Electrostatic Sensitivity, Combustion Efficiency

[110] Impact of Nano Zinc Oxide, Zinc Oxide and Zinc Methionine Supplementation on the Growth performance of Broiler Chicken

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Abstract: Nanotechnology is an emerging technology that transform the various sectors including poultry sector around the world. Zinc is an essential trace mineral that requires a regular supply in poultry diet. Zinc has been used in many forms, organic (zinc amino acid, zinc chelate) or inorganic (zinc oxide, zinc sulfate). Although organic zinc has higher bioavailability than inorganic zinc, but its use in animal diet is limited due to its higher cost. To meet the needs of animals, inorganic zinc is added; 20-to-30-fold higher than the normal requirement of animals because of the low utilization rate of inorganic zinc. Nanoparticles of zinc oxide has attracted attention as an alternative feed supplement for poultry. 300 day old (Vencobb 430Y) straight run commercial broiler chicks were reared for a period of 42 days on deep litter system. Chicks were individually weighed upon arrival and distributed randomly on equal body weight basis into four

treatment groups (T_1, T_2, T_3, T_4) and one control group (T_0) having four replicates of 15 chicks in each group. Birds were fed standard broiler diet as per BIS, 2007 without supplementation of Zn (T_0), basal diet supplemented with ZnO @ 100 mg/kg of feed (T_1), nZnO @ 20 mg/kg of feed (T_2), nZnO @ 30 mg/kg of feed (T_3) and Zn-Met. @ 40 mg/kg of feed (T_4). Experimental results indicated that, at the end of 6^{th} week, parameters viz., weekly live body weight, weekly body weight gain, cumulative body weight gain, weekly FCR, cumulative FCR and performance index were found to be significant. However, weekly and cumulative feed intake did not differ significantly. It was concluded that dietary supplementation of nano ZnO @ 30 mg/kg of feed significantly improved the growth performance and feed efficiency of broiler chicken as compared to inorganic zinc (ZnO) and organic zinc (Zn-methionine).

Keywords: Nano zinc oxide, broiler, performance

[111] Synthesis and Structural Characterization of Rare-Earth-Doped M-type Hexa-Ferrites for EMI shielding application

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Abstract: The emission of high-frequency electromagnetic radiation can cause electromagnetic interference (EMI), which can cause damages to communication system, safety operations of electronic [i] devices, unacceptable degradation of system and their performance, which is a serious problem. To address this, EMI shielding materials are required to block or reduce the impact of incoming electromagnetic waves. Rare-earth-doped M-type ferrites have brought significant attention for their enhanced structural, dielectric, and electromagnetic properties making them useful for EMI shielding. In this present work, Ba0.9X0.1Fe12O19 (X=La, Dy) and BaFe12O19 were synthesized by solid state method, calcinated at 1000°C and again at 1100°C temperatures respectively. As prepared samples were then characterized by XRD (X-ray diffraction), showing its characteristics peaks as per JCPDS no.#01-078-0133, which confirmed the successful formation of M- ferrite. Average crystallite size of the samples was determined which shows synthesis of nanoparticles. VNA (vector network analyzer) measurements in X-band revealed dielectric and reflection loss. The results demonstrate that rare-earth doping effectively modulates the properties of M-ferrites for EMI shielding applications.

Keywords:- Electromagnetic interference shielding, rare-earth doping, M-Ferrite, Solid state method.

[112] Synthesis, Structural and luminescence studies of Dy^{3+} doped $KCaVO_4$ nanophosphors for white light applications via combustion synthesis

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Abstract: The increasing demand for low-cost, energy-efficient, and durable lighting has led researchers to explore new phosphor-converted LEDs that can be effectively excited in the blue,

near-ultraviolet, and ultraviolet ranges. In this study, KCaVO4 phosphor doped with Dy^{3+} was synthesized via the combustion method, and its structural, optical, and morphological properties were examined for dopant concentrations ranging from 0 to 3 mol%. X-ray diffraction (XRD) confirmed the crystallization of KCaVO4 in an orthorhombic phase with space group Pnma. The XRD patterns exhibited intense, sharp peaks indexed to the standard card of KCaVO4, indicating high crystallinity. Photoluminescence (PL) studies, conducted using a 349 nm excitation source, revealed emission peaks at 450–500 nm (blue), 550–600 nm (yellow), and a weak peak at 650–700 nm (red), corresponding to Dy^{3+} transitions: $^4F_{9/2} \rightarrow {}^6H_{15/2}$, $^4F_{9/2} \rightarrow {}^6H_{13/2}$, and $^4F_{9/2} \rightarrow {}^6H_{11/2}$, respectively. The emitted light color was influenced by the intensity ratio of blue and yellow emissions. Doping levels (0.25–3 mol%) altered the band gap, ranging from 3.341 to 3.866 eV. Field-emission scanning electron microscopy (FESEM) images showed agglomerated particles with irregular shapes and nanoscale dimensions. These findings suggest that Dy^{3+}-doped KCaVO4 is a promising phosphor candidate for UV-LED-based solid-state lighting and display applications.

Keywords: X-ray diffraction (XRD), Field-emission scanning electron microscopy (FESEM).

[113] **Photonic Spin Hall Effect in 1D Photonic Crystals with Sugar Solution Defect Layers**

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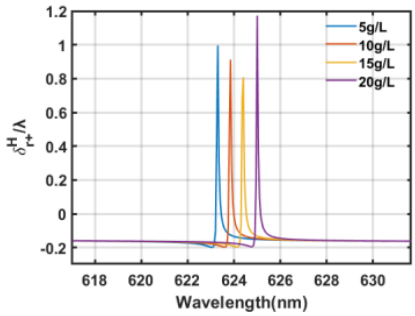
Abstract: This study investigates the photonic spin Hall effect (PSHE) in a 1-dimensional Photonic Crystal (PhC) with defect layers consisting of sugar solution at various concentrations, measured at the optical Tamm state. The transverse displacement, a key feature of the PSHE, reaches a maximum value of 1.1λ, indicating significant spin-dependent deflection in the presence of the defect layers. The impact of varying sugar solution concentrations on the displacement and overall optical response is analyzed, demonstrating the tunability of the system with respect to refractive index changes. The sensitivity of the structure is found to be 76.66 nm/RIU, showcasing the system's potential for high-precision refractive index sensing. These findings highlight the feasibility of using sugar solution defect layers in designing advanced sensors based on the PSHE, with applications in biosensing and other nanophotonic systems.



Keywords: Photonic spin Hall effect (PSHE) , nanophotonic systems **.**

[114] **Bio-Inspired Nanomaterials for CO2 Capture and Energy Storage: A Dual Function Sustainable Approach**.

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Abstract: With rising atmospheric CO2 levels, there is an urgent need for sustainable carbon capture technologies that can also contribute to clean energy solutions. This study explores bio inspired nanomaterials derived from biopolymers (chitosan, lignin, cellulose) and algae-based carbon as a sustainable dual-function approach for CO2 capture and energy storage. Microorganisms such as cyanobacteria, algae, and carbon-sequestering bacteria naturally fix CO_2 and can be harnessed to produce biogenic carbon nanomaterials. Additionally, fungal and bacterial-assisted green synthesis of nanoparticles (e.g., Fe_3O_4, ZnO, MgO) offers a sustainable alternative to chemically synthesized adsorbents. These materials possess high surface area, tunable porosity, and functional groups (e.g., amines, and hydroxyls) that enhance CO2 adsorption and energy storage applications like supercapacitors and batteries. Bio-based materials can efficiently capture CO2 by physical adsorption and chemical adsorption. Functionalizing metal oxide (MgO, CaO) or nitrogen doping further improves adsorption kinetics and stability. Once CO2 is captured, it can be converted into graphene-like porous carbon via a thermochemical or electrochemical process, enabling its integration into high-performance energy storage devices. The resulting bio-derived carbon exhibits high conductivity, electrochemical stability, and superior capacitance, making it a promising alternative to synthetic materials used in batteries and supercapacitors. A theoretical assessment of adsorption isotherms, energy storage efficiency, and material stability highlights the potential of bio-nanomaterials as an eco-friendly alternative to conventional CO_2 capture and storage (CCS) methods. Future work focuses on optimizing nanostructure design, scalability, and integration into industrial applications. This study provides scalable and multifunctional nanotechnology solution that addresses both climate change mitigation and sustainable energy challenges.

Keywords: CO_2 capture, bio-inspired nanomaterials, microbial synthesis, biopolymer derived carbon, green nanotechnology, sustainable energy storage, environmental biotechnology.

[115] **Complex Impedance Spectroscopy and Dielectric Analysis of $Li_4Ti_5O_{12}$(LTO) alternative anode material for Li-ion batteries**

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Abstract: Lithium-ion (Li-ion) batteries dominate the energy storage market because of their high energy density and long cycle life. Among the various components of a Li-ion battery, the anode plays a crucial role in determining its overall capacity, efficiency, and cycle life. Extensive research is ongoing to develop advanced anode materials that can enhance battery performance, focusing on aspects such as energy density, charge-discharge rate, and long-term stability. While conventional graphite anodes are widely used, alternative materials like silicon, metal oxides, and lithium titanate ($Li_4Ti_5O_{12}$, LTO) are being explored for their superior characteristics. Among these, LTO has gained attention due to its excellent safety, long-cycle stability, and fast charging capability. In this work, LTO was synthesized using the conventional solid-state method, and its structural and electrochemical properties were analyzed. X-ray diffraction (XRD) confirmed the formation of a cubic spinel structure with a space group Fd-3m with a crystallite size of approximately 228.76 A°. The impedance and permittivity analysis is conducted on the sample using Impedance spectroscopy, revealing that the relaxation process is predominantly controlled by grain boundaries, highlighting their impact on the material's conductivity. The sample's average AC conductivity was 1.31×10^{-2} S/cm, while the activation energy was determined to be 5.25×10^{-3} eV. These findings are consistent with previous studies, further validating the structural and electrochemical characteristics of LTO. This study enhances the existing body of knowledge by providing deeper insights into the influence of grain boundaries and dielectric behaviour on LTO's performance, offering a more comprehensive understanding of its functional properties in Li-ion battery applications.

Keywords: Li-ion Battery;Anode;LTO;Impedence spectroscopy;

[116] **Enhanced UV-activated NO_2 Sensing using ALD-grown ZnO thin film**

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Abstract: This work focuses on fabricating a zinc oxide (ZnO)-based sensor for detecting nitrogen dioxide (NO_2) gas and examining their reaction to UV light exposure at ambient temperature (300 K), using atomic layer deposition (ALD) technique to achieve high precision and uniformity. The sensor is fabricated by depositing ZnO film on a 1 µm silicon oxide (SiO_2)/ silicon (Si) *p*-type (100) (ZnO–SiO_2–Si) substrate. The thin film, in its as-deposited state, was examined using various material characterization methods, such as X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), energy dispersive X-ray spectroscopy

(EDS), atomic force microscopy (AFM), and ultraviolet-visible (UV-Vis) spectroscopy. When exposed to UV light, the sensor demonstrated a remarkable increase in sensitivity, reaching a sensitivity factor of 1.96×10^3, along with fast response and recovery times of 10 seconds and 100 seconds, respectively. These improvements are attributed to increased surface reactivity and charge carrier generation under UV light. Comparative analysis with similar studies highlights the superior performance of ALD-grown ZnO films. The findings demonstrate the potential of UV-activated ZnO-based sensors for real-time NO_2 monitoring, offering advancements in environmental and industrial safety applications.

Keywords: ZnO, ALD, UV, NO_2 gas sensing.

[117] **Comparative Study of Acid-Assisted Hydrothermal Growth of TiO_2 Thin Films**

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Abstract: The morphology of TiO_2 thin films plays a crucial role in determining their performance in photovoltaic and optoelectronic applications. This study investigates the influence of different acids on the hydrothermal synthesis of TiO_2 thin films, aiming to understand how varying chemical environments affect film growth, crystallinity, and optical properties. A range of acids—including strong mineral acids (HCl, HNO_3, H_2SO_4) and organic acids (CH_3COOH, $C_6H_8O_7$, $C_2H_2O_4$) were systematically introduced into the hydrothermal growth process. The resulting films were characterized using X-ray diffraction (XRD) for phase identification, scanning electron microscopy (SEM) for morphological analysis, and optical spectroscopy to assess band gap variations. Preliminary findings indicate that acid type significantly influences TiO_2 crystallite size, surface texture, and porosity, which are critical for optimizing electron transport and light absorption in solar cell applications. This study provides new insights into the tunability of TiO_2 thin film properties through acid-assisted synthesis, offering potential strategies for tailoring these films for improved photovoltaic performance.

Keywords: Acidic, TiO2, Hydrothermal, Characterization

[118] **Theme: Materials and technologies for a sustainable environment**

Bioplastic: A Sustainable Material for a Greener Future

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Abstract: Bioplastics have emerged as a revolutionary alternative to conventional plastics, offering an environmentally friendly solution to plastic pollution and a reduction in carbon emissions. These materials are derived from renewable sources such as starch, lignocellulosic biomass, proteins, and algae, reducing reliance on petroleum-based plastics. Bioplastics not only provide biodegradability but also have the potential for recyclability and compostability, making them crucial in achieving sustainability goals. The development of bioplastics involves various processing technologies, including extrusion, injection molding, and blending with reinforcements like nanocellulose to enhance mechanical properties. They are widely used in packaging, agriculture, medical applications, and the automotive industry, demonstrating their versatility. However, challenges such as high production costs, slow biodegradation in certain environments, and competition with food crops remain significant barriers. Future advancements focus on increasing durability, improving compostability, and utilizing waste biomass to create cost-effective and high-performance bioplastics. By integrating artificial intelligence in material optimization and promoting government policies for sustainable alternatives, bioplastics can drive a circular economy and reduce environmental footprints. This presentation explores their importance, applications, biodegradability, recycling potential, and future innovations, highlighting their essential role in achieving a more sustainable future.

Keywords: Bioplastics, sustainable material, policies, recyclability, processing technology

[119] As2Se3 based Sandwiched photonic crystal fiber for mid-infrared region for dispersion compensation

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Abstract: This study presents a sandwiched photonic crystal fiber (PCF) made from As2Se3 chalcogenide glass. The arrangement of air holes is made in such a way that rings of air holes of same size are sandwiched between the different sized air hole rings offering a novel design that enhances dispersion properties of the PCF. The proposed PCF shows a significant reduction in dispersion, with values shifting from -800.11 ps/km-nm in a conventional PCF (with uniform hole sizes) to -8158.58 ps/km-nm in the designed PCF. This enhancement in dispersion is advantageous for applications requiring precise dispersion management. Negative dispersion is beneficial for pulse compression and mitigating pulse broadening in high-speed transmission systems. Additionally, the effective mode area of the proposed PCF is 50.11 μm^2. This increased mode area improves performance in nonlinear optical processes, reduces power losses, and ensures better signal integrity. The use of Arsenic Selenide as the core material is particularly advantageous for operation in the mid-infrared spectrum from 2 to 10 μm. This design could provide significant value to researchers focused on specialized optical fibers within the optical frequency range

Keywords: Sandwiched PCF; Negative dispersion; effective mode area

[120] **Enhancing the hydrogen evolution reaction efficiency of hydrothermally synthesized Fe-PbBr2 and Co-PbBr2 catalysts through electrochemical water splitting method**

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Abstract: High-efficiency and low-cost catalysts for the hydrogen evolution reaction (HER) in basic electrolytes are critical for electrochemical water splitting to produce clean and green hydrogen, fuel for sustainable energy conversion and storage. The main challenge in the production of green hydrogen is to obtain continuous and effective hydrogen evolution at high current densities which is unattainable due to the quick degradation of performance that occurs with extended large-current operation. In this work, Fe-PbBr2 and Co-PbBr2 nano composites were prepared using simple hydrothermal method with the objective of improving electrocatalytic green hydrogen production at industrial current densities. X-ray diffraction (XRD), scanning electron microscopy (SEM), and X-ray photoelectron spectroscopy (XPS) were used to analyse the crystalline structure, morphology, and chemical composition of the synthesised nanocomposites. The prepared Fe-PbBr2 and Co-PbBr2 catalysts exhibit excellent electrochemical water-splitting activity, a low overpotential, a high current density, and extended stability lasting more than 15 hours. Our work has been developed a new electrocatalysis which is one of the earth-abundant, stable, and highly effective catalysts for water electrolysis. Fe-PbBr2/NF improves conductivity, and its nanosheet structure, which offers a large surface area for catalytic activity is one of the most promising electrocatalysts for HER than Co-PbBr2/NF, especially in an alkaline medium, because of its outstanding catalytic activity, excellent stability, and simple production method.

Keywords: Water Splitting, Electrochemical Analysis, Fe doping, Co doping, HER

[121] **Emerging Trends in Nanoparticle-Mediated Textile Dye Treatment: A Comprehensive Review**

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Abstract:The biggest concern for global food safety and the environment today is the rapid rise of anthropological invasion that has led to contamination from organic/inorganic composites. Research has been done on a number of physical and chemical techniques to eliminate dangerous contaminants from the environment. There has been a restriction on the production of hazardous compounds due to their high costs, ineffective cleaning methods, and large capital needs. As such, it is critical to build and achieve environmental sustainability via the use of efficient, environmentally responsible, and financially viable approaches. This study addresses the problems caused by wastewater containing dyes by investigating the creative use of nanoparticles for the removal of dyes from the textile industry. An effective and environmentally friendly method of removing dyes from materials is to use nanoparticles as adsorbents. The study explores the special qualities of nanoparticles including surface area, porosity, and functionalization—that make them ideal for dye adsorption. The effectiveness of several nanoparticle types such as graphene oxides, carbon-based nanoparticles, and polymer-based nanoparticles in dye removal applications is investigated. The study also covers the mechanics underlying the adsorption process, highlighting the significance of interactions between dye molecule and the surface chemistry of nanoparticles. Insights into the practical application of dye removal technologies based on nanoparticles are provided through case studies and recent developments. The potential impact of nanoparticle-based methods in improving the textile industry's sustainability through efficient dye wastewater treatment is highlighted in the study's conclusion.

Keywords: Nanotechnology; Textile industry; Dyes; Treatment; Adsorption.

[122] **Catalytic activity of MXene (MX) and Vanadium Nanocomposite on the hydrogen storage performance of MgH_2**

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Abstract:Hydrogen is an ideal energy carrier. Magnesium hydride has a high capacity (7.6 wt%) making it a desirable option for storing hydrogen. However, the development of this material is impeded by its slow kinetics and unstable thermodynamics. MXene is a 2D material with good electrical conductivity, mechanical properties and thermal stability. MXene has a large surface area and can be easily functionalized by introducing different groups. That makes them more suitable for hydrogen applications. MXene can improve energy storage efficiency, enhance electromagnetic interference shielding, advance water treatment and desalination technologies, provide corrosion-resistant solutions, enable flexible electronics development, and address critical material science challenges. This study uses the ball milling method to prepare nanocomposites of Mg + 5wt % (Ti_3C_2F+V). The nano-composite of Mg + 5 wt% (MX+V) has a hydrogen storage of 3.94 wt% at 320˚C. The thermogravimetric figure indicates that the onset temperature is 183.3˚C, the thermal decomposition temperature is 413.9˚C, and the termination point is 432.8˚C. The total weight loss is 3.1 wt%, showing desorption reactions and thermal behavior caused by additives. Samples are characterized using XRD and SEM. The dehydrating reaction has an activation energy of 179 kJ/mol.

Keywords- 2D Material, MXene, Ball-Milling, Hydrogenation, storage.

[123] Complex Impedance Spectroscopy and Dielectric Analysis of $Li_4Ti_5O_{12}$ (LTO) alternative anode material for Li- ion batteries

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Abstract: Lithium-ion (Li-ion) batteries dominate the energy storage market because of its high energy density and long cycle life . Among the various components of a Li-ion battery, the anode plays a crucial role in determining its overall capacity, efficiency, and cycle life. Extensive research is ongoing to develop advanced anode materials that can enhance battery performance, focusing on aspects such as energy density, charge-discharge rate, and long-term stability. While conventional graphite anodes are widely used, alternative materials like silicon, metal oxides, and lithium titanate ($Li_4Ti_5O_{12}$, LTO) are being explored for their superior characteristics. Among these, LTO has gained attention due to its excellent safety, long cycle stability, and fast charging capability.In this work, LTO was synthesized using the conventional solid-state method, and its structural and electrochemical properties were analyzed. X-ray diffraction (XRD) confirmed the formation of a cubic spinel structure with a space group Fd-3m with crystallite size approximately 228.76 A°.The impedance and permittivity analysis is conducted on the sample using Impedance spectroscopy,revealing that the relaxation process is predominantly controlled by grain boundaries, highlighting their impact on the material's conductivity.The average AC conductivity of the sample was found to be 1.31×10^{-2} S/cm, while the activation energy was determined to be 5.25×10^{-3} eV. These findings are consistent with previous studies, further validating the structural and electrochemical characteristics of LTO. This study enhances the existing body of knowledge by providing deeper insights into the influence of grain boundaries and dielectric behavior on LTO's performance, offering a more comprehensive understanding of its functional properties in Li-ion battery applications.

Keywords: Li-ion Battery;Anode;LTO;Impedence spectroscopy;

[124] Phytochemical-Assisted Synthesis of Zinc Sulphide Nanoparticles for Photocatalytic Purification of Contaminated Water

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Abstract:Phytochemical, naturally occurring bioactive compounds derived from plants, have gained significant attention for their role in the green synthesis of nanomaterials. This study explores the use of phytochemicals as reducing and stabilizing agents in the synthesis of zinc sulphide (ZnS) nanoparticles, which are known for their photocatalytic properties. The synthesis process leverages the eco-friendly and sustainable nature of phytochemicals, avoiding the use of toxic chemicals and harsh reaction conditions. The phytochemical-assisted ZnS nanoparticles were characterized using techniques such as X-ray diffraction (XRD), scanning electron microscopy (SEM), and ultraviolet-visible (UV-Vis) spectroscopy to confirm their crystalline structure, morphology, and optical properties. The photocatalytic activity of the synthesized nanoparticles was evaluated for the degradation of organic pollutants in contaminated water

under visible light irradiation. The results demonstrated that the phytochemical-assisted ZnS nanoparticles exhibited enhanced photocatalytic efficiency, effectively degrading pollutants such as dyes and phenolic compounds. This study highlights the potential of phytochemicals in the green synthesis of nanomaterials and their application in environmental remediation, particularly in the purification of contaminated water. The findings provide a foundation for further research into the development of sustainable and efficient photocatalytic materials for water treatment.
Keywords: Phytochemicals, green synthesis, zinc sulphide nanoparticles, photocatalysis, water purification, environmental remediation.

[125] **Eco-friendly phytochemical extraction: harnessing Soxhlet with distilled water for FTIR and GC-MS investigation**

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Abstract: Phytochemicals, bioactive compounds derived from plants, are extensively studied for their potential applications in medicine, food, and agriculture due to their antioxidant and therapeutic properties. This study focuses on the extraction of phytochemicals using distilled water as the solvent in a Soxhlet extraction system, a green and efficient method for isolating plant-based compounds. The extraction process was optimized by varying parameters such as the extraction time and temperature to achieve maximum yield.The phytochemicals extracted from plant were characterized using Fourier-transform infrared (FTIR) spectroscopy and gas chromatography-mass spectrometry (GC-MS). FTIR analysis provided insights into the functional groups present in the extract, confirming the presence of key phytochemicals such as flavonoids, phenolics, and alkaloids. GC-MS analysis further identified and quantified the specific bioactive compounds present, highlighting the predominance of compounds with known antioxidant and antimicrobial properties.The results demonstrate that distilled water is an effective solvent for extracting a wide range of phytochemicals, making the process eco-friendly and suitable for applications in industries focused on sustainability. This study underscores the utility of Soxhlet extraction coupled with FTIR and GC-MS for the detailed characterization of bioactive plant compounds, providing a foundation for further research and development in the fields of nutraceuticals, pharmaceuticals, and functional foods.
Keywords: Phytochemicals, Soxhlet extraction, distilled water, FTIR, GC-MS, green chemistry.

[126] **Sustainable Photocatalysis and Antimicrobial Potential of Fenugreek-Mediated Biogenic Co_3O_4 Nanoparticles**

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Abstract:This study introduces an innovative approach to synthesizing cobalt oxide (Co_3O_4) nanoparticles (NPs) using an extract of *Trigonella foenum-graecum* (TFG, fenugreek). The natural phytochemicals in fenugreek extract act as reducing agents, facilitating the formation of Co_3O_4 nanoparticles while enhancing their photocatalytic activity. The synthesis method employs a co-precipitation technique to optimize the efficiency and performance of Co_3O_4 NPs for environmental remediation applications. The incorporation of fenugreek extract in the synthesis process significantly influences the surface properties and structure of the nanoparticles. This research highlights the potential of fenugreek-mediated Co_3O_4 nanoparticles as a promising solution for eliminating Congo red dye from polluted water sources. These nanoparticles are favored for their rapid, cost-effective synthesis and exceptional dye degradation capabilities through photocatalysis. The Co_3O_4 NPs were synthesized via the co-precipitation method and extensively characterized using UV-visible absorption spectroscopy, FTIR spectroscopy, XRD, SAED, HRTEM, and XPS techniques. The synthesized Co_3O_4 NPs exhibited desirable properties, including high crystallinity, a small crystallite size of 1.6 nm, and an ultrafine average particle size of 5.5 nm. Notably, these NPs achieved a photocatalytic degradation efficiency of 100% for Congo red dye at a concentration of 120 mg/L within 60 minutes. This outcome underscores the effectiveness of fenugreek-mediated Co_3O_4 NPs in degrading target dyes under specific conditions. Beyond their photocatalytic capabilities, these nanoparticles exhibit significant antimicrobial activity against Gram-negative and Gram-positive bacteria, underscoring their broader environmental importance. Their potential applications extend to various ecological fields, reinforcing their role as a sustainable and efficient approach for addressing water contamination and microbial threats.

Keywords: Sustainable synthesis, Cobalt oxide nanoparticles, Fenugreek extract, Photocatalytic degradation, Dye removal, Environmental remediation, antimicrobial activity.

[127] ADVANCED THEORICAL MODELING OF WAVE COEFFICIENTS AND PHASE SHIFTS IN POLARISED LASER INTERACTION WITH STRATIFIED MEDIA

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Abstract: This research investigates the behavior of reflection, transmission, and absorption coefficients for S- and P-polarized electromagnetic waves incident at an angle on various materials, including plasma, hydrogels, and metallic foils. Using a slab geometry, the study explores how the absorption coefficient changes with slab thickness and incident angle, identifying conditions for maximum absorption. Additionally, it examines the phase variations in materials with complex permittivity, such as hydrogels. The findings provide deeper insights into wave–medium interactions, with potential applications in photonics and materials science.

Keywords: wave coefficients, polarized electromagnetic wave, oblique incidence, different dielectrics, phase shift.

[128] Unleashing the feasibility of zinc oxide nanoparticles in soil heavy metal phytoremediation: A critical review towards a sustainable approach

Pooja Choudhary, Sunil Kumar

Abstract:The escalating threat posed by metal contamination to both biota and the environment has become a significant global concern. These pollutants have the potential to enter the food chain and pose adverse health effects on human beings. Heavy metals extraction from the soil is crucial for establishing a safe, sustainable, and long-lasting ecosystem. Remedial technologies that include physical, chemical, and biological methods are frequently employed to eradicate heavy metals (HMs) from contaminated soil, but are often costly and time-consuming. To eliminate these limitations, an eco-friendly technique like phytoremediation is required. Phytoremediation leverages the ability of certain plants to absorb, break down, or stabilize contaminants, and it has attracted much interest as an economical and sustainable method of decontaminating polluted soil. The principles, workings, and mechanisms of phytoremediation, along with the toxicological aspects of heavy metals, are thoroughly examined in this review study. To increase the efficacy and efficiency of phytoremediation, nanoparticle applications have lately been proposed to eliminate pollutants, encourage plant growth, and enhance pollutant phyto-availability. Meanwhile, the application of Zinc oxide nanoparticles (ZnO NPs) affects crop growth and yield. Preferable plants and nanoparticle characteristics for nano-phytoremediation are also discussed. Additionally, the review addresses the limitations related to phytoremediation and plant-nanoparticle interaction in augmenting the phytoremediation efficiency and post-harvest utilization of plants. The promising role of this technique in sustainable environmental management through a critical synthesis of recent research findings was discussed. Further investigation into the possible environmental risk posed by nanoparticles is necessary to understand their toxicity.

Keywords: Heavy metals, Zinc oxide nanoparticles, Phytoremediation

[129] **Lead-Free Piezoelectric Materials**

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Abstract: The widespread use of lead and its derivatives as piezoelectric materials has been causing immense environmental and notable public health issues. Herein, we are principally going to review lead-free piezoelectric materials. It is well known that Lead zirconate titanate (PZT) is prominent for its dominating piezoelectric qualities, but the primary cause of lead's extended environmental persistence is its non-biodegradable nature. Presently, several materials are being explored as potentially appealing PZT substitutes for particular uses. This study explores recent advances in lead-free materials, including zinc oxide (ZnO) nanostructures, inorganic ceramics such as Bismuth layer-structured ferroelectrics (BLSFs), sodium bismuth titanate (BNT), sodium potassium niobate (KNN), barium titanate (BT), and polymers such as silk fibroin and PVDF. It focuses on their biocompatibility, high electromechanical coupling

factor, and stable electrical properties, focusing on preparation, structure-property correlation, and finding promising applications in bioengineering, military, optoelectronic information, and energy. Lastly, the difficulties and viewpoints surrounding lead-free piezoelectric materials and devices are discussed.

Keywords: Piezoelectric, lead-free materials, inorganic ceramics, polymers

[130] Study of XRD, dielectric properties and ionic conductivity of Li-Ai-Si-O4 ceramic solid electrolyte synthesized by solid state method

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Abstract: The All-Solid-State Batteries (ASSBs) is recognized as the promising candidate for energy storage devices with overcoming safety issues and providing high energy density. The solid-state electrolytes (SSEs), being the most critical component of ASSBs mainly leads to the future battery development. However, traditional Li-ion batteries have critical safety issues due to highly flammable liquid electrolytes or thermally instable polymer electrolytes, causing safety issues. Whereas, ceramic based solid-state electrolyte shows high thermal stability, good ionic conductivity and electrochemical stability compared to other electrolytic system in Li-ion batteries. $LiAlSiO_4$(LASO) ceramics have been demonstrated to be a fast Li ion conductor and is much more cost effective as aluminum and silicon are more cheaper and abundantly available on the earth, this high-efficient and low-cost material open up new possibilities for ceramic based solid-state batteries commercialization. Herein, in this work LASO ceramic solid electrolyte was synthesized using the conventional solid-state reaction method, ThermoGravemetric Analysis (TGA) and X-ray diffraction (XRD) were used to analyze the thermal stability (calcination and sintering temperature ranges) and crystal structure of the material. The average crystallite size of the LASO is calculated by scherrer`s formula and W-H plot from intense peaks of XRD pattern. Furthermore, Impedance spectroscopy (IS) was performed to analyze the ionic, electronic conductivity and dielectric properties of the ceramic solid-state electrolyte.

Keywords: solid state battery, Ceramic solid electrolyte, LASO, ionic conductivity

[131] Harnessing Carbon dots and Zinc Ferrite nanocomposite for photocatalytic degradation of Polycyclic Aromatic Hydrocarbon

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Abstrate: Polycyclic aromatic hydrocarbon compounds (PAHs) are recognized as hazardous pollutants because of their persistent nature and most of the PAHs are mutagenic and carcinogenic. In this study, carbon dots were synthesized from lignocellulosic waste utilizing an eco-friendly and sustainable approach. These carbon dots were incorporated with zinc ferrite to develop novel nanocomposite material for the degradation of sulfamethoxazole. The resulting composite demonstrated significant photocatalytic degradation under visible light. The performance was evaluated under varying conditions such as catalyst dosage, pH, and pollutant concentration to explore the degradation kinetics and mechanism. The integration was found to enhance the surface properties, electron transfer and light harvesting efficiency in order to degrade sulfamethoxazole. The findings of this study highlighted the potential of carbon dots and zinc ferrite nanocomposite as an efficient and sustainable nanomaterial for environment remediation.

Keywords: Carbon dots; Zinc ferrite; Polycyclic aromatic hydrocarbon; Sulfamethoxazole; Degradation; Visible light

[132] **Advances in Triboelectric Nanogenerator Performance Through Material Technology And Power Management Circuitry.**

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Abstract: Triboelectric nanogenerators (TENGs) have gained significant attention as a viable technology for conversion of mechanical energy to electrical energy. However, the effective harnessing of TENG-generated energy faces significant obstacles, primarily due to developing sustainable durable materials and limitations in power management circuitry (PMC). Key challenges include environmental challenges, unsatisfactory durability in harsh conditions, low resilience in the current available materials set for TENG, impedance mismatch, suboptimal energy conversion efficiency, and the inconsistent, pulsed nature of TENG outputs are some of the challenges faced in designing optimal PMC which stem from their irregular operational characteristics. This review paper provides a comprehensive analysis of recent advancements in material technology, and power management strategies to improve the output performance of the TENG. We further deep dive into the diverse applications of TENGs with the latest technology focusing on self-powered sensors, wearable and flexible electronics, and health monitoring. We

conclude by identifying major areas for future innovation like materials research to develop biodegradable composites, machine learning algorithms for real-time adaptive control of PMC by optimizing energy extraction under variable conditions using smart control technologies, sustaining higher charge generation capacity while also keeping a lookout on the overall economic view on sustainability and scalability of TENGs.

Keyword: Triboelectric nanogenerators (TENGs), Power management circuitry (PMC), TENG.

[133] **Green synthesis of TiO_2 nanoparticle and its Applications**

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Abstract:Titanium dioxide (TiO_2) nanoparticles have attracted a lot of interest because of their unique optical, electronic, and photocatalytic properties. The green synthesis of TiO_2 nanoparticles is considered an environmentally friendly and sustainable method that reduces the use of hazardous chemicals and minimizes the impact on the environment by exploiting biological resources such as plant extracts, microorganisms, and biomolecules. Moreover, this approach will bring about advantages in cost-effectiveness, toxicity reduction, and biocompatibility improvement. Green-synthesized TiO_2 nanoparticles can be used in various applications like photocatalysis, water purification, biomedical applications, sensors, and energy storage. But with these findings in nanotechnology, further potential will be seen about its antimicrobial activity, drug delivery, and environmental remediation. In addition to this, green synthesis will also enhance stability as well as functionalization of TiO_2 nanoparticles making them suitable for industrial applications; therefore, studies are focused recently on parameters of synthesis to synthesize efficiently and perform better. The use of green-synthesized TiO_2 in solar cells and self-cleaning coatings is also gaining momentum. Future research may lead to scalable manufacturing techniques for industrial-scale or environmental applications on a large scale.

Keywords: green synthesis, TiO_2 nanoparticles, environmentally friendly, photocatalysis, antimicrobial properties, nanotechnology, environmental cleanup, sustainable method, self-cleaning coatings, solar energy conversion.

[134] **Evaluation of Optical Properties of Nano-Ferrites and Their Photodegradation Applications for Dyes**

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Abstract: In the present research work, Nickel ferrite ($NiFe_2O_4$), Cobalt ferrite ($CoFe_2O_4$) and Zinc ferrite ($ZnFe_2O_4$) nanoparticles were synthesized by the method of sol gel synthesis. The nanoparticlesare characterized by the use of XRD diffraction. The optical properties are studied by the help of UV spectroscopy and Raman spectral analysis. The Raman spectra of ferrites show two primary stretching vibrational frequencies at tetrahedral and octahedral sites associated with metal-oxygen interactions. The energy band gap was evaluated by UV spectral analysis which came out to be 3.5 eV, 3.6 eV and 3.8 eV for $NiFe_2O_4$, $CoFe_2O_4$ and $ZnFe_2O_4$ ferrites. The spectrum showed that these ferrites are active in UV region. The prepared nanoparticles showed good photocatalytic activity for degradation of dyes in the presence of UV light.

Keywords: Sol gel, Raman spectra, Photocatalysis

[135] Antibacterial and Antibiofilm activity of Sustainable Carbon dots from Lignocellulosic waste against Biofilm producing bacteria

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Abstract: The biofilm forming bacteria are major contributors to biofouling in industrial, marine sectors and environmental systems leading to reduced efficiency of equipment, increased maintenance cost and energy consumption. The current research work highlights the sustainable approach to eliminate these biofilm producing bacteria which are mainly involved in biofouling. In this work, the biofilm producing bacteria were isolated from wastewater system to ensure practical application using Congo red method, microtiter assay, tube test and followed by their evaluation of biofouling potential. Subsequently, Carbon dots (CDs) were synthesized from lignocellulosic wastes in order to eliminate these biofilms. The synthesized CDs have demonstrated high antibacterial and antibiofilm activity against these isolated bacteria. Therefore, the valorisation of lignocellulosic waste to CDs not only reduces negative impacts of these waste but also plays a crucial role in effective mitigation of biofilms and biofouling.

Keywords: Carbon dots; Lignocellulosic biomass; Biofouling; Antibacterial; Antibiofilm; Wastewater biofilm bacteria

[136] Harnessing Carbon dots and Zinc Ferrite nanocomposite for photocatalytic degradation of Polycyclic Aromatic Hydrocarbon

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Abstract: Polycyclic aromatic hydrocarbon compounds (PAHs) are recognized as hazardous pollutants because of their persistent nature and most of the PAHs are mutagenic and carcinogenic. In this study, carbon dots were synthesized from lignocellulosic waste utilizing an eco-friendly and sustainable approach. These carbon dots were incorporated with zinc ferrite to develop novel nanocomposite material for the degradation of sulfamethoxazole. The resulting composite demonstrated significant photocatalytic degradation under visible light. The performance was evaluated under varying conditions such as catalyst dosage, pH, and pollutant concentration to explore the degradation kinetics and mechanism. The integration was found to enhance the surface properties, electron transfer and light harvesting efficiency in order to degrade sulfamethoxazole. The findings of this study highlighted the potential of carbon dots and zinc ferrite nanocomposite as an efficient and sustainable nanomaterial for environment remediation.

Keywords: Carbon dots; Zinc ferrite; Polycyclic aromatic hydrocarbon; Sulfamethoxazole; Degradation; Visible light

[137] **PVDF/WS_2 based piezoelectric nanogenerator for efficient energy harvesting**

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Abstract:A promising approach to self-technology is energy harvesting from ambient energy sources and human motion, which has drawn a lot of attention due to its capacity to convert mechanical energy from the surroundings into electrical power. Piezoelectric nanogenerators (PENGs) are being investigated, to capture electrical energy from mechanical vibrations. Here in, we report the fabrication of piezoelectric nanogenerator based on PVDF/WS_2 nanocomposite thin films. WS_2 nanosheets are synthesized by exfoliation method. Further, WS_2 with different weight percentage is incorporated in PVDF and the resulting thin films are analysed using XRD and FTIR and PE. Results show that the improved piezoelectric response is the consequence of uniform dispersion WS_2 nanosheets inside the PVDF matrix and their beneficial interfacial characteristics in nanocomposites. The output of nanogenerator is finally examined by measuring the open circuit voltage (V_{OC}) and short circuit current I_{SC}) and the results indicate that the incorporation of WS_2 nanosheets improves the output of piezoelectric nanogenerator. The generated nanogenerator shows significant potential for sustainable energy harvesting and self-powered electronic devices.

Keywords: nanogenerator, polymers, nanocomposites, electrical properties

[138] **Structural and spectroscopic characterization of CTAB-Modified ZnO nanoparticles synthesized via a Precipitation-Cum-Hydrothermal Method**

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Abstract:The present study explores the synthesis of zinc oxide nanoparticles (ZnO NPs) modified with cetyltrimethylammonium bromide (CTAB) through a sequential precipitation and hydrothermal process. The wurtzite hexagonal phase of ZnO is confirmed by X-ray diffraction (XRD) analysis, with the average crystallite size determined to be 47.12 nm, further estimated using Williamson-Hall (107.8 nm) and modified Debye-Scherrer (41 nm) methods. UV-Visible spectroscopy displays a distinct absorption peak at 430 nm, corresponding to a direct band gap of 3.2 eV, which indicates significant quantum confinement effects. Fourier-transform infrared (FTIR) spectroscopy confirms the presence of functional groups in ZnO NPs, with characteristic Zn-O stretching vibrations identified at 738 cm^{-1} and 679 cm^{-1}. The introduction of CTAB as a surfactant plays a vital role in controlling the size of nanoparticles, preventing agglomeration, and improving structural integrity. This study provides an in-depth structural and spectroscopic analysis of CTAB-functionalized ZnO NPs, emphasizing their relevance for advanced material science research.

Keywords: ZnO nanoparticles, CTAB modification, XRD, UV-Vis spectroscopy, FTIR analysis.

[139] **From Atoms to Algorithms: Exploring the intersection of AI and Nanotechnology**

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Abstract:In this era of technology, nanomaterials (NMs) with their wide applications are playing a crucial role in developing the world. The fusion of artificial intelligence (AI) and nanotechnology is driving significant advancements in scientific research and technological development, leading to innovations in materials science, healthcare, energy, and computing. AI-driven techniques, such as machine learning and deep learning, are accelerating nanoscale material discovery, optimizing fabrication processes, and enhancing characterization methods. At the same time, nanotechnology is enhancing AI by enabling high performance computing architectures and energy-efficient hardware. This review explores the synergy of AI and nanotechnology focusing on their collaborative potential in different sectors like diagnostics,

material design and environmental applications. It explores AI's impact on predictive modeling, automated nanomaterial synthesis, and nanoscale imaging while also discussing how nanotechnology is shaping next-generation AI hardware. Additionally, challenges, ethical considerations, and interdisciplinary research opportunities are analyzed.

By bridging the gap between atoms and algorithms, the integration of AI and nanotechnology is poised to revolutionize multiple domains, paving the way for next-generation intelligent systems and nanotechnological innovations.

Keywords— Artificial Intelligence, Nanotechnology, Machine Learning, Nanomaterials, AI-Driven Innovation.

[140] **Antibacterial and Antibiofilm Activity of Sustainable Carbon Dots from Lignocellulosic Waste and Metal-Organic Frameworks (MOFs) Against Biofilm-Producing Bacteria**

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Abstract: Biofilm-forming bacteria are a major cause of biofouling in industrial, marine, and environmental systems, leading to reduced equipment efficiency, increased maintenance costs, and higher energy consumption. This study explores an eco-friendly approach to tackling biofouling by targeting these bacteria with sustainable nanomaterials. Bacterial strains capable of forming biofilms were isolated from a wastewater system to ensure real-world applicability. Their biofilm-forming ability was confirmed using the Congo red method, microtiter assay, and tube test. To combat these bacteria, carbon dots (CDs) were synthesized from lignocellulosic waste, offering a sustainable solution to both biofouling and waste management. Additionally, metal-organic frameworks (MOFs) were synthesized and tested for their antibacterial properties. A hybrid approach combining CDs and MOFs was developed to enhance their antimicrobial and antibiofilm effects. Results showed that both CDs and MOFs exhibited significant antibacterial and antibiofilm activity, with the CD-MOF combination demonstrating even greater efficacy. This research highlights the potential of converting agricultural and industrial waste into valuable nanomaterials while offering an effective strategy for biofilm and biofouling control.

Keywords: Carbon dots, Lignocellulosic waste, Metal-organic frameworks, Biofouling, Antibacterial, Antibiofilm, Hybrid nanomaterials.

[141] **Photocatalytic Degradation of Antibiotics in Water using Functionalized Carbon Quantum Dot-Embedded Y-ZnO Nanosheets under Visible Light**

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Abstract: Antibiotics present in aquatic environments have generated significant concern due to their potential risks to natural ecosystems and human health. In this study, a novel amino acid-functionalized carbon quantum dot (A-CQD) was synthesized and incorporated into Y-ZnO to form a Y-ZnO/A-CQD hybrid nanocomposite via a two-step hydrothermal process. To identify the optimal photocatalyst, different concentrations of A-CQD were embedded into Y-ZnO, resulting in Y-ZnO/A-CQD-0.5, Y-ZnO/A-CQD-1.0, and Y-ZnO/A-CQD-1.25 composites. Among these, Y-ZnO/A-CQD-1.0 exhibited superior photocatalytic activity against azithromycin and sulfasalazine under visible light irradiation. The photocatalytic kinetics for azithromycin degradation was approximately five times faster, while the rate constant for sulfasalazine degradation was over 12 times higher compared to bare Y-ZnO.

The incorporation of A-CQD into Y-ZnO significantly affected the nanocomposite's crystallinity, bandgap energy, surface area, and photoluminescence (PL) properties. The high electron affinity of A-CQDs facilitated efficient electron transfer across the Y-ZnO/A-CQD structure, promoting rapid charge carrier separation and preventing recombination, thereby enhancing charge stabilization. Radical quenching experiments revealed that holes, hydroxyl radicals, and superoxide anions contributed to the photocatalytic degradation to varying extents. Furthermore, Y-ZnO/A-CQD-1.0 demonstrated excellent reusability, retaining approximately 87% degradation efficiency for azithromycin after four consecutive cycles. The enhanced photocatalytic performance can be attributed to the reduced bandgap energy and the quenching of PL intensity, which indicates decreased charge carrier recombination. The heterojunction formation between A-CQD and Y-ZnO further improved photodegradation efficiency, underscoring the nanocomposite's potential for wastewater treatment applications.

Keywords: Carbon quantum dots, Photocatalysis, Antibiotics

[142] **Multifunctional green-synthesized ZnO-MoS_2/RE nanocomposite for heavy metal and microbial remediation of Yamuna water: RSM optimization and mechanistic insights**

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Abstract :This study presents an advanced remediation approach for Yamuna River water through the adsorption-based removal of contaminants using a novel *Rheum emodi*-mediated ZnO-MoS_2 (ZMR) nanocomposite. The influence of key operational parameters, including contact time (80 min), pH (9.0), and adsorbent dosage (0.15 g/L), was systematically optimized using RSM within a CCD framework. The ZMR nanocomposite was synthesized via a sustainable hydrothermal route and comprehensively characterized via FT-IR, XRD, SEM, TEM, BET and TGA. The material exhibited high selectivity towards Cr(VI) removal from Yamuna water samples collected from Okhla, New Delhi. Post-treatment assessment of physicochemical water quality parameters— including BOD, DO, COD, pH, and electrical conductivity—demonstrated substantial improvements. Notably, the ZMR nanocomposite achieved Cr(VI) and Ni removal efficiencies of 98.84% and 57%, respectively, as determined by ICP-OES. The adsorption process was determined to be thermodynamically feasible and endothermic, adhering to pseudo-second-order kinetics. The interaction mechanisms governing Cr(VI) adsorption were attributed to electrostatic attractions, dipole-dipole hydrogen bonding,

complexation, reduction pathways, C-π cation interactions, and π-π stacking interactions. Furthermore, the nanocomposite exhibited intrinsic antimicrobial activity by inhibiting the growth of the Gram-negative bacterium *Serratia marcescens*, present in the untreated Yamuna water. The material retained high adsorption efficiency over five consecutive adsorption-desorption cycles, underscoring its reusability. In conclusion, the synthesized ZMR nanocomposite represents a multifunctional, sustainable, and cost-effective material for comprehensive water purification, integrating efficient heavy metal remediation with antimicrobial properties.

Keywords: Yamuna water, Adsorption, RSM, Chromium, Zinc Oxide, Molybdenum Sulphide, Rheum Emodi, Antibacterial activity, Physio-chemical parameters

[143] Carbon Quantum Dots Decorated Titanium Disilicide Nanohybrid For Enhanced Photocatalytic Activity

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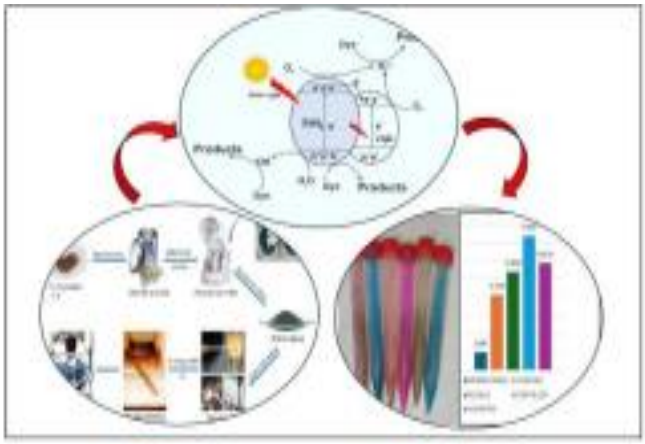

Abstract: This research is focussed on the synthesis of a low-band gap semi-conducting composite material to harness the visible light radiations for photocatalytic applications. $TiSi_2$ is selected as the semiconducting material because of its wide band-gap and its combination with the Carbon Quantum Dots (CQD) to act as an electron reservoir to retard the electron-hole recombination rate and increase light absorption. The thermally stable and non-toxic behaviour of $TiSi_2$/CQD composite makes it a good candidate to be tested for the visible light driven photocatalysis. Organic dyes were chosen as the target contaminant which has a significant share in the category of waterways organic pollutants. Hence, the selected composite would be employed for the photocatalytic degradation study of both an anionic as well as a cationic dye and their mixture under white light LED and direct sunlight. Different reaction parameters such as catalytic dosage, initial dye concentration and pH were optimised accordingly to achieve the maximum degradation efficiency. Multiple scavengers were employed to propose a plausible mechanism for the photocatalytic process. The kinetic study of the photocatalytic process of the thus prepared composite was also be studied. Excellent adsorption as well as photocatalytic results were obtained where the composite showed excellent results compared to pure $TiSi_2$ and

other similar TiO_2/CQD composites. This work elaborates the synthesis, properties, structural and optical characterizations and photocatalytic dye degradation. The future aspects of the novel Carbon Quantum Dots/$TiSi_2$ nanohybrid are also discussed.

Keywords: Novel Carbon Quantum Dots/$TiSi_2$ nanohybrid.

[144] AN INSIGHT INTO FERROMAGNETISM IN DOPED METAL OXIDES

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Abstract: The type of magnetism known as ferromagnetism occurs when some materials exhibit significant magnetic properties as a result of the alignment of their atomic magnetic moments. This article presents a perspective on the phenomenon of ferromagnetism, which is exhibited in metal oxide nanoparticles that have been doped with a variety of ferromagnetic and paramagnetic dopants, including Fe, Mn, Co, and Ni. An extensive variety of study fields are made available as a result of ongoing efforts to manufacture information storage devices that are much smaller. The objective of spin-based electronics is to develop ferromagnetic semiconductors at room temperature by combining the properties of semiconductors and ferromagnets. Dilute magnetic semiconductor oxides possess ferromagnetic characteristics at temperatures higher than the room temperature is a significant obstacle that is still present. It is for this reason that there has been a rapid increase in interest to get room temperature ferromagnetic semiconductor metal oxides because of the potential use of these materials in spintronics devices. This article draws attention to the ferromagnetism that can be found in nanoparticles which contain ZnO, TiO_2, SnO_2, and In_2O_3.

Keywords: ferromagnetism, nanoparticles.

[145] Conducting polymer/Graphene Oxide Composite: An Efficient Photocatalyst

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Abstract: Graphene Oxide (GO) which has demonstrated a great potential over last decades as an adsorbent and photocatalyst. In the current study GO has been doped to a conducting polymer, polyindole (PIn) to prepare an efficient photocatalyst with improved cyclic reusability and easy extraction. In-situ chemical oxidative polymerization technique was employed for the synthesis of PIn and composites using ferric chloride as an oxidant. A range of PIn/GO nanocomposites were synthesized by varying GO contents (%w/w) between 10 to 25. Morphological, optical and structural properties of the composites, sole GO and PIn were investigated by various spectroscopic techniques like XRD, SEM, UV−visible, FTIR, XPS, PL etc. The photocatalytic activity of different composites was studied for the degradation of dyes mixture. The aqueous mixture of dyes was prepared to mimic real wastewater conditions. Photocatalytic activity of anionic and cationic dyes mixtures was investigated separately and various parameters such as catalytic dosage, initial dye concentration and pH were optimized in order to get the best photocatalytic efficiency. Anionic dye mixture contains Alizarin red (AR), Eosin yellow (EY), Coomassie Brilliant Blue R (CBBR) and Bromocresol Green (BCG) whereas cationic dye mixture consists of Acridine Orange (AO), Bismarck Brown (BB), Fuchsin Basic (FB) and Victoria Blue (VB). Such vast dye composition was taken to study the catalytic activity of the composite in varied chemical environment. The composite showed an enhanced photocatalytic activity as compared to pure GO and PIn and demonstrated a great cyclic activity. Excellent results demonstrated by PIn/GO composite makes it a promising photocatalyst for future applications.

Keywords: Graphene Oxide (GO), Photocatalytic, Spectroscopic techniques.

[146] METAL FERRITES: AN ADAPTABLE MATERIAL FOR ELECTROCHEMICAL SENSORS, AND BIOMEDICAL AND SPINTRONICS APPLICATIONS

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Abstract: Ferrites, a class of ceramic materials composed of iron oxides with other metal oxides, have garnered noteworthy attention in cutting-edge applications due to their exclusive electrical, magnetic, and chemical properties. This review explores the diverse applications of ferrites in the frontiers of electrochemical sensors, and biomedical and spintronics areas. The recent development and use of metal ferrites in biomedicine, highlighting their innovative potential and the inevitability of constant study to get beyond current roadblocks and fully utilise their potential in clinical settings. Metal ferrites have shown ability to surpass conventional materials in terms of functionality, scalability, and stability. This has been proved by recent developments in the synthesis, characterisation, and integration of ferrites into spintronic devices. In biomedical applications, ferrites, particularly as nanoparticles, have emerged as a promising materials due to their biocompatibility, low toxicity, and superparamagnetic behavior. In the field of electrochemical sensors, ferrites exhibit excellent catalytic activity, and high stability, making them ideal candidates for detecting various analytes, including glucose, heavy metals, and gases. Their ability to enhance electron transfer kinetics and offer a large surface area improves the sensitivity and selectivity of sensor devices. This review article gives a broad impression of the state of metal ferrites in the realm of nanomaterials today, going over their basic characteristics, technical uses, and potential future advancements that could lead to a revolution in nanodevice fabrication. This piece of writing highlights the enhancements achieved through doping and pioneering synthesis methods, enabling precise control of their properties for specific applications.

Keywords: Promising material, Nanodevice fabrication.

[147] **Optical and Electrochemical Properties of Green Synthesized Li-doped Mn – Zn Nanoferrite**

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Abstract:This study investigates the structural and optical properties of green synthesized $Mn_{0.5}Zn_{0.5}Li_{0.5}Fe_{1.5}O_4$ ferrite prepared by sol-gel auto–combustion method using neem bark as a chelating agent. The zeta potential charge was found to be -12.5 mV. UV-vis spectroscopy was carried out and bandgap energy was calculated using the Tauc plot. A cyclic voltammetry monitoring potentiostat is used to analyze the electrochemical properties of the doped ferrite. These results demonstrate that Li-doped Mn-Zn nanoferrites could be applied to optical and electrochemical applications.

Keywords: ferrite, sol-gel, UV-spectroscopy, bandgap, Cyclic Voltammetry

[148] **Synthesis and characterization of Cr doped TiSe2 single crystal**

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Abstract: We report on the synthesis and characterization of bulk Cr doped $TiSe_2$ single crystal, which is prepared by a chemical vapor transport (CVT) method. The $TiSe_2$, is present in group IV-B in a class of transition metal dichalcogenides (TMDs), which shows charge density wave (CDW) feature at a temperature of 200 K, also shown in inset of fig.1 in ρ-T measurements [1]. Due to the small band gap or overlapping of bands in $TiSe_2$, it is not surprising that addition of other elements (such as- Pd, Cu, Co etc.) and growth conditions can affect the transport properties drastically of $TiSe_2$ [2]. The single crystal nature of $Cr_{0.05}TiSe_2$, is characterized by X-ray diffraction (XRD), which is shown in the main panel of fig.1. The observed XRD peaks are similar to previous results [3]. The field emission scanning electron microscopy (FESEM), is used for surface morphology and elemental composition characterization of $Cr_{0.05}$TiSe2

single crystal, which shows the layered growths in Cr doped $TiSe_2$ single crystal. The surface morphology appears very clean, and no defects are observed in SEM images of average size 10 μm in $Cr_{0.05}TiSe_2$ single crystal. Both the constituent elements viz. Ti, Cr and Se found to be in near to stoichiometric ratio in $Cr_{0.05}TiSe_2$ single crystal. Also, the EDX spectra shown in fig.2 shows the peaks only for Ti, Cr and Se atoms that also shows that the synthesized sample is phase pure, and no other impurity detected. The analysis of vibrational modes of Cr doped $TiSe_2$ analyzed by Raman spectroscopy, resulting the occurrence of both A_{1g} and E_g modes. Our future aim to, analyze the CDW features with different doping of Cr material and also analyze the electrical and magneto transport properties.

Keywords: Chemical vapor transport (CVT) method, Charge density wave (CDW).

[149] **Highly Porous Ni-Based MOFs for Efficient and Stable CO_2 Capture Under Humid Flue Gas Conditions**

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Abstract: Ni-based MOFs synthesized via solvothermal method exhibited high crystallinity, porosity, and efficiency in capturing CO_2 from humid flue gases. Their well-defined crystalline morphology and sphere-like structures, contributed to a substantial surface area of approximately 1450 $m^2\ g^{-1}$ and microporosity in range of 47–56%. Developed MOFs followed type V adsorption isotherms and displayed reversible CO_2 adsorption mechanism at lower relative pressures ($P/P_0 < 0.5$). At 293 K and 1 bar, Ni-BTC and Ni-Cu-BTC demonstrated CO_2 adsorption capacities of 4.5 mmol g^{-1} and 5.71 mmol g^{-1}, respectively. The estimated isosteric heat of adsorption was 20 kJ mol^{-1} for Ni-BTC, while Ni-Cu-BTC exhibited a higher value of 33.6 kJ mol^{-1}. Long-term adsorption-desorption assessments confirmed that these MOFs maintained their CO_2 uptake capacity consistently over 30 cycles without significant variation.

Even under flue gas conditions with humidity levels reaching 40%, CO_2 adsorption performance remained stable, indicating excellent resistance to humidity. The exceptional CO_2 adsorption capability of these Ni-based bimetallic MOFs, particularly at low pressures and high temperatures in humid environments, highlights their potential as advanced materials for CO_2 capturing technology.

Keywords: MOFs synthesized, Humid flue gases.

[150] **Highly Porous Ni-Based MOFs for Efficient and Stable CO_2 Capture Under Humid Flue Gas Conditions**

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Abstract: Ni-based MOFs synthesized via solvothermal method exhibited high crystallinity, porosity, and efficiency in capturing CO_2 from humid flue gases. Their well-defined crystalline morphology and sphere-like structures, contributed to a substantial surface area of approximately 1450 $m^2\ g^{-1}$ and microporosity in range of 47–56%. Developed MOFs followed type V adsorption isotherms and displayed reversible CO_2 adsorption mechanism at lower relative pressures ($P/P_0 < 0.5$). At 293 K and 1 bar, Ni-BTC and Ni-Cu-BTC demonstrated CO_2 adsorption capacities of 4.5 mmol g^{-1} and 5.71 mmol g^{-1}, respectively. The estimated isosteric heat of adsorption was 20 kJ mol^{-1} for Ni-BTC, while Ni-Cu-BTC exhibited a higher value of 33.6 kJ mol^{-1}. Long-term adsorption-desorption assessments confirmed that these MOFs maintained their CO_2 uptake capacity consistently over 30 cycles without significant variation. Even under flue gas conditions with humidity levels reaching 40%, CO_2 adsorption performance remained stable, indicating excellent resistance to humidity. The exceptional CO_2 adsorption capability of these Ni-based bimetallic MOFs, particularly at low pressures and high temperatures in humid environments, highlights their potential as advanced materials for CO_2 capturing technology.

Keywords: Solvothermal method, Ni-based bimetallic MOFs.

[151] **Synthesis and Structural Characterization of Rare-Earth-Doped M-type Hexa-Ferrites for EMI shielding application**

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Abstract

The emission of high-frequency electromagnetic radiation can cause electromagnetic interference (EMI), which can cause damages to communication system, safety operations of electronic devices, unacceptable degradation of system and their performance, which is a serious problem. To address this, EMI shielding materials are required to block or reduce the impact of incoming electromagnetic waves. Rare-earth-doped M-type ferrites have brought significant attention for their enhanced structural, dielectric, and electromagnetic properties making them useful for EMI shielding. In this present work, Ba0.9X0.1Fe12O19 (X=La, Dy) and BaFe12O19 were synthesized by solid state method, calcinated at 1000°C and again at 1100°C temperatures respectively. As prepared samples were then characterized by XRD (X-ray diffraction), showing its characteristics peaks as per JCPDS no.#01-078-0133, which confirmed the successful formation of M- ferrite. Average crystallite size of the samples was determined which shows synthesis of nanoparticles. VNA (vector network analyzer) measurements in X-band revealed dielectric and reflection loss. The results demonstrate that rare-earth doping effectively modulates the properties of M-ferrites for EMI shielding applications.

Keywords:- Electromagnetic interference shielding, rare-earth doping, M-Ferrite, Solid state method.

[152] **A Feasibility Study Of Conductive Thread using Microcontroller for Smart Wearable Devices**

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Abstract: Flexible and textile electronics are becoming more important in wearable devices because they can expect to replace conventional wires. They exhibit limited resistance to the mechanical stress occurring in body applications. The rapid advancements in flexible electronics have enabled the seamless integration of smart technologies into wearable devices, particularly in e-textiles. Wearable Health Devices (WHD) often use I^2C sensors which need reliable high-frequency communication. To replace the conventional wires, conductive embroidered threads are employed and it is used to embroider the conductive lines onto the cotton fabric this research aims to enhance the flexibility, robustness, and wearability of electronic textiles. Preliminary measurements were conducted to characterize the material's response to signals typically used within the I^2C communication protocol at various path lengths. The investigation focuses on evaluating the electrical performance, mechanical reliability, and signal integrity of embroidered conductive traces under various environmental conditions, including temperature variations, artificial sweat exposure, and mechanical stress. The results were promising and validated our conductive paths for digital signal communication, demonstrating the potential of these materials to enhance the performance and durability of wearable health devices. This study paves the way for future advancements in wearable electronics, emphasizing the importance of integrating conductive embroidered threads in I^2C sensor communication for enhanced performance and user comfort.

[153] Ab-initio Calculations of Electronic and Thermoelectric Properties of WS2 and MoS2

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Abstract: - Transition metal dichalcogenides (MX_2) are front runners in applications covering wide spectrum of sensing, optoelectronics. photovoltaic solar cells, etc. The density functional theory has been used to compute the band structure and density of states of WS_2 and MoS_2. The smothered Fourier interpolation algorithm for the Boltzmann equation with self-consistent plane wave density functional theory computations gives insight into the electrical conductivity and electronic thermal conductivity of WS_2 and MoS_2.

Keywords: - Transition Metal Dichalcogenides, Density Functional Theory, electrical conductivity, electronic thermal conductivity.

[154] $NiWO_4$/PANI/MXene ternary nanocomposite for photocatalytic degradation of norfloxacin

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Abstract

The contamination of water sources by pharmaceutical residues has become a significant environmental issue. Norfloxacin (NOR), a widely used fluoroquinolone antibiotic, is particularly problematic due to its low biodegradability, leading to its accumulation in aquatic environments and potential risks to human health. Visible-light-driven photocatalysis has emerged as a promising and sustainable method for wastewater treatment. In this study, a $NiWO_4$/PANI/MXene ternary nanocomposite was developed and evaluated for its photocatalytic efficiency in degrading NOR under visible light irradiation. The composite's properties were characterized using XRD, SEM, BET, UV-visible spectrophotometry, XPS, and TEM analyses. The influence of key reaction parameters, including NOR concentration, catalyst dosage, and solution pH, was systematically analyzed. The prepared $NiWO_4$/PANI/MXene nanocomposite exhibited superior degradation efficiency compared to its bare components. Maximum degradation was achieved at natural pH conditions, where favorable electrostatic interactions between the catalyst and NOR molecules enhanced adsorption and photocatalytic activity. Furthermore, radical trapping experiments identified h^+ and $OH^\bullet$ radicals as the primary reactive species responsible for NOR degradation. These findings highlight the potential of $NiWO_4$/PANI/MXene as an advanced photocatalyst for NOR remediation. The findings provide valuable insights into improving photocatalytic water treatment technologies, contributing to the efficient elimination of pharmaceutical pollutants and minimizing their environmental impact.

[155] Effect of Calcium Doping on the Structural, Morphological, and Dielectric Properties of Manganese Ferrite

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Abstract:

This study investigates the synthesis and characterization of calcium-doped manganese ferrite $Ca_xMn_{1-x}Fe_2O_4$ (x = 0.0, 0.2, 0.4, 0.6, 0.8, and 1.0) nanoparticles using a facile hydrothermal method. In this work, we systematically varied the calcium concentration (x) to explore its influence on the structural, morphological, and dielectric characteristics of the resulting nanoparticles. According to the XRD pattern, every composition had a rhombohedral single spinel phase structure without any impurities. The average crystallite sizes, as determined by Williamson-Hall (W-H) graphs, were found to be between 48 and 79 nm. SEM images show some agglomeration of particles, and EDX helps to confirm the presence of all the desired elements. As a function of frequency and composition, the dielectric constant (Ɛ′ and Ɛ") values varies in the range of 8680.02 to 2306.08 and 22331.1 to 6697.63 at 1.15MHz frequency respectively, and dielectric loss (tanδ) were also examined, and this behaviour was described by Maxwell-Wagner Model. It was shown that when frequency increases, dielectric loss decreases. The synthesized material may be used in radio frequency applications, sensors, and transformers.

Keywords: Ferrites, Hydrothermal method, Structural properties, Dielectric

[156] Engineering Silicon-Platinum Heterostructures for Cryogenic Transport Characterization

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Keywords: Silicon Nanowires (SiNWs), Metal Assisted Chemical etching (MACE), Focused Ion Beam (FIB).

ABSTRACT:

Silicon nanowires (SiNWs) are revolutionizing nanoelectronics, offering groundbreaking potential in quantum computing, energy harvesting, and sensor technologies [1]. In this study, we unveil a breakthrough in SiNW synthesis using the Metal-Assisted Chemical Etching (MACE) technique, producing nanowires with striking dimensions of ~3.91 µm in length and ~146 nm in width. Leveraging a Focused Ion Beam (FIB) facility, we engineered precise Pt contacts in a four-probe geometry to explore the nanowires' electronic transport properties at ultra-low temperatures. Inside a Dilution Refrigerator, operating at a chilling ~100 mK, we measured resistance as a function of temperature, magnetic field, and current-voltage (I-V) characteristics. Intriguingly, we discovered non-linear I-V behaviour spanning 100 mK to 1000 mK—a phenomenon that challenges conventional transport models and opens new avenues for exploration. These findings not only deepen our understanding of electronic transport in diffusive and ballistic regimes but also set the stage for designing next-generation nanoelectronics devices with unprecedented performance. This work propels SiNW research forward, bridging the gap between fundamental science and transformative technological applications.

[157] **Development of an Ionic Liquid-Gold Nanoparticle-Modified Carbon Paste Electrode for Efficient Immobilization of anti-Ag85 Antibodies.**

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Abstract: The development of a highly sensitive and stable biosensing platform for detecting Ag85, a key biomarker for mycobacterial infections, is crucial for early diagnosis and disease monitoring. This study introduces a novel gold nanoparticle (AuNP)-modified carbon paste electrode (CPE) for the efficient immobilization of antibodies against Ag85 (anti-Ag85). The modification process involved chemically treating the CPE surface to introduce positively charged ammonium (NH^{3+}) groups, facilitating the electrostatic attachment of negatively charged AuNPs. The incorporation of AuNPs significantly enhanced the electrode's surface area, improved biomolecule adsorption, and increased electrical conductivity, thereby optimizing biosensor performance. To assess the structural and chemical modifications, comprehensive characterization techniques, including Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Fourier-Transform Infrared Spectroscopy (FTIR), and X-ray Diffraction (XRD), were employed. SEM and TEM analyses confirmed the uniform distribution of anti-Ag85 and AuNPs on the electrode surface, while FTIR spectra verified the formation of covalent bonds between the modified surface and anti-Ag85. The integration of AuNPs effectively improved the stability and sensitivity of the biosensor, highlighting its potential for accurate Ag85 detection. This innovative biosensing platform offers a promising approach for early and precise detection of mycobacterial infections, paving the way for improved diagnostic strategies.

[158] **Bridging Ayurvedic Medicine with Nanotechnology for Breast Cancer Treatment: A Review**

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Abstract. Cancer is a prevalent condition causing the majority of deaths worldwide with breast cancer being the primary cause of death in females in India. Traditionally chemotherapeutic and surgical methods are applied as a form of treatment but they fall short as they are invasive and are not specific in targeting cancer cells. Nanotechnology has emerged as an alternative treatment method being actively employed for variety of cancers, including breast cancer, with a widespread use of carbon nanostructures for drug delivery and diagnosis. Despite their effectiveness, metallic nanomaterials exhibit toxicity over prolonged use. This toxicity can be alleviated with the incorporation of ayurvedic methods. Ayurvedic Bhasma—a herbal formulation containing bioactive nanoparticles— is a traditional treatment originating in India applied on various ailments, including cancer. Linking ayurveda and nanotechnology can provide a safer approach to cancer treatment. This review discusses breast cancer and the traditional treatment for breast cancer, with a focus on the emerging field of ayurvedic nanotechnology and green nanotechnology in formulating biobased nanoparticles for treating breast cancer, as well as the prospects for this technology.

Keywords: nanotechnology, breast cancer, Ayurveda, green nanotechnology

[159] **"From Fundamentals to Innovations: Activated Carbon for Supercapacitor Energy Storage"**

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Abstract: The increasing consumption of fossil fuels, driven by modern lifestyle activities and growing energy demands, has intensified environmental challenges. Further, inefficient and costly energy storage systems are big problems in utilizing renewable energy resources. A promising solution to address these concerns involves converting waste biomass into valuable electrode materials such as activated carbon. In recent years, carbonaceous materials derived from waste biomass have gained attention for their potential use in energy storage systems, particularly in supercapacitors. Supercapacitors have emerged as the most appealing energy storage system due to their high specific power, extended lifespan, insightful safety features, and low maintenance cost. Researchers have successfully synthesized porous activated carbon (AC)

from various waste biomass sources, including fruit peel, leaves, barks, bamboo trash, green tea waste, agri-waste, and plant fibers. These AC materials have demonstrated exceptional performance as electrode materials in supercapacitors due to inherent porous structure and doping sites, achieving specific capacitances of ~ 400 F/g or higher. This review summarises the most recent advancement in utilizing biowaste as carbon precursors that is required from both an environmental perspective and the drive for sustainable resource recycling.

Keywords: Energy storage; waste utilization; Carbon; Sustainability

[160] **Simple Approach for Effective Green Synthesis of Mixed Valent Li-Nanoferrites using Sugarcane & Lemon Juice for Magnetic Hyperthermia**

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Abstract: Over decades, spinel nanoferrites remain in limelight owing to their extraordinary chemical & physical properties along with noval application of biomedical engineering. In this study, ~18 nm, ~11 nm and ~12 nm sized nanoferrites viz; $Li_{0.5}Fe_{2.5}O_4$, $Li_{0.25}Zn_{0.25}Fe_{2.5}O_4$ and $Li_{0.25}Mn_{0.25}Fe_{2.5}O_4$ (hereafter referred to as LF, LZF and LMF respectively) were prepared via green self-combustion route using mixture of sugarcane & lemon juice. PXRD, FTIR and Raman analysis affirmed phase pure sugar coated LF, LZF and LMF nanoparticles (NPs) in primitive cubic symmetry. Observation of S shaped hysteresis loops established dominant superparamagnetic (SPM) character of LF, LZF and LMF NPs at 300K, which upon cooling turned into a soft ferrimagnetic state at 5K. Further, IFC & ZFC magnetization data recorded as a function of temperature in 100Oe showed departure between IFC & ZFC mode at ~295K along with monotonic decrement in the ZFC magnetization down to 5K, while IFC mode almost unaffected upon cooling. These findings indicative for a wide size distribution of the NPs, as most of the NPs remain in blocked state at 300K and thus, exhibits dominant superparamagnetic character at 300K. It is also noted that near flattening of the IFC magnetization at low temperatures is indicative for the surface spin freezing. Moreover, typical broad peak in the ZFC mode (referred as characteristic blocking temperature T_B) of SPM for LZF & LMF with T_B= 62 K and 67 K respectively, while for LF the T_B is above 300K. Notably, coexistence of SPM and soft ferrimagnetic states in LF, LZF and LMF NPs is also affirmed by ^{57}Fe - Mössbauer analysis at 300K. Specific Absorption Rate (SAR) are found to be 1011 W/g, 550 W/g, and 351 W/g for LF, LMF, and LZF respectively making them suitable for cancer theranostics.

Keywords: Green synthesis, Spinel ferrites, Superparamagnetism, Soft ferrimagnetism, Magnetic Hyperthermia.

[161] **Plant-Medicated Green synthesis of Copper Oxide Nanoparticles for Enhanced Photocatalytic Degradation of Pollutants in Water**

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Abstract: The increasing levels of water pollution caused by organic contaminants necessitate the development of efficient and eco-friendly treatment solutions. This study focuses on the plant-mediated green synthesis of copper oxide (CuO) nanoparticles, utilizing natural plant extracts as biogenic reducing and stabilizing agents. This sustainable approach offers an environmentally friendly alternative to conventional chemical synthesis methods by eliminating toxic reagents and reducing energy consumption. The structural, morphological, and optical properties of the synthesized CuO nanoparticles will be characterized using X-ray diffraction (XRD), ultraviolet-visible spectroscopy (UV-Vis), field emission scanning electron microscopy (FESEM), high-resolution transmission electron microscopy (HRTEM), Brunauer-Emmett-Teller (BET) surface area analysis, and Fourier transform infrared spectroscopy (FTIR). The photocatalytic performance of CuO nanoparticles will be assessed for the degradation of organic pollutants in wastewater under visible light irradiation. It is expected that the green-synthesized CuO nanoparticles will exhibit superior photocatalytic activity, demonstrating their potential as an efficient and sustainable material for water purification applications.

Keywords: Copper Oxide Nanoparticles, Green Synthesis, Photocatalysis, Plant-Mediated Approach, Water Purification

[162] Influence of Tungsten Doping in SnO_2 Electron Transport Layers on Perovskite Solar Cell Performance through Experimentation and Numerical Simulation

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The placement of energy bands and the conductivity of electron transport layers (ETLs) are critical factors that limit the efficiency of planar perovskite solar cells (p-PSCs). The doping methodology is an efficient strategy applied to ETLs, thereby enhancing the performance of related PCSs. Tin oxide (SnO_2) is a key material in electron transport layers (ETLs) owing to its mild synthesis conditions; however, its low conduction band position and constrained intrinsic carrier concentration present challenges for effective electron transport. This study investigates the improvement of PSC efficiency through the optimization of surface morphological characteristics and optoelectronic properties of the ETL via tungsten (W) doping in SnO_2. Doping with W can elevate the conduction band of SnO_2, thereby decreasing the energy barrier for electron extraction and mitigating interface recombination between the electron transport layer and perovskite. High-quality PSCs featuring enhanced ETL exhibited a significant improvement in power conversion efficiency (PCE) relative to those utilising pristine SnO_2 ETL. The findings present a viable approach for the fabrication of p-PSCs with high efficiency. Finally, the simulation investigation is conducted at temperature 300K and AM 1.5G solar spectrum to clarify the fundamental optoelectrical features of the PSCs, with simulated results confirming experimental findings.

Keywords: Perovskite Solar Cell, Electron Transport Layer, Tungsten Doping, SCAPS-1D Simulation, Performance Enhancement

[163] $CoFe_2O_4$ Nanoparticles for Efficient Adsorption of Residual Triiodide Ions from Iodinated Water

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Abstract: This study investigates the adsorption performance of cobalt ferrite ($CoFe_2O_4$)-based magnetic nanoadsorbents (CFMNs) for the removal of triiodide ions (I3-) from iodinated water. The synthesized CFMNs exhibited a crystallite size of 42 nm and a specific surface area of 26.98 m^2/g, as determined by X-ray diffraction (XRD). Field emission scanning electron microscopy (FESEM) revealed a porous morphology, while vibrating sample magnetometry (VSM) confirmed ferromagnetic properties with a saturation magnetization of 74.98 emu/g, facilitating efficient magnetic separation. Batch adsorption experiments demonstrated a dose-dependent reduction in I3- concentration, with UV-Vis spectroscopy confirming characteristic absorbance peaks at 288 nm and 351 nm. The initial I3- concentration of 13.751 mg/L was progressively reduced as CFMNs dosage increased from 0.2 to 2.0 mg/mL, achieving a maximum removal efficiency of 61.6%. However, diminishing adsorption efficiency was observed at higher dosages, indicating the presence of an optimal dosage range for effective I3- removal. Statistical analysis revealed a strong correlation between CFMNs concentration and I3- removal, highlighting the role of increased adsorption site availability in enhancing performance. Beyond 1.4 mg/mL, adsorption efficiency exhibited diminishing returns, suggesting adsorption site saturation. These findings establish $CoFe_2O_4$ nanoparticles as a promising magnetic nanoadsorbent for the remediation of iodine-based contaminants in aqueous systems. The results provide critical insights for optimizing adsorbent dosage to maximize removal efficiency while minimizing material consumption, making CFMNs a viable candidate for sustainable water purification and environmental remediation applications.

Keywords

Magnetic nanoadsorbents, Cobalt ferrite, Adsorption efficiency, Triiodide removal, Water treatment, Environmental remediation.

[164] Nanothermites: Applications, Limitations, Safety Considerations, and Future Prospects

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Abstract: The continuous advancement of energetic materials is critical for modern defense, aerospace propulsion, space exploration, and high-performance pyrotechnic applications. Among these, nanothermites—thermite compositions containing at least one nanoscale component—

exhibit superior energy density, rapid reaction kinetics, and high combustion temperatures, making them highly attractive for next-generation energetic systems. Their unique properties, including high linear burning rates, tunable reaction heats, and the ability to form hybrid energetic compositions, enable their use in diverse applications such as propellant formulations, micro-thrusters, and reactive materials. However, their widespread adoption faces several challenges. Issues such as the formation of condensed combustion products, which contribute to two-phase flow losses in propulsion systems, and their heightened sensitivity to electrostatic discharge (ESD) pose significant safety risks. Additionally, storage stability and scalability remain major concerns. This study explores the opportunities presented by nanothermites, critically examines their limitations, and discusses key safety considerations. Finally, future research directions are outlined to address existing challenges and enhance the applicability of nanothermites in both civilian and military domains.

Keywords

Nanothermites, Energetic Materials, Propellants, Safety Concerns, Electrostatic Sensitivity, Combustion Efficiency

[165] **Inference of Ferromagnetic Quantum Criticality in LaCoGe, Using First Principles**

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Abstract: The magnetic nature of LaCoGe remains debated, with experimental studies suggesting both nonmagnetic and antiferromagnetic ground states. To resolve this, we employed first-principles density functional theory (DFT) calculations using the local density approximation (LDA). Our results predict a ferromagnetic ground state, conflicting with the experimentally observed lack of long-range order, suggesting the dominance of strong spin fluctuations. To probe the stability of ferromagnetism, we analyzed the electronic density of states (DOS), Stoner criterion, and electronic specific heat. The results indicate that LaCoGe is near a ferromagnetic quantum critical point (FMQCP), where spin fluctuations suppress magnetic ordering. Further insights from fixed spin moment calculations and Ginzburg–Landau free energy expansion support the role of zero-point quantum fluctuations, similar to those observed in LaCoSi. The interplay of electronic structure and quantum fluctuations positions LaCoGe as a promising system for studying quantum criticality in itinerant ferromagnets. These findings provide new insights into the magnetic instability in LaCoGe and its connection to quantum criticality, with potential implications for correlated electron systems and unconventional magnetic behavior.

Keywords: Ferromagnetic Quantum Criticality, Density Functional Theory, Spin Fluctuations, Stoner Criterion

[166] **Citrus waste valorization to design biopolymer nutraceutical health supplement by molecular imprinting**

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Abstract: Nagpur, Maharashtra's third-largest city, is famous for its high-quality mandarins, earning it the title "orange city." India produces about 7.8 million tons of citrus waste annually. This waste, rich in polyphenolic antioxidants, can be sustainably repurposed for plant-based nutraceuticals in healthcare application, benefiting both the environment and sustainable practices. Molecular imprinting was used to selectively recover Hesperidin from citrus waste pomace extract using Deep Eutectic Solvents (DES) for nutraceutical development.
Molecularly Imprinted Polymers (MIPs) were used to recover hesperidin after extraction with DES. The efficiency of DES extraction was optimised based on time, temperature, solid/liquid ratio, and water content. The polyphenolic antioxidant extraction was evaluated through total phenolic and flavonoid content, as well as antioxidant and antimicrobial analysis. MIPs were synthesised using a dummy template strategy with hesperetin as the template, Chitosan as the functional monomer, and Calcium Chloride and STPP as crosslinkers, supplemented by zinc acetate dihydrate. The MIP was successfully developed, using the specified composition, alongside a non-imprinted polymer (NIP) which contains all components except the template. The synthesis of MIP and NIP was followed by the characterization of all precursors, MIP, and NIP using techniques such as FTIR, XRD, and SEM. The results indicated that the optimal conditions were 30 mg, 120 minutes, pH 3, and 200 ppm. Kinetic studies revealed that the adsorption process follows pseudo-second-order kinetics, while isotherm studies showed that the Langmuir adsorption isotherm best describes the adsorption of Hesperetin by NIP.

Keywords: Deep Eutectic Solvents; Molecularly Imprinted Polymers; Nutraceuticals; Healthcare application; Sustainable extraction.

[167] **Advancements in Zinc-Copper Bimetallic Chitosan Composites for Photocatalytic Dye Degradation**

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Abstract: The increasing environmental pollution caused by industrial dyes has necessitated the development of efficient and sustainable photocatalytic materials for their degradation. Zinc-copper bimetallic chitosan composites have emerged as a promising candidate for photocatalytic applications due to their unique structural, electronic, and catalytic properties. This study provides a comprehensive overview of recent advancements in the synthesis, characterization, and application of zinc-copper bimetallic chitosan composites for the photocatalytic degradation of dyes. The synergistic effects of zinc and copper nanoparticles, combined with the high surface area and excellent electron transport properties of graphene, enhance the photocatalytic activity of these composites. Various synthesis methods, including chemical reduction, hydrothermal, and solvothermal techniques, are discussed, along with their impact on the structural and photocatalytic properties of the composites. The study also highlights the mechanisms of dye degradation, emphasizing the role of reactive oxygen species (ROS) and the influence of operational parameters such as pH, dye concentration, and light intensity. Furthermore, the challenges and future prospects of zinc-copper bimetallic chitosan composites in large-scale environmental remediation are addressed. This study aims to provide valuable insights for researchers working on the development of advanced photocatalytic materials for environmental applications.

Keywords: Zinc-copper bimetallic composites; chitosan; photocatalysis; dye degradation; reactive oxygen species; environmental remediation.

[168] **Strategic Interface Design for Boosted Charge Extraction in $CsPbBr_3$ Perovskite Solar Cells**

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ABSTRACT: In recent years, perovskites made entirely of inorganic components have gained attention as a potentially stable semiconductor material for use in photoactive optoelectronic layers. However, improving the performances of all-inorganic perovskite-based photovoltaics still requires solving the crucial issue of forming high-quality thin films and trap-reduced interfaces. The performance of perovskite solar cells (PSCs) is directly affected by the alignment of energy levels and the extraction of charges at the interfaces. In this study, a better interface between the all-inorganic $CsPbBr_3$ perovskite and its hole transport layer (spiro-OMeTAD) was achieved by aligning the energy levels using tetraphenylphosphonium iodide (TPPP (I)). The use of TPPP(I) mitigates surface imperfections, enhances grain size, and diminishes surface trap states, resulting in improved light absorption and expedited carrier movement. Therefore, much improved power conversion efficiency (PCE) has been achieved thus making the use of PSCs more viable in the field of photovoltaics. Moreover, the stability of the device is also improved under the application of TPPP(I). This can be attributed to the fact that TPPP(I) offers a good protection against moisture reducing the non-radiative recombination. Consequently, incorporation of TPPP(I) significantly improves the device's performance and further makes the PSC more stable under environmental conditions, which put PSCs a step ahead towards commercialization.

Keywords: Inorganic perovskite solar cell, $CsPbBr_3$, energy alignment, passivation, additive engineering, TPPP(I)

[169] Synthesis and characterization of nickel oxide and Gd doped Ceria nanocomposite as active anode material for solid oxide fuel cell

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Abstract: - Solid oxide fuel cells (SOFC) are now being seriously considered for alternate energy source because of the environmental hazards associated with the use of fossil fuels and their limited availability. We have synthesis Nikel Oxide (NiO) and Gd doped Ceria (GDC) by ball mailing method and characterized by different characterization techniques like XRD, Raman, FESEM, HRTEM. In this paper, we present the study of NiO-stabilized GDC as an anode material in SOFC made by tape casting of slurry of NiO, GDC and glass. The role of NiO in stabilizing GDC and the possible reasons for the increase in catalytic activity of the relevant composition have been discussed using the experimental data. The NiO-GDC synthesis, where a

considerable improvement in activation energy is observed at the low-temperature region. Such low activation energies were later associated with the adsorption/desorption process of water molecules at the surface of NiO-GDC composite, indicating a high activity towards hydrogen oxidation.

Keywords: - Solid Oxide Fuel Cell (SOFC), Anode Material, Nickel Oxide (NiO), GadoliniumDoped Ceria

[170] **Development of Highly Sensitive and Stable Humidity Sensors for Multifunctional Applications**

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Abstract: The demand for highly sensitive and stable humidity sensors is increasing due to their critical role in environmental monitoring, industrial automation, and healthcare applications. This study presents the development of next-generation humidity sensors with enhanced sensitivity, rapid response, and long-term stability. By optimizing material composition, surface functionalization, and nanostructured architectures, the proposed sensors exhibit superior adsorption-desorption kinetics, leading to precise and repeatable humidity detection across a broad relative humidity (RH) range. Electrical resistance analysis confirms significant resistance variations in response to humidity fluctuations, ensuring accurate sensing performance. Furthermore, the sensors demonstrate excellent durability, low hysteresis, and minimal drift over extended operational periods. These advancements position the developed sensors as reliable candidates for real-world applications requiring precise humidity monitoring.

Keywords: Humidity sensor, High sensitivity, Stability, Nanostructured materials, Electrical impedance, Environmental monitoring.

[171] **Effect of Post-deposition annealing on the physical properties of ALD-grown ZnO Films for photovoltaic applications**

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Abstract: In this work, we present the effect of post-deposition annealing (PDA) on the structural, optical and electrical properties of ZnO films deposited using atomic layer deposition (ALD) and their impact on Al/ZnO/p-Si/Al heterojunction devices. ALD offers precise, low-temperature and conformal film growth, making it a promising technique for heterojunction silicon solar cells. ZnO films of 100 nm thickness were deposited at 150 °C and annealed at 450 °C for 15, 30 and 45 minutes in a forming gas ambient. Structural, optical and morphological properties were studied using X-ray diffraction (XRD), UV-Vis spectroscopy, scanning electron microscopy (SEM), and energy dispersive X-ray (EDS) spectroscopy. The XRD and UV-Vis

results showed improved crystallinity and an increased optical band-gap with longer annealing times, while the average optical transmittance in the visible region improved from 73 % to 85 %. Electrical properties were analyzed using current-voltage (I-V) measurements to extract barrier height, ideality factor and series resistance. From the I-V characteristics, the lowest magnitudes of ideality factor of 2.5 and series resistance of 166.33 Ω have been found for the device annealed for 30 min. Capacitance-voltage (C-V) measurements were performed at different frequencies (10 kHz–1 MHz) for the as-deposited and annealed devices to further understand their electrical behaviour. The measurements showed that the series resistance and interface state density significantly influenced the capacitance and admittance characteristics of the devices. These findings highlight the enhanced structural, optical and electrical properties of annealed ZnO films, and emphasize the potential of ZnO as interfacial layers in silicon solar cells for improved device stability.

Keywords: ALD, heterojunction, Annealing, ZnO, solar cell

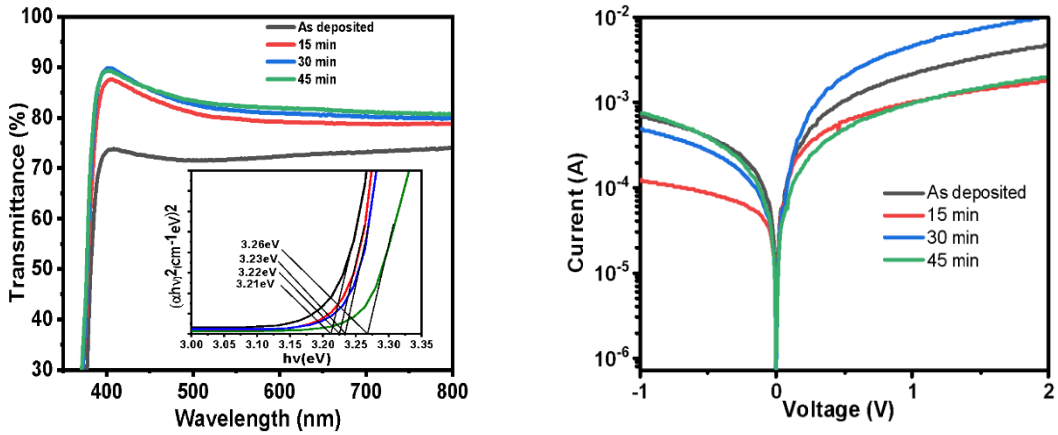

Figure 1. (a) Optical transmittance spectra of as deposited and annealed ZnO thin films deposited on glass substrate and inset shows a plot of $(\alpha h\nu)^2$ as a function of photon energy ($h\nu$) and (b) Current-voltage characteristics of as deposited and annealed Al/ZnO/p-Si/Al hetrojunctions at room temperature.

[172] Total Ionization cross section of Zinc atom by electron impact

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Abstract: This study investigates the Ionization cross-section of zinc atom by the electron impact, a fundamental process with a wide range of applications in Plasma Physics, Material Science, and Astrophysics. We discussed here the ionization cross section with the help of Semi Empirical approach by electron impact. Which has been studied under the energy range from threshold to 5120 eV through electron impact mass spectrometry. Our calculations have been

studied computationally to get a good agreement graph between energy and cross section. Zinc atom fragmented ions like Zn+, Zn++,Zn+++,Zn++++ were studied in this work. Our results are compared with the previous results and they are found in good agreement.

Keywords: Electron Impact, Cross section, Ionization, Zinc atom and Zinc fragments.

[173] **Sustainable synthesis of anatase TiO_2 nanoparticles from Song of India plant**

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Abstract: This study focuses on the green synthesis and characterization of titanium dioxide (TiO_2) nanoparticles using extracts from Song of India (Dracaena reflexa) leaves, an unreported plant source, highlighting an environmentally sustainable approach to nanomaterial production. X-ray diffraction (XRD) analysis confirmed the formation of anatase-phase TiO_2 nanoparticles, with prominent diffraction peaks observed at characteristic Bragg's angles corresponding to specific lattice planes. The crystallite size was determined to be 8.89 nm using Debye-Scherrer's equation. UV-Vis spectroscopy analysis revealed a strong absorption peak at 250 nm with an optical band gap of 3.63 eV, indicative of strong optical properties, making the synthesized nanoparticles suitable for various photocatalytic applications. Fourier Transform Infrared Spectroscopy (FTIR) confirmed the presence of Ti–O–Ti vibrations, along with hydroxyl (–OH) and aromatic (C=C) stretching bands, suggesting effective interaction between bioactive molecules and the TiO_2 surface, contributing to nanoparticle stabilization and enhanced surface functionality. The use of Song of India as a novel plant source not only promotes green chemistry but also enhances the accessibility of sustainable nanomaterials for advanced applications. This study underscores the potential of plant-mediated synthesis in developing eco-friendly and cost-effective nanotechnology solutions.

Keywords: Green synthesis, Song of India, TiO_2 nanoparticles, XRD, UV-Vis, FTIR.

[174] **Sustainable synthesis of MgO nanoparticles from Pinus patula**

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Abstract: This study investigates the green synthesis of MgO nanoparticles using extracts from *Pinus patula* leaves, an unreported plant source, highlighting an environmentally sustainable approach to nanomaterial production. X-ray diffraction (XRD) analysis confirmed the formation of anatase-phase MgO nanoparticles, with prominent diffraction peaks observed at Bragg's angles of 36.99°, 43.00°, 62.35°, 74.71°, and 78.65°corresponding to the (100), (002), (101), (102), and (110) lattice planes. The crystallite size was determined to be 55.6 nm using Debye-Scherrer's equation. UV-Vis spectroscopy analysis revealed a band gap of 3.34eV, indicative of strong optical properties, making the synthesized nanoparticles suitable for various photocatalytic applications. Fourier Transform Infrared Spectroscopy (FTIR) confirmed the presence of MgO vibrations, along with hydroxyl (–OH) and aromatic (C=C) stretching bands, suggesting effective interaction between bioactive molecules and the MgO surface, contributing to nanoparticle stabilization and enhanced surface functionality. The use of *Pinus patula* as a

novel plant source not only promotes green chemistry but also enhances the accessibility of sustainable nanomaterials for advanced applications. This study underscores the potential of plant-mediated synthesis in developing eco-friendly and cost-effective nanotechnology solutions.

Keywords: Green synthesis, *Pinus patula*, MgO nanoparticles, XRD, UV-Vis, FTIR.

[175] **Sustainable synthesis of CuO nanoparticles from *Cannabis sativa***

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Abstract: This study investigates the green synthesis of CuO nanoparticles using extracts from *Pinus patula* leaves, an unreported plant source, highlighting an environmentally sustainable approach to nanomaterial production. X-ray diffraction (XRD) analysis confirmed the formation of anatase-phase CuO nanoparticles, with prominent diffraction peaks observed at Bragg's angles of 35.54°, 36.48°, 38.77°, 42.33°,48.84°,53.48°,58.26°,61.45°,66.31°,68.06°,73.62°corresponding to the (110),(002),(-111),(111),(200),(-112),(-202),(020),(202),(-113) and (022) lattice planes. The crystallite size was determined to be 14 nm using Debye-Scherrer's equation. UV-Vis spectroscopy analysis revealed a band gap of 3.18eV, indicative of strong optical properties, making the synthesized nanoparticles suitable for various photocatalytic applications. Fourier Transform Infrared Spectroscopy (FTIR) confirmed the presence of CuO vibrations, along with hydroxyl (–OH) and aromatic (C=C) stretching bands, suggesting effective interaction between bioactive molecules and the MgO surface, contributing to nanoparticle stabilization and enhanced surface functionality. The use of *Pinus patula* as a novel plant source not only promotes green chemistry but also enhances the accessibility of sustainable nanomaterials for advanced applications. This study underscores the potential of plant-mediated synthesis in developing eco-friendly and cost-effective nanotechnology solutions.

Keywords: Green synthesis, *cannabis sativa CuO* nanoparticles, XRD, UV-Vis, FTIR.

[176] **Photonic Sensors for Emerging Technologies**

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ABSTRACT
Photon sensors offer non-contact, real-time, and extremely accurate measurements across a variety of sectors by utilizing light-based technologies as fiber optics, laser interferometry, and plasmonics. These days, optical circuits and devices are becoming essential parts of many application areas, including chemistry, biotechnology, automotive, aerospace, medical, and food quality control. Photonic sensors are used in a wide range of industries, including defense (LIDAR, surveillance, and secure communication), industrial automation (structural health monitoring, precision manufacturing), environmental monitoring (gas and pollutant detection), and healthcare (biomedical diagnostics, imaging, and wearable health monitoring). Even though

these technologies are still in the early stages of research, these new technologies have the potential to significantly influence the future of photonic products over the last few decades. In this paper, the general currents and advancement in photonic sensor emerging technology will be discussed. We anticipate this investigation will shed light on the novel kinds of photonic sensors that are now on the market.

Keywords - photonic sensors, Laser interferometry, LIDAR

[177] **Electrochemical performance of bismuth-based perovskite in NaOH electrolyte for energy storage applications**

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Abstract: The growing need for high-performance energy storage solutions has driven significant research into advanced electrochemical storage technologies. In this study, $BiNi_{0.6}Mn_{0.4}O_3$ nanostructures were synthesized via a hydrothermal process that enabled precise tuning of morphology and composition. The synthesized material has a tetragonal phase at 400 °C. The electrochemical performance was evaluated in a 6 M NaOH electrolyte, which played a crucial role in facilitating effective faradaic redox reactions involving Ni and Mn. The material exhibited a specific capacitance of approximately 163 F/g at 1 A/g and maintained 77% capacitance retention after 2000 cycles at 6 A/g, demonstrating the material's potential for advanced energy storage applications. The synergistic effect of Bi, Ni, and Mn contributed to improved electrochemical kinetics, making $BiNi_{0.6}Mn_{0.4}O_3$ a promising candidate for high-performance energy storage applications. These findings pave the way for further research into transition metal-based oxides with optimized electrochemical properties for next-generation supercapacitors and hybrid energy storage systems.

[178] **Impact of Transition Metal Doping (Co, Cu, Fe) on Structural, Electrical, and Magnetic Properties of $Ba_5CaTi_2Nb_8O_{30}$**

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Abstract: Pristine and substituted $Ba_5CaTi_2Nb_8O_{30}$ (BCTN) were synthesized by substituting different metal ions at specific sites. In the doped versions, Transition metals were introduced at the Ti site forming $Ba_5CaTi_{1.96}M_{0.04}Nb_8O_{30}$ where M = Co, Cu or Fe. The study aimed to understand how these substitutions affect the material's local structure, the oxidation states of the cations, and the formation of defects that help maintain charge neutrality. To investigate these effects, a combination of spectroscopic, structural, and magnetic measurements was used. Techniques included X-ray powder diffraction for structural analysis, and dielectric and impedance spectroscopy measurements to study electrical conductivity and VSM to study the magnetic properties. XRD reveals the presence of Tetragonal structure and Raman spectroscopy give good agreement with reported phase. Vibrating Sample Magnetometry (VSM) measurements showed that the introduction of dopants improved the material's magnetic characteristics. This discussion provided insights into how the material's conductivity is influenced by the type and amount of dopants, as well as the resulting defects.

[179] **Biogenic Synthesis of Titanium Dioxide Nanoparticles for Efficient Water purification via Photo catalysis**

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Abstract: Water contamination remains a significant global concern, necessitating the development of efficient and sustainable treatment solutions. In this study, eco-friendly nickel oxide (NiO) nanoparticles were synthesized using a hydrothermal method, offering a green and cost-effective approach for water purification applications. The synthesis process was optimized to obtain well-defined nanoparticles with high surface area and enhanced adsorption capabilities. The physicochemical properties of the synthesized NiO nanoparticles will be characterized using X-ray diffraction (XRD), ultraviolet-visible spectroscopy (UV-Vis), field emission scanning electron microscopy (FESEM), high-resolution transmission electron microscopy (HRTEM), Brunauer-Emmett-Teller (BET) surface area analysis, and Fourier transform infrared spectroscopy (FTIR). These characterizations will provide insights into the structural, morphological, optical, and surface properties of the nanoparticles. The anticipated results suggest that NiO nanoparticles possess high adsorption efficiency, making them suitable candidates for removing pollutants from wastewater. This study highlights the potential of hydrothermally synthesized NiO nanoparticles as an eco-friendly and efficient material for water treatment applications.

Keywords: Nickel Oxide, Nanoparticles, Water Treatment, Eco-Friendly.

[180] **Eco-Friendly Nickel Oxide Nanoparticles for Water Treatment: A Hydrothermal Synthesis Approach**

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Abstract: Water contamination remains a significant global concern, necessitating the development of efficient and sustainable treatment solutions. In this study, eco-friendly nickel oxide (NiO) nanoparticles were synthesized using a hydrothermal method, offering a green and cost-effective approach for water purification applications. The synthesis process was optimized to obtain well-defined nanoparticles with high surface area and enhanced adsorption capabilities. The physicochemical properties of the synthesized NiO nanoparticles will be characterized using X-ray diffraction (XRD), ultraviolet-visible spectroscopy (UV-Vis), field emission scanning electron microscopy (FESEM), high-resolution transmission electron microscopy (HRTEM), Brunauer-Emmett-Teller (BET) surface area analysis, and Fourier transform infrared spectroscopy (FTIR). These characterizations will provide insights into the structural, morphological, optical, and surface properties of the nanoparticles. The anticipated results suggest that NiO nanoparticles possess high adsorption efficiency, making them suitable candidates for removing pollutants from wastewater. This study highlights the potential of hydrothermally synthesized NiO nanoparticles as an eco-friendly and efficient material for water treatment applications.

Keywords: Nickel Oxide, Nanoparticles, Hydrothermal Synthesis, Water Treatment, Eco-Friendly

[181] **Synthesis of Iron Oxide Nanoparticles for Photocatalytic Degradation of Pollutants in Water**

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Abstract: Water pollution caused by industrial and agricultural contaminants poses a serious environmental threat, necessitating the development of sustainable and effective remediation technologies. In this study, iron oxide nanoparticles (Fe_2O_3 NPs) were synthesized using a green synthesis approach, employing eco-friendly plant extracts as reducing and stabilizing agents. This method eliminates the need for hazardous chemicals, making it an environmentally benign alternative to conventional synthesis techniques. The synthesized nanoparticles will be characterized using X-ray diffraction (XRD), ultraviolet-visible spectroscopy (UV-Vis), field emission scanning electron microscopy (FESEM), high-resolution transmission electron microscopy (HRTEM), Brunauer-Emmett-Teller (BET) surface area analysis, and Fourier transform infrared spectroscopy (FTIR) to determine their structural, morphological, and optical properties. The photocatalytic activity of the Fe_2O_3 NPs will be evaluated for the degradation of organic pollutants in water under visible light irradiation. The anticipated results suggest that green-synthesized iron oxide nanoparticles exhibit excellent photocatalytic efficiency, making them a promising material for sustainable water treatment applications.

Keywords: Green Synthesis, Iron Oxide Nanoparticles, Photocatalysis, Water Treatment, Environmental Remediation

[182] **Sustainable Synthesis of Zinc Oxide Nanoparticles for Enhanced Photocatalytic Water Treatment Applications**

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Abstract: The increasing demand of for the eco-friendly and efficient water treatment has started the researches on sustainable nanomaterials synthesis methods. This study presents the green synthesis of zinc oxide(ZnO) nanoparticles(NPs) using *Aglaonema* plant extract via a hydrothermal process. It eliminates the need of toxic reagent in the synthesis of NPs. The phytochemical presents in aglaonema plant extract helps as natural reducing and stabilizing agents, which helps in the formation of the ZnO NPs with more stability and smaller size. Many characterization techniques, including X-ray diffraction(XRD), ultraviolet-visible spectroscopy(UV-Vis), high-resolution transmission electron microscopy(HRTEM), field emission scanning electron microscopy(FESEM), and Brunauer-Emmett-Teller(BET) surface area analysis, will be done to check the structural, morphological, optical, and surface characteristics of the synthesized NPs. The photocatalytic activity of ZnO NPs will be calculated for the degradation of the organic pollutants in wastewater under UV light, which shows their potential for the environmental cleanness. By combining the green chemistry principle with nanotechnology, this study aims to contribute to the development of cost-effective and sustainable solution for water purification, and reducing the environmental footprint associated with conventional nanoparticles synthesis.

Keywords: Green synthesis, zinc oxide nanoparticles, *Aglaonema* extract, photocatalysis, sustainable nanotechnology

[183] **Magnetically Separable and Recyclable Ionic Liquid-Modified Nanospheres for Green and Efficient Catalysis**

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Abstract: This study reports the synthesis of magnetic core-shell silica nanospheres functionalized with a di-cationic ionic liquid (Fe_3O_4@SiO_2@D-IL), providing a high surface area and multiple active sites for facilitating organic reactions. The nanocatalyst is magnetically separable, allowing for easy recovery and reuse. Various analytical techniques, including FT-IR, P-XRD, FE-SEM, TGA, VSM, BET, and TEM, confirmed its structural and thermal stability as well as its magnetic properties. Its catalytic performance was evaluated in the one pot synthesis of tetrahydroquinoline derivatives, employing different aliphatic and aromatic aldehydes with active methylene compounds and cyclic diones. The catalyst demonstrated outstanding efficiency, delivering high product yields with minimal catalyst usage, even at room temperature. Furthermore, it was successfully recycled multiple times without significant loss of activity, confirming its durability. The cost-effective preparation, atom-economic process, and use of environmentally friendly solvents without waste production make this catalyst a promising green alternative for organic synthesis.

Keywords: Active methylene compound, ionic liquid, magnetic, nanospheres, one pot synthesis, recyclable, tetrahydroquinoline.

[184] Experimental and Theoretical Investigation of Copper Zinc Tin Sulphide (Cu2ZnSnS4) Nanoparticles: A potential thermoelectric material

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Abstract: Copper Zinc Tin Sulfide (CZTS) nanoparticles (NPs) has emerged as a promising material for thermoelectric applications due to its earth-abundant composition, non-toxicity, and favorable electronic properties. In this study, CZTS was synthesized and systematically characterized to investigate its structural, optical, and electronic properties. X-ray diffraction (XRD) analysis confirmed the formation of a kesterite phase with characteristic diffraction peaks corresponding to the (112), (200), (220), (312), (224), (314), (008), and (332) planes, with an estimated crystallite size of 15 nm. Optical studies using UV-Vis spectroscopy revealed a direct band gap of 1.63 eV, suitable for thermoelectric performance. Morphological and compositional analysis was carried out using Field Emission Scanning Electron Microscopy (FESEM) and Energy Dispersive X-ray Analysis (EDAX), confirming uniform elemental distribution without impurities. X-ray Photoelectron Spectroscopy (XPS) further validated the oxidation states of Cu^{+}, Zn^{2+}, Sn^{4+}, and S^{2-}, ensuring phase purity. Transmission Electron Microscopy (TEM) analysis showed particle sizes ranging from 15-20 nm, with a well-defined selected area electron diffraction (SAED) pattern, indicating crystallinity. To complement the experimental findings, Density Functional Theory (DFT) calculations were performed, revealing an electronic band structure with a calculated band gap of 1.5 eV. Total Density of States (TDOS) analysis provided insight into the electronic structure, highlighting the contributions of different atomic orbitals. The comprehensive experimental and theoretical analysis demonstrates the potential of CZTS for thermoelectric applications. CZTS NPs thermoelectric properties measurement work is in progress.

Keywords: Copper Zinc Tin Sulfide (CZTS), kesterite, optical, thermoelectric, XPS, Density Functional Theory (DFT)

[185] Sustainable Photosynthesis of TiO_2 Nanoparticles Using *Justicia adhatoda* Extract for Enhanced Photocatalytic Performance

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Abstract: The eco-friendly synthesis of titanium dioxide TiO_2 NPs using *Justicia adhatoda* leaf extract presents a sustainable alternative to conventional chemical methods, eliminating the need for hazardous substances. In this study, *Justicia adhatoda* extract functioned as a natural reducing and stabilizing agent for TiO_2 NP synthesis. Characterization through X-ray diffraction

confirmed a crystallite size of approximately 5.5 nm. Transmission electron microscopy revealed a spherical morphology, while UV-Vis spectroscopy, Fourier transform infrared spectroscopy, and scanning electron microscopy (provided further insights into the structural, optical, and morphological attributes of the nanoparticles. The FTIR analysis of the *Justicia adhatoda* extract exhibited distinct absorption peaks at specific wavenumbers, signifying the presence of biomolecules that contribute to nanoparticle reduction and stabilization. The synthesized TiO_2 NPs demonstrated a bandgap energy of 3.7 eV, indicating their suitability for photocatalytic applications. With remarkable photocatalytic efficiency, these green-synthesized TiO_2 NPs hold significant promise for environmental remediation, biomedical applications, and energy storage. This study highlights a cost-effective, non-toxic, and sustainable approach to TiO_2 nanoparticle synthesis while examining the contribution of *Justicia adhatoda*-derived biomolecules in their formation and stabilization.

Keywords Biomolecule-assisted stabilization process. Green Synthesis. Justicia adhatoda extract. Ecological restoration. Fabrication of TiO_2 nanoparticles. Photocatalytic utilization

[186] The Systematic Study of Magnetic Properties and Microwave Absorption Properties in X-Band due to the Substitution of Rare Earth Elements in Ba Z-Type Hexaferrite

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Abstract: The rare earth elements (REE's) are known for their high magnetic moments and strong interaction with the material's magnetic sub-lattice. $Ba_3Co_2Fe_{24}O_{41}$ (BCFO) with rare earth doping can affect the magnetic properties of the material and the same is studied in this present work. The REE's substituted Barium Z- type Hexaferrite i.e. $Ba_{2.7}X_{0.3}Co_2Fe_{24}O_{41}$ (X=La, Pr, Nd, Ho, Dy) named as X-BCFO have been systematically synthesized by solid-state method at 1260°C sintering temperature. The structure has been investigated by XRD and the peak shifts due to the rare earth substitution have been observed which arise due to the change in ionic radii of substituted REE's. The M-H loop of the prepared sample at room temperature shows the variation in magnetic properties which establishes the interaction of REE's in BCFO. In addition, the variation in microwave properties in X-Band has been studied in detail.

Keywords:-Rare earth substitution (REE's), Barium Z-Type Hexaferrite (BCFO), Microwave absorption, Dielectric properties.

[187] Smart Sm_2O_3/COK-12 Nanostructures for Efficient Humidity Detection and Dye Degradation

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Abstract: This investigation explores the multifunctional applications of Sm_2O_3/COK-12 nanostructures, offering a novel approach to advanced nanomaterials for environmental

monitoring and remediation. Utilizing COK-12's high surface area (951 m^2g^{-1}) and porosity as an ideal host for samarium doping, the hydrothermally synthesized nanomaterial was thoroughly characterized. Humidity sensing assessments across 11–98% relative humidity reveal an impressive 4.9-fold resistance drop with rapid response (12 s) and recovery (9 s) times. Additionally, the nanostructures demonstrate enhanced photocatalytic efficiency, achieving 80% degradation of Rose Bengal dye under UV light, surpassing pristine silica's 52% adsorption. These findings highlight the versatility of Sm_2O_3/COK-12 for advanced sensing and sustainable photocatalysis.

Keywords: Nanostructures; doping; environmental monitoring; humidity sensing; photocatalysis.

[188] Engineering High-Surface-Area Mesoporous Materials for Enhanced Humidity Sensing

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Abstract: The development of highly sensitive and stable humidity sensors is crucial for applications in environmental monitoring, industrial automation, and healthcare. This study focuses on the synthesis and characterization of mesoporous materials for efficient humidity sensing. The well-defined porous architecture and high surface area of mesoporous structures enhance their adsorption capacity and structural stability, which are essential for reliable humidity detection. The synthesized mesoporous sensors exhibit excellent response and recovery characteristics across a broad range of relative humidity (RH) levels, with improved sensitivity and repeatability compared to conventional materials. The presence of tunable surface functional groups and a high density of active sites facilitates rapid water molecule adsorption and desorption. Electrical resistance measurements confirm the superior humidity sensing performance, demonstrating significant resistance changes in response to varying humidity conditions. Additionally, the sensor exhibits long-term stability and minimal hysteresis, making it a promising candidate for practical humidity sensing applications.

Keywords: Mesoporous materials, Humidity sensor, Surface adsorption, Electrical impedance, Environmental monitoring, High surface area

[189] Quantum Confinement Effects in Silver Quantum Dots: A Theoretical Study Using Energy Spectrum, Wavefunctions, and Dipole Matrix Elements

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Abstract: Because of the distinct quantum confinement effects, which affect the electrical and optical characteristics, silver quantum dots (Ag QDs) are of great interest. To provide light on the underlying quantum behaviour of confined electrons in Ag QDs, this theoretical investigation examines their energy spectrum, wavefunctions, and dipole matrix components. We analyse the influence of confinement on the energy eigenvalues and eigenfunctions by solving the time-independent Schrödinger equation using the effective mass approximation using numerical method (Finite Difference Method).By discretizing continuous domains, the Finite Difference Method (FDM) is a numerical technique for approximating solutions to differential equations. It makes it possible to solve difficult physics and engineering equations like heat conduction, fluid dynamics, and quantum mechanics by substituting finite difference equations for derivatives to simple algebraic equations. FDM's simplicity, effectiveness, and suitability for a range of boundary conditions makes it a popular technique. To investigate their spatial probability distributions and provide insight into how confinement affects charge localization, the wavefunctions of confined charge carrier is generated. The dipole matrix elements that control optical transitions and electrical interactions inside the quantum dots are determined in a significant way by these wavefunctions. To comprehend how these matrix elements vary with quantum dot size, we carefully analyse them. The modulation of quantum states by confinement strength is shown by theoretical predictions, which offer insights into adjustable optoelectronic applications of Ag QDs. This work paves up the possibilities for future experimental validation and technological applications by offering a thorough theoretical framework for appreciating the confined electronic states in Ag QDs.

Keywords: Quantum Dot, Schrödinger equation, Finite Difference Method, Confinement

[190] **Synthesis and Optical Characterization of Silver Quantum Dots for Nanophotonic Applications**

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Abstract: Silver quantum dots (Ag QDs) have attracted significant attention due to their unique optical properties, which stem from quantum confinement effects and localized surface plasmon resonance (LSPR). These nanostructures are intriguing candidates for use in optoelectronics, biosensing, and photonics because of their increased photostability, strong nonlinear optical responses, and controllable fluorescence. Ag QDs are synthesized in this work utilizing both chemical and green synthesis techniques, and their optical characteristics are then thoroughly examined. To produce monodisperse and stable Ag QDs, a number of synthesis methods have been investigated, including chemical reduction, sol-gel procedures, microwave-assisted synthesis, and green synthesis employing biological agents. Controlling the size, shape, and surface chemistry of the quantum dots is largely dependent on the selection of precursors, capping agents, and synthesis conditions. Surface passivation and ligand exchange are examples of post-synthesis changes that improve their stability and fluorescence efficiency. Time-resolved fluorescence measurements, photoluminescence (PL) spectroscopy, and UV-Vis

absorption spectroscopy were used to investigate the optical characteristics of Ag QDs. Because of the quantum confinement effect, the quantum dots show size-dependent optical absorption, with the absorption peak shifting to the blue as the particle size reduces. Ag QDs are distinguished from other semiconductor nanocrystals by their significant absorption in the visible spectrum, which is also a result of the LSPR phenomenon. According to photoluminescence research, the synthesis conditions, surface changes, and embedding media can all be changed to customize the emission properties. Strong third-order optical nonlinearity is confirmed by nonlinear optical (NLO) experiments including Z-scan and pump-probe spectroscopy, which qualifies Ag QDs for photonic applications like optical limiting and ultrafast switching.

This study highlights the potential of silver quantum dots for new nanophotonic technologies by offering insightful information about their manufacture and optical characterization. High-performance Ag QD-based devices for sensing, imaging, and optical communication applications will be made possible by additional developments in synthesis methods, doping schemes, and hybrid nanostructure manufacturing.

Keywords: Silver quantum dots; UV-Vis spectroscopy; quantum confinement; photonic applications.

[191] Modified Co-doping based $BaSrTiO_3(Ba_{0\cdot9}Sr_{0.08}Ti_{1-x}Co_xO_3)$ ferroelectric ceramic for Optical and energy storage device applications

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Abstract: In this investigation, we report the room temperature synthesis of Cobalt (Co) doped Barium Strontium Titanate (BST) ceramics through Solid-State Reaction Technique. The effect of substitution of cobalt on synthesized ceramic and its morphological, structural and optical properties have been explored using scanning electron microscopy (SEM), X-ray diffraction (XRD), Photoluminescence (PL), FTIR, Vibrating Sample Magnetometer (VSM), Raman Spectroscopy. XRD pattern indicates the change of phase structure from cubic to tetragonal and estimated crystallite size from Scherer equation around 26nm-40nm, which exhibits the crystallite size increases and micro-strain, dislocation density decreases with increasing Co doping concentration from x=0.00 to x=0.25. FT-IR results showed the absorption peaks at wavenumber 470cm^{-1} (bare $BaSrTiO_3$) was shifted to 1250cm^{-1} with doping concentration of Co. Raman characterisation results indicate that the number of modes decreases with the increase in the Co concentration. The photoluminescence spectra (PL) reveals the optical emissions band located at 602nm to 659nm were attributed to charge transfer through intrinsic defects within the oxygen octahedron. The VSM results show the maximum corrosivity of 162.85Oe.These results elucidate the significant contribution in energy storage devices and in optoelectronics applications.

Keywords: Barium strontium titanate, Vibrating Sample Magnetometer, Magnetic properties, Optoelectronic.

[192] Enhanced thermoelectric performance of chalcogenide SnSe by Carbon Fiber Inclusion

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Abstract: We report enhancement in thermoelectric properties of SnSe by composite formation with carbon fiber (CF). SnSe + x wt.% C.F. (x=0, 0.2, 0.4, 0.6) composites have been prepared by spark plasma sintering process. It is concluded that addition of carbon fiber improves the maximum power factor from 444 μW/mK^2 at 773K for pure SnSe to ~ 614 μW/mK^2 at 773K for SnSe + 0.6% CF. In addition, carbon fiber inclusion also contributes towards low thermal conductivity due to phonon scattering mechanism at grain boundaries. A maximum zT value of ~ 1.1 is achieved for SnSe + 0.2% CF at 773K. Our findings provide a probable approach to improve thermoelectric performance of SnSe.

[193] Evaluation of different machine learning models' response toward graphene structure diversification: An RDKit based Topological Study

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Abstract: Machine learning has brought a revolution in every aspect of our daily life. In chemistry, there is growing needs to evaluate the capacity of machine learning models to solve simpler tasks of chemistry. The simple and uniform arrangement of atoms in graphene provides a robust study material to evaluate performance of machine learning. Graphene is largely characterized from arrangement of carbon in benzene-like hexagonal lattice structure. In recent years, many mathematical tools, such as topological indices, have been used to study simple benzenoid structures. However, the application of these tools was limited to heptacyclic aromatic compounds, such as coronene. Further, these compounds were uniform in chemical composition, so the model did not include any heteroatoms. With RDKit supported topological descriptor and molecular fingerprinting, it is possible to analyses larger graphene structures and obtain more insight into different structural features. However, the data generated from these tools are in the form of numerical values that is difficult to understand from the perspective of a person with ordinary chemistry knowledge. This challenge can be resolved through application of machine learning models and visualize the outcome in suitable charts. Therefore, using simple chemical structure editing software present study construct simple graphene structure. The structure then diversified through introduction of holes, doping and fragmentation. The topological descriptors and molecular fingerprints obtained from these structures were subjected different machine learning models which included conventional unsupervised models to advanced neural networks.

The outcome of the machine learning models are mapped to correlate the changes in graphene structure during diversification.

Keywords: Graphene, Polycyclic fragments, Topological Descriptor, Molecular Fingerprinting, Machine learning, Visualization

[194] Spectroscopic and photoluminescence studies of Eu^{3+} ions doped Strontium Calcium Tungstate phosphor for intense red photonic device applications in W-LEDs.

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ABSTRACT: Strontium Calcium Tungstate (SCW) phosphor doped with Eu^{3+} ions by varying concentrations has been synthesized using conventional solid-state reaction technique. X-ray Diffraction (XRD) studies have carried out the crystal structure and phase analysis of the as-prepared phosphor as diffraction peaks align with the standard JCPDS pattern. DRS spectra were used to calculate the optical bandgap for all the prepared samples. Under 465 nm excitation, the as-prepared phosphor exhibits intense visible red emission at 614 nm. It has been observed that 4.0 mol% of Eu^{3+} ions concentration is optimum for producing intense visible red emission. The CIE coordinates were also evaluated. The result shows that Eu^{3+} ions doped strontium calcium tungstate phosphor can be suitable for red emission in solid state lightning and display devices.

Keywords: Photoluminescence; Tungstate; W-LEDs, rare earth elements, Phosphors .

[195] "TiO2-based Photocatalysts for Environmental Sustainability: Semiconductor Properties and Applications"

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ABSTRACT: Nano-enhanced photocatalysts have attracted considerable interest due to their potential applications in environmental remediation, particularly in the breakdown of organic pollutants when exposed to UV or visible light. Among the most extensively researched materials are nanostructured semiconductors, particularly titanium dioxide (TiO_2)-based catalysts, which exhibit remarkable photocatalytic properties. Upon exposure to light, these catalysts produce electron-hole pairs that engage with adsorbed pollutants, facilitating their oxidation or reduction and converting them into less harmful substances. This method proves to be highly effective for treating pollutants in wastewater, air and soil, providing photocatalysis a promising approach for environmental cleanup. The superior efficiency of nano-photocatalysts can be attributed to their distinctive characteristics, including high surface areas, enhanced

charge carrier separation and improved light absorption, which surpass those of conventional bulk materials. These attributes contribute to accelerated reaction rates and greater pollutant degradation. In the field of TiO_2-based catalysts, numerous modifications have been explored, including the doping of metal or non-metal elements and the creation of composites with other nanomaterials. These approaches aim to improve the photocatalyst performance under visible light while also enhancing its stability and reusability. Despite the encouraging findings, several challenges persist in optimizing these catalysts for practical applications. Issues such as catalyst deactivation over time, the requirement for prolonged UV light exposure, and the relatively low efficiency of certain photocatalysts under visible light remain subjects of ongoing research. Additionally, developing cost-effective and scalable production methods for these advanced materials. This paper examines the mechanisms underlying nano-photocatalysts, highlights advancements in TiO_2-based systems, other innovative catalysts and discusses their environmental applications alongside the challenges encountered in scaling these technologies for practical use.

Keywords: Photocatalysts, Titanium dioxide (TiO_2), Nanostructured semiconductors, Nanomaterials, Environmental Sustainability.

[196] **Optical, electronic, morphological and DFT studies of Au/g-C_3N_4 Nanocomposite**

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Abstract: Graphitic carbon nitride (g-C_3N_4) in which an effective approach for enhancing optical property is decorating or deposing or embedding or composite with nobel metal nanoparticles (NPs) on surface of g-C_3N_4 semiconductor. Due to that it enhances electron hole pair separation and avoids fast recombination of the generated electron-hole pairs at the interface. In present our work, Au/g-C_3N_4 nanocomposite was prepared by a chemical reduction route. The as synthesized nanocomposite was systematically characterized by XRD reveals the crystal planes are well matched with Au NPs and g-C_3N_4 confirmed the formation of nanocomposites. Uv-Vis (UV-Vis) spectroscopy show the bandgap of g-C_3N_4 is 2.7 eV and nanocomposite case it drastically reduced to 2.21eV which is attributed to the characteristic feature of surface plasmon resonance (SPR) absorption peak of Au nanoparticles (NPs). The SPR generated by Au NPs can cause the strong local field enhancement around Au NPs, which significantly accelerating the separation rate of photogenerated electrons and holes pairs. Fourier transform infrared spectroscopy (FT-IR) exhibits the absorption at 810–880 cm^{-1} is characteristic of the out-of-plane bending modes of CN heterocycles of triazine units of g-C_3N_4 and the Au-O vibration band was generally observed at 818 cm^{-1}. The HRTEM results showed Ag shows the spherical shape NPs were deposited randomly over g-C_3N_4 nanosheet having an average size of 10-15 nm. Density functional theory (DFT) attributes that electronic band structure g-C_3N_4 indirect bandgap nature with value 2.81 eV which is good agreement with experimental results. The partial density of states PDOS graph provides detailed information about the contribution of atomic orbitals to the electronic states of C, N and Au.

Keywords: Au/g-C_3N_4, SPR, Optical, nanocomposites, Density functional theory

[197] **Application of Nanomaterials and their impact on Environment**

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ABSTRACT: Today, nanotechnology has become the top research topic for scientists and researchers as these have unique physical and chemical properties. The present review covers classifications and different applications of nanomaterials including catalysis, water treatment, sensors, energy storage, as well as their positive and negative impact on environment. Nanoparticles are ultra small particles with exceptional properties, but some nanomaterials also exhibit harmful properties. Nanomaterials will not only have toxic effect on microorganisms, but will also improve the microbial activity of specific waste and toxic material which will reduce the overall cost. This is the reason why we must continue to study them and their potentially damaging effects.

Keywords: Nanoparticles, Environment, Nanomaterials, Catalysis, Water treatment.

[198] Artificial intelligence: A journey into future

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ABSTRACT: Artificial intelligence (AI) is revolutionizing various industries by unlocking unprecedented power and potential . With its ability to analyse vast amounts of data. AI enables us to make more informed decisions and automate complex tasks. From healthcare to transportation, AI is transforming the way we live and work. In healthcare, AI is enhancing diagnostic and treatment plans, leading to more accurate and personalized recommendations. Moreover, AI is revolutionizing the field of finance, enabling better fraud detection, risk assessment and investment strategies. In education, AI is facilitating personalized learning experiences, adapting to individual needs and improving educational outcomes. This abstract explores the current land scape of AI, highlightning key advancements, challenges and future directions. It begins by providing an overview of AI techniques including machine learning, natural language processing, computer vision and their applications in solving complex problems and enhancing decision-making processes.

Keywords– Artificial intelligence, fraud detection, risk assessment, education.

[199] **Numerous environmental uses of TiO_2 photocatalysis.**

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ABSTRACT: Photocatalysts are substances that accelerate chemical reactions upon exposure to light, typically ultraviolet (UV) or visible light. They function by absorbing photons, generating electron–hole pairs, and facilitating reactions without being consumed in the process. This property makes them valuable in various applications, including environmental remediation, energy production, and organic synthesis. Photocatalysts are employed to degrade pollutants in air and water. For instance, titanium dioxide (TiO_2) is widely used to break down organic contaminants under UV light. Recent studies have explored enhancing TiO_2's photocatalytic performance through modifications like air-plasma treatment, which reduces crystallite size and creates oxygen vacancies, leading to improved degradation of substances. Compared to the typical chemical treatments, Advanced Oxidation Technology (AOT) is a method that uses a range of technologies to the increase oxidation power. In order to further improve the immigration of photo-induced charge carriers during excitation state, considerable effort has to be exerted to further improve the heterogeneous photocatalysis under UV/visible/solar illumination.

Keywords- Photocatalysts, , Advanced Oxidation Technology (AOT), Titanium dioxide (TiO_2), Air-plasma treatment

[200] **Sustainable synthesis of TiO_2 nanoparticles from Pinus patula**

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Abstract: This study investigates the green synthesis of TiO_2 nanoparticles using extracts from *Pinus patula* leaves, an unreported plant source, highlighting an environmentally sustainable approach to nanomaterial production. X-ray diffraction (XRD) analysis confirmed the formation of anatase-phase TiO_2 nanoparticles, with prominent diffraction peaks observed at Bragg's angles of 25.32°, 37.88°, and 47.94°, corresponding to the (101), (112), and (200) lattice planes. The crystallite size was determined to be 2.27 nm using Debye-Scherrer's equation. UV-Vis spectroscopy analysis revealed a band gap of 3.82 eV, indicative of strong optical properties, making the synthesized nanoparticles suitable for various photocatalytic applications. Fourier Transform Infrared Spectroscopy (FTIR) confirmed the presence of Ti–O–Ti vibrations, along with hydroxyl (–OH) and aromatic (C=C) stretching bands, suggesting effective interaction between bioactive molecules and the TiO_2 surface, contributing to nanoparticle stabilization and enhanced surface functionality. The use of *Pinus patula* as a novel plant source not only promotes green chemistry but also enhances the accessibility of sustainable nanomaterials for advanced applications. This study underscores the potential of plant-mediated synthesis in developing eco-friendly and cost-effective nanotechnology solutions.

Keywords: Green synthesis, *Pinus patula*, TiO_2 nanoparticles, XRD, UV-Vis, FTIR.

[201] **Zinc Stannate (Zn_2SnO_4): Synthesis, Characterization and DFT Studies**

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Abstract: A comprehensive investigation of hydrothermally synthesized Zinc Stannate (Zn_2SnO_4) nanomaterials, combining experimental characterization and theoretical analysis through density functional theory (DFT). The structural, morphological, optical, and electronic properties of Zn_2SnO_4 were analyzed using advanced characterization techniques, including X-ray diffraction (XRD), UV-Visible spectroscopy, Raman spectroscopy, field emission scanning electron microscopy (FESEM), and X-ray photoelectron spectroscopy (XPS). XRD confirmed the formation of a cubic spinel structure with high crystallinity and phase purity. FESEM and elemental mapping revealed uniform nanostructured particles with well-distributed Zn, Sn, and O atoms, while XPS provided insights into the chemical states and stoichiometry of the material. Optical characterization using UV-Visible DRS demonstrated an enhancing energy band gap due to quantum size effect. Theoretical insights from Density Functional Theory (DFT) calculations strongly validate the experimental results, particularly in determining the electronic properties of Zn_2SnO_4. The calculated direct bandgap of 2.91 eV aligns well with experimental observations, confirming the material's semiconducting nature and its suitability for optoelectronic applications. The Total Density of States (TDOS) and Projected Density of States (PDOS) analysis further elucidates the contributions of Zn, Sn, and O orbitals in shaping the electronic structure, providing deeper insight into the charge carrier dynamics. The band alignment analysis highlights the material's potential in photocatalysis, energy storage, and sensing applications.

Keywords: Zn_2SnO_4, Density Functional Theory (DFT), X-ray photoelectron spectroscopy (XPS), Hydrothermal, Density of States.

[202] A STUDY OF PHOSPHATE ION RELEASE KINETICS IN VITRO FROM SYNTHESIZED NANO-HYDROXYAPATITE.

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Abstract: Bioinspired synthetic hydroxyapatite nanoparticles, resembling the mineral structure of bone and teeth, are gaining attention as sustainable materials for use in agriculture. These salts, characterized by their limited solubility, demonstrate self-regulating dissolution in under-saturated aqueous environments—a phenomenon that remains inadequately understood at the molecular and nano-scale levels. Investigating the mechanisms of particle dissolution is essential for improving the delivery efficiency of macronutrients to plants. In this study, the release kinetics of phosphorus from synthesized nanohydroxyapatite (nHAP) was investigated using a holistic methodology under static water conditions over a 21-day period. Nanohydroxyapatite was synthesized via a sol-gel method and characterized through Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), dynamic light scattering (DLS), and Ca/P molar ratio. Phosphate release was estimated in nHAP and conventional phosphorus fertiliser, super phosphate (SSP) in triplicates, with measurements recorded every 24 hours alongside pH monitoring of the solution. The anion release mechanism was further explored using theoretical models, including zero-order, first-order, Higuchi, and Korsmeyer-Peppas

kinetic models. The results indicated that the potential controlled release mechanism was predominantly governed by diffusion and dissolution processes, with a potential contribution from ion exchange. Notably, the highest phosphorus release percentages were observed on the 1st and 11th days of nanoparticle immersion in the liquid medium. These findings enhance our understanding of the dissolution behaviour of nanohydroxyapatite and provide insights into its potential as a controlled-release phosphorus nano fertilizer for sustainable agricultural practices.

Keywords: Sustainable agriculture, release kinetics, kinetic models, nano-fertiliser, nano-hydroxyapatite

[203] **Evaluation of antibacterial properties of 2D Graphitic Carbon Nitride ($g\text{-}C_3N_4$): An experimental and DFT studies**

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Abstract: Microbial contamination is very harmful to human health in many ways. Different types of bacteria can give a serious illness or even death of humans. The graphitic carbon nitride ($g\text{-}C_3N_4$) is a novel metal-free polymeric material with energy band gap energy of 2.7 eV. It is non-toxic, high photo as well as chemical stability, a wide light adsorption spectrum of sunlight, minimal recombination of photogenerated charge carriers, and ease preparation method. Herein, we report synthesis, density functional theory study (DFT) study and antibacterial activity of $g\text{-}C_3N_4$. As synthesized materials are characterized for various techniques such as XRD reveals graphitic structure of $g\text{-}C_3N_4$, with the (100) peak reflecting in-plane structural packing and the (002) peak indicating interlayer stacking of the graphitic sheets. UV-Vis spectra shows the absorption at 455 nm with corresponding energy bandgap 2.72 eV. Raman Spectra interpret the existence of 2D, G and 3S bands confirm the formation of $g\text{-}C_3N_4$. FTIR spectra shows that C=N and C−N stretching vibration of CN heterocycles as well as the sharp breathing mode of triazine units. FESEM, EDAX and elemental analysis confirm the morphology and elemental composition of C and N. Theoretical study done by first principal calculations with density functional theory (DFT) attribute that electronic band structure indirect bandgap nature with value 2.93 eV which is good agreement with experimental value. The partial density of states PDOS graph provides detailed information about the contribution of atomic orbitals to the electronic states. The $g\text{-}C_3N_4$ are used for antibacterial application against *E. coli*, *S. aureus*, and *Pseudomonas* using the microdilution method. The resazurin microdilution assay is a rapid and sensitive method to assess the antimicrobial activity of compounds against microorganisms which shows $g\text{-}C_3N_4$ effective material for biomedical applications.

Keywords: Graphitic carbon nitride ($g\text{-}C_3N_4$), Photocatalysis, X-ray Photoelectron Spectroscopy (XPS), Density Functional Theory (DFT), Electronic structure, Density of States (DOS)

[204] STUDIES ON RADON LEVEL IN WATER SAMPLES OF BIDAR DISTRICT, SOUTH INDIA

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Abstract: Radon activity measurements in water samples from several parts of Bidar district, south India. Radon in drinking water can lead to internal exposure, increasing the risk of stomach cancer. However, this risk is generally considered lower compared to the risk of lung cancer from radon inhalation. The radon level in water is measured using the emanometry technique. The radon concentrations range from 1.49 to 14.2 Bq/l, with an average value of 7.67 Bq/l. All the radon levels fall under the reference range of 100 Bql -1 suggested by the WHO and EU Commission. The total effective dose of radon concentration in our study area ranges from 4.89 μSv/y to 29.67 μSv/y with an average value of 10.341 μSv/y. The action level of 100 μSv/y suggested by the WHO and EU Commission is lower than the yearly average ingestion dosage levels. Overall, most of the results aligned with the US-EPA's worldwide guidelines. However, there were a few instances where the limits were exceeded, and constant monitoring is recommended. This study establishes a baseline for radon concentration in the area and provides a basis for future studies.

Keywords: Radon, Emanometry, Total effective dose, Ingestion, and Inhalation

[205] Studies on distribution of polonium (210 Po) and lead (210 Pb) activity in undisturbed sandy clay soil in Belagavi region, Karnataka, India

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Abstract: In this study, activity concentrations of 210 Po and 210 Pb in undisturbed sandy clay soil in the Belagavi region of Karnataka, India were determined. Radiochemical methods and a

scintillation-based alpha counting system were used to measure the radionuclides 210 Po and 210 Pb. The average of 210 Po activity in soil samples ranges from 1.3 to 8.4 Bq kg -1 , with an average of 3.9 Bq kg -1 . In soil samples, the 210 Pb activity ranges from 4.5 to 24.6 Bq kg -1 , with an average value of 11.3 Bq kg -1 . 210 Po and 210 Pb activity ratio range from 0.2 to 0.5 Bq kg -1, with an average value of 0.4 Bq kg -1. A positive significant correlation is observed between the radionuclides of 210 Po, and 210 Pb activity with organic matter content and clay minerals of soil. The activity of 210 Po and 210 Pb was observed in the dissolved phase due to the removal of these reactive radionuclide particles from the solution. The frequency distribution curves for 210 Po and 210 Pb were studied using SPSS software. The 210 Po and 210 Pb activity concentrations are substantially within the WHO' s recommended limits.

Keywords: Polonium, Lead, 210 Po/ 210 Pb ratio, Physico chemical parameter, Correlation.

[206] **Polyherbal genesis of Silver Nanoparticles from fruits of Amalaki, Bibhitaki, and Haritaki and Their Antibacterial Activity**

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Abstract: Nanotechnology has revolutionized multiple scientific domains, particularly in medicine, environmental sustainability, and materials science. Green synthesis of nanoparticles using plant-based extracts offers an eco-friendly alternative to conventional chemical methods, reducing toxicity while enhancing biocompatibility. This study explores the biogenic synthesis of silver nanoparticles (AgNPs) using Triphala, a traditional Ayurvedic herbal blend consisting of Terminalia chebula (Haritaki), Terminalia bellerica (Bibhitaki), and Emblica officinalis (Amla). The polyphenol-rich phytochemicals in these plants serve as natural reducing and stabilizing agents, facilitating the formation of biofunctional AgNPs. The synthesized nanoparticles were characterized using UV-Vis spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM), and X-ray Diffraction (XRD) to confirm their structural integrity, stability, and morphology. The antimicrobial efficacy of the AgNPs was evaluated against Gram-positive (Staphylococcus aureus) and Gram-negative (Escherichia coli) bacteria using the agar well diffusion method. Results demonstrated significant antibacterial activity, with the Triphala-derived AgNPs outperforming conventional antibiotics in inhibiting bacterial growth. This research underscores the potential of herbal-mediated nanomaterials in combating antimicrobial resistance while promoting green chemistry approaches. The findings highlight the promising biomedical applications of Triphala-synthesized AgNPs, particularly in wound healing, antimicrobial coatings, and pharmaceutical formulations. The integration of traditional herbal wisdom with modern nanotechnology presents a sustainable pathway toward innovative therapeutic solutions.

Keywords: Nanotechnology, Silver Nanoparticles, Triphala, Green Synthesis, Antibacterial Activity, Phytochemicals, Biomedical Applications.

[207] Synthesis of ZnO nanoparticles, its characterization and calculating properties using WIEN2K software

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Abstract: ZnO nanoparticles have a great importance in multiple fields as they have great physical and chemical properties and we can utilize these properties in other fields also. ZnO-NPs have attractive antibacterial properties due to increased surface areas, as the reduction in the particle size leads to increased particle surface reactivity.[1] Zno is a material which has a broader energy gap (3.370 eV) which is suitable for semiconductors, UV lasers, solar cells, etc. It can also be used for UV resistant coating, electrochemical nano-devices, photo-printing, anti-bacterial agents, etc[2]. Hence it has a wide range of applications and needs to be studied more so that it can be used in multiple applications. In this study the synthesis of ZnO nanoparticles is carried out using Zinc Nitrate Hexahydrate by sol-gel method followed by stirring and centrifugation and calcination.[3]. This sample is then tested for FTIR where the obtained result does not match the ideal ZnO FTIR graph. Hence the method we followed needs to be verified and further studied to rectify the defects and also perform the further characterization. The ZnO structure is also studied in WIEN2K software which uses Density functional theory (DFT) to analyze the material. Using the structure of ZnO, properties like Band structure, Density of states, Electron densities, optical properties (like absorption coefficient, optical conductivity, electron energy loss, dielectric tensor, extinction coefficient, optical reflectivity and refractive index), etc. to verify the plots obtained from WIEN2K.

Keywords: *ZnO nanoparticles, sol-gel method, optical properties, characterization, WIEN2k software*

[208] Electrochemical Corrosion Inhibition Studies of Brass in Marine Environments Using Eco-Friendly Inhibitors

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Abstract: A major industrial and ecological difficulty associated with corrosion in marine environments is the aggressive conditions found in seawater, including high salinity, dissolved oxygen, temperature fluctuations, and biofouling. The projected yearly cost of corrosion-related damages worldwide is about $2.5 trillion, with marine sectors making a significant contribution. Corrosion alone accounts for more than 30% of maintenance expenses in the maritime sector .This study aims to assess effectiveness of sustainable and eco-friendly inhibitors in reducing corrosion of brass in seawater conditions. The main objective is to identify inhibitors that offer strong corrosion resistance while adhering to environmentally friendly practices. Electrochemical tests will be performed on brass specimens in a synthetic marine environment using a three-

electrode setup. Corrosion rates will be examined with and without the presence of eco-friendly inhibitors. Techniques such as potentiodynamic polarization and electrochemical impedance spectroscopy (EIS) will be used to evaluate inhibitor performance. Initial findings indicate that plant-based inhibitors form a protective barrier on the brass surface, effectively reducing corrosion rates. These inhibitors provide a sustainable alternative to conventional corrosion control methods. The results suggest that biodegradable, plant-derived inhibitors are promising solutions for mitigating brass corrosion in marine environments. These inhibitors not only enhance corrosion resistance but also support environmental sustainability by avoiding the use of harmful chemicals, making them suitable for broader application in marine industries.

Keywords: Corrosion, Marine Environments, Eco-Friendly Inhibitors, Sustainable Materials

[209] **CuO nanoparticles mediated by coffee powder extract an impeder of *biofilm*: An experimental and DFT studies**

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Abstract: Green synthesis method is novel, facile, eco-friendly, nontoxic compared to conventional physical and chemical methods. The plant extract contains various phytoconstituents which act as a both reducing and stabilizing agent. Herein, we present the green synthesis of CuO NPs using coffee powder extract. The synthesized CuO NPs are characterized using different techniques like X-ray Diffraction (XRD) reveals crystal structure of monoclinic and the average crystalline size is found to be 15 nm. UV-Vis spectroscopy shows absorption in the range between 265 to 285 nm which confirms the formation of CuO NPs. Fourier Transform Infrared Spectrometry (FTIR) shows a strong band at 422 cm^{-1} which can be attributed to vibration of CuO. FESEM reveals that all the particles are uniformly distribution of particles with spherical morphology and elemental mapping was taken which reveals the presence of Cu and O. Raman Spectrum shows very sharp and good Raman peaks at 282, 330 and 616 cm^{-1} which assigned to Ag and modes. Theoretical study done by using first principle calculations with DFT approach LDA +U about the electronic and optical properties which shows that certain transitions within the band structures are dipole forbidden, whereas the fundamental band gaps obtained with value of 2.74 eV indirect nature which is good agreement with experimental value. The synthesized CuO NPs are explored for inhibition of biofilm of *candida albicans* fungus. Our results shows that about 65 % reduction of biofilm which reveals that CuO is effective material for biomedical applications.

Keywords – CuO (copper oxide), DFT, Green synthesis, candida albicans fungus

[210] **Oxidation Mechanism of Zn Thin Films: Understanding the Effect of Diffusion Kinetics, Thermodynamics, and Surface Energy Towards the Growth of ZnO Nanostructures**

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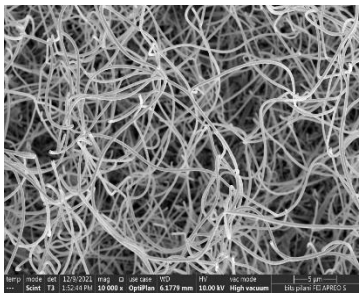
Abstract: Zinc oxide (ZnO) appears in a wurtzite crystal structure of hexagonal lattice, exhibiting properties that make it a preferred material for various scientific applications. It's an intrinsic n-type semiconductor, due to oxygen vacancies, having a direct bandgap in the UV range, ranging between 3-4 eV. At the nanoscale, ZnO manifests diverse surface morphologies and crystal orientations, maximizing its surface area relative to volume. These nanostructures possess high sensitivity to various gases and volatile organic compounds, owing to their unique surface redox chemistry. This versatility makes ZnO a natural choice for gas sensing applications. Researchers are particularly focused on studying the oxidation mechanism of ZnO to form a wide variety of nanostructures with preferred lattice orientations, which can be used in gas sensing applications to enhance device performance in terms of sensitivity. In this study, we demonstrate a precise technique for growing a wide variety of ZnO nanostructures with a special focus on the oxidation mechanisms explained in terms of diffusion kinetics, thermodynamics, and surface energy. High-purity zinc metal films are deposited on clean quartz substrates at room temperature using a vacuum-assisted thermal evaporation technique (pressure< 10^{-5} mbar). Highly dense and extremely long ZnO nanowires have been grown by following a simple thermal step-oxidation method in which various oxidation methods of as-deposited Zn thin films are performed in an air ambient condition. The crystal structure of as-grown ZnO nanowires has been determined by using XRD. The morphological analysis of as-grown ZnO nanowires was carried out by using field emission scanning electron microscopy. Raman spectroscopy and XPS have been used to get a precise analysis of the optical and chemical properties of the ZnO nanostructures. The initial oxidation of Zn thin films was observed at about 400ºC. However, the asymmetric growth (nanowires/rods) of ZnO is only observed after prolonged oxidation at 550ºC for 5 hours and lasts up to 800ºC due to higher thermal diffusion of O_2. The formation of poor crystalline nanostructures of ZnO due to the higher thermal diffusion results in the desorption of O_2, where nanoclusters start dominating over others at 1000ºC. The overall oxidation mechanism to grow these nanostructures of ZnO is well explained in terms of thermal diffusion, thermodynamics, and growth kinetics at higher temperatures and validated through formaldehyde sensing.

Keywords: ZnO nanostructures, Thermal oxidation, Oxidation mechanism, Formaldehyde sensing.

Figure:



[211] **Tuning the dielectric properties of liquid crystal by dispersing green synthesized ZnO nanoparticles**

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Abstract: In the current research work, integration of green synthesized ZnO nanoparticles dispersed nematic liquid crystals (NLCs) has been studied. Prepared green ZnO NPs were characterized by different methods such as UV-Visible spectroscopy, FTIR and XRD. 5CB (4-Cyano-4'-pentylbiphenyl) as NLCs used as host material. To prepare the composite of ZnO NPs in 5CB, 0.5% wt. green synthesised ZnO NPs were dispersed in 5 CB. Surface morphology of both pure 5CB & 0.5% wt. ZnO-NPs doped sample were observed by polarised optical microscope (POM) at different temperatures. Additionally, the nanoparticles influence the dielectric properties, resulting in an increased polarization response when an electric field is applied. This is leads to improved dielectric permittivity and lowering the dielectric loss, making the material promising for advanced applications in displays and optoelectronics. The interaction between the nanoparticles and liquid crystals offers opportunities for designing functional materials with optimized properties.

Keywords: Green synthesis, ZnO-nanoparticles, surface morphology, dielectric properties.

[212] **Rheology and Conformations of Nano-sized Dendrimers: Effect of Spacer Length**

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Abstract: We investigate the rheology and conformation of nano-sized dendrimers theoretically within the framework of the optimized Rouse−Zimm theory in dilute solutions with varying the spacer length. Here, the hydrodynamic interactions (HIs) between the monomer pairs are modeled through preaveraged Oseen tensor. The storage and loss moduli are calculated for different generations of dendrimers by changing the spacer lengths. Here we calculate the radius of gyration and static structure factor that provides the knowledge about compactness and open structure of dendrimers. We also calculate the intrinsic viscosity of dendrimers of different generations with varying the spacer length and observe the behavior of maxima in intrinsic viscosity. The conformation of the dendrimer is generally the result of rearrangement of spacer chains to reduce excluded volume interactions between the monomers of dendrimers.

[213] Ag/g-C_3N_4 nanocomposite for antibiofilm: An experimental and density functional theory (DFT) studies

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Abstract: *Candida albicans* is an important opportunistic human fungal pathogen capable of morphogenetic conversions between yeast and hyphal morphologies and biofilm formation, the major virulence attributes to establish infection in the host. In the present study of Ag/g-C_3N_4 nanocomposite was prepared by a chemical reduction route. The as synthesized nanocomposite with structural, optical, morphological studies was systematically carried out by using various techniques such as XRD, UV-Vis, FT-IR, PL, FESEM, HRTEM and EDAX. XRD reveals that the intensity of diffraction peaks become higher owing to Ag nanoparticles dispersed on g-C_3N_4 nanosheets with presence of crystal planes of FCC for Ag. The HRTEM results showed Ag shows the spherical shape NPs were deposited randomly over g-C_3N_4 nanosheet having an average size of 10-15 nm. The Ag NPs were deposited on the surface of g-C_3N_4 nanosheet to enhance visible-light absorption through the localized surface plasmon resonance (LSPR) effect, in which increases the absorption of visible light so that decreases recombination of free charges, quick separation and fast transportation of electrons–holes studied by PL. DFT calculations further elucidated the electronic properties of g-C_3N_4, indicating an indirect bandgap of 2.93 eV, consistent with experimental observations. The partial density of states (PDOS) analysis provided insights into the contributions of atomic orbitals to the electronic states. The as synthesized Ag/g-C_3N_4 nanocomposite are explored for inhibition the growth of *Candida albicans,* FESEM result shows that the more that 70% inhibition of biofilm. The novel functionalities of g-C_3N_4 based nanocomposites can be used for biomedical field which can be extended to other species of fungal pathogens.

Keywords: Candida albicans, Ag/g-C_3N_4, nanocomposite, Density Functional Theory, Biofilm

[214] **Synthesis, characterization and application of a flexible SERS-active film with trisiloxane-modified poly(methylmethacrylate)-gold nanoparticle hybrid assembly**

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Abstract: Homopolymers with well-defined end groups represent an important family of functional polymers with wide-ranging applications. The present study reports atom transfer radical polymerization (ATRP) approach to integrate discrete trisiloxane group in poly(methyl methacrylate) of varying molar mass. The polymer 1 with M_n/PDI as 9.1×10^3/1.3 provides a useful platform for the construction of a hybrid film comprising densely packed ensembles of individual AuNPs of 60 ± 15 nm in diameter with surface roughness of 1.31 nm at water-chloroform interface. The plasmonic film serves as a flexible surface enhanced Raman scattering (SERS) substrate for the detection of methylene blue (MB) and pyridine (Py) at a concentration as low as 10^{-7} M under 532 and 785 nm laser excitation, respectively. The Raman enhancement factor is on the order of $3 \pm 1.0 \times 10^3$ for MB and $2 \pm 0.5 \times 10^5$ for Py under repeated cycles.

Keywords Atom transfer radical polymerization, trisiloxane, poly(methyl methacrylate), gold nanoparticles, surface enhanced Raman scattering

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[215] **FABRICATION AND CHARACTERISATION OF STARCH- CROSSLINKED-GUM ACACIA FOR REMOVAL OF METHYLENE BLUE DYE.**

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Abstract: Adsorption-based colour removal from wastewater has received a lot of attention in water pollution treatment. This study involves the fabrication and preparation of biopolymeric network particles called hydrogels, which have the ability to swell and hold a significant amount of water. As an alternative to synthetic polymer-based hydrogels, natural or edible hydrogels, such as those made of proteins and polysaccharides, can swell to form three-dimensional structures with water. First, a non-toxic hydrogel composite made of starch that had been bonded with gum acacia was formed. Our super-adsorbent hydrogel's high swelling ratio and great water permeability enable massive visibility of the internal adsorbates to methylene blue dye (MB). Where adsorption batch experiments were used to evaluate how the cationic dye methylene blue was absorbed. This study demonstrates that calcium chloride alone can produce an SGA hydrogel with a well-cross-linked structure, and it also shows that the calcium chloride-based super-adsorbent hydrogel has a promising use in the elimination of organic dyes. XRD [X-ray diffraction], TGA [thermogravimetric analysis], FESEM [Field Emission Scanning Electron Microscopy], BET [Brunauer-Emmett-Teller], FTIR [fourier transform infrared], and XPS [X-ray photoelectron spectroscopy] investigations were used to further characterise the starch and gum acacia composites.

Keywords: Hydrogel, starch, gum acacia, antimicrobial, adsorption.

[216] **A red-emitting Eu^{3+}-doped calcium aluminozincate phosphor designed for use in w-LEDs**

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Abstract: A calcium aluminozincate phosphor doped with Eu^{3+} ions has been successfully synthesized using the conventional solid-state reaction method and thoroughly characterized to evaluate its structural, morphological, and photoluminescence (PL) properties. The characterization techniques employed include X-ray diffraction (XRD), scanning electron microscopy (SEM), diffuse reflectance spectroscopy (DRS), and spectrofluorophotometry. XRD analysis confirms that the synthesized phosphor exhibits a single-phase orthorhombic structure, as all observed peaks align well with the standard ICDD card data. Under near-UV excitation, the PL spectra reveal a prominent and intense red emission. The study identifies 2 mol% Eu^{3+} as the optimal doping concentration for achieving maximum red emission intensity in this host matrix. This finding aligns with the CIE chromaticity coordinates calculated from the PL data, which show values of x = 0.628 and y = 0.371 for the optimized sample. These coordinates are comparable to those of the commercial red phosphor $Y_2O_2S:Eu^{3+}$ (x = 0.622, y = 0.351) and closely match the standards set by the National Television System Committee (NTSC).

Keywords- XRD, PL, Monophase calcium aluminozincate, Solid state reaction, FT-IR.

[217] **A Review: Copper Oxide Nanoparticles for Optoelectronic Applications**

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Abstract: Metal oxide semiconductors exhibit diverse chemical, optical, and electronic properties at the nanoscale level. Among them, copper oxide (CuO) nanoparticles (NPs) have gained significant attention for optoelectronic applications due to their tunable band gap energy. This review explores the synthesis of CuO NPs using both chemical and biological methods, focusing on their photoluminescence (PL) behavior and electrical conductivity under varying excitation wavelengths and heat treatment conditions. The findings indicate that PL spectra are strongly influenced by nanoparticle size and shape, while electrical conductivity exhibits variation with increasing temperature. Based on these observations, CuO NPs demonstrate strong potential for applications in sensors and optoelectronic devices.

[218] *In silico* evaluation, antioxidant and antibacterial activities of Bio-functionalized ZnO-NPs synthesized from *Syzygium samarangense* ethanol extract against some selected Gram- negative and Gram-positive bacteria

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Abstract

Syntheses of zinc oxide nanoparticles using medicinal plants have been suggested to have antioxidant and antibacterial activities. ZnO-NPs were synthesized using $Zn(CH_3COO)_2.6H_2O$ as a precursor and ethanol leaf extract of *Syzygium samarangense*s. The GC-MS analysis, characterization of ZnO-NPs, antioxidant, and antibacterial activities and *in silico* study was determined using standard methods. The phytochemical analysis of the extract shows that it contains saponins, flavonoids, alkaloids, tannins, etc. The GC-MS analysis of the extract indicated the presence of 28 different compounds, with (Z)-3-(pentadec-8-en-1-yl) phenol being the most abundant. The EDX indicates that the ZnO-NPs contain zinc (36.09%) and oxygen (54.42%) while SEM shows an agglutinated quasi-spherical-like shape. UV–vis analysis has absorption peaks at 368 nm. The optical energy band gap of 3.371804 eV was obtained. The average crystallite size of the ZnO NPs was 43.4217 nm with a dislocation density of 0.000530379042610 $(nm)^{-2}$. FTIR spectrum revealed the presence of organic moieties serving as reducing and capping agents. The *S. samarangense*s extract and the ZnO-NPs had antioxidant scavenging activities. The extract exhibited strong antibacterial response against *Klebsiella pneumonia* and *Escherichia coli* while tetracycline solution exhibited potent response against *Klebsiella pneumonia*, *Salmonella typhi*, and *Staphylococcus aureus.* The nanoparticles exhibited a weak and moderate response. The MIC and MBC values of the extract against the bacteria strains ranged from 25 to 50, and 75 to 100 mg/mL, respectively. *In silico* study shows that the most favorable interaction was observed between Phenol, 3-pentadecyl- and *E. coli*, with a binding energy (BE) of -7.6 kcal/mol. Cedran-diol, (8S,14)- exhibited a BE of -6.5 kcal/mol with *K. pneumoniae*, while *S. typhi* and *S. aureus* showed binding energies of -6.0 kcal/mol with n-Hexadecanoic acid and (Z)-3-(Heptadec-10-en-1-yl) phenol, respectively.

Keywords: *Syzygium samarangense*s, phytochemical analysis; ZnO-NPs, antioxidant, antibacterial activity and molecular docking.

[219] **Exploring Metamaterials Based Devices**

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Abstract: Metamaterials are on ascent recently. These are basically artificially realized subwavelength structures with properties beyond naturally existing materials. Here, we discuss metallic resonators forming lattice of metamaterials along with recent developments. This has potential to bring enticing device applications broadly in sectors of photonics, sensing, engineering and information.

Keywords: Metamaterials, Photonics, Applications, Subwavelength, Devices

[220] **Enhanced antibacterial activity of a novel drug-conjugated nontoxic nanocarrier**

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Abstract: Antibiotics, including metronidazole, sulfamethoxazole, erythromycin, trimethoprim, penicillin, and, amoxicillin have become the most widely used medications in recent years to treat a variety of illnesses in aquaculture, contemporary husbandry, and people. However, the use of these antibiotics may show several side effects. Serious adverse effects include liver damage, hearing loss, serious or life-threatening allergic reactions, abnormal heartbeats, and diarrhea linked to clostridium deficiency. $MgFe_2O_4$ nanoparticles have been synthesized by sol-gel method and applied to target the antibiotic Amoxicillin (10 mol% drug has been conjugated). The samples have been well characterized by the analysis of the XRD, EDS pattern, FESEM and TEM images analysis. The enhanced activity of the drug-conjugated sample against Gram-negative bacteria has been confirmed by Agar – cup assay and MIC study. It has been revealed that the drug-conjugated nanoparticles (with 10 mol% drug) and the pure 100% drug have almost similar efficacy against bacteria. This confirms the enhanced activity of amoxicillin after its conjugation with the nanoparticles.
Keywords: Nanoparticles; Drug Delivery; Antibacterial; Microstructure; XRD
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[221] **ZrO_2@chitosan composite for the simultaneous removal of emerging pollutants and antibacterial applications**

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Abstract: Emerging contaminants (ECs) are commonly found in water bodies due to their widespread use and the limitations of conventional wastewater treatment in fully eliminating them. The persistence of ECs in the environment poses significant environmental and health risks, making their effective removal a critical concern. Photocatalysis, as a tertiary treatment, presents a promising and sustainable solution for the degradation of ECs and the reuse of wastewater. This study introduces a chitosan-based zirconia nanocomposite (ZrO_2CTS-NC) as an efficient photocatalyst for the individual and simultaneous degradation of multiple ECs, including Congo red (CR), Methyl orange (MO), and 4-hydroxybenzoic acid (4-HA), under visible light irradiation. The ZrO_2CTS-NC was successfully synthesized, confirmed by theoretical studies and a variety of characterization techniques. The photodegradation efficiencies of ZrO_2CTS-NC were found to be 91.11%, 69.11%, and 78.40% for CR, MO, and 4-HA, respectively, as determined by HPLC analysis (standard deviations of 0.5–0.95). The degradation process was driven by the generation of reactive hydroxyl radicals. A detailed degradation mechanism was carried out using LC-MS/MS analysis, along with assessments of COD and TOC reductions. Additionally, the composite demonstrated excellent reusability, retaining its photocatalytic efficiency over multiple cycles, and exhibited strong antibacterial properties against *E. coli* and *S. aureus* strain.
Overall, the ZrO_2CTS-NC composite emerges as a promising material for the effective removal of residual ECs in tertiary wastewater treatment, offering a sustainable solution for water reuse and pollution control.

Keywords: Emerging contaminants, Chitosan, Zirconia, Photodegradation, Bacterial inactivation

[222] **Impact of Dy^{3+} Doping on Structural and Optical Investigations of Li_2NaPO_4 phosphor**

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Abstract: Phosphates are effective dopant host materials for rare-earth ions for the production of luminescent materials or phosphors. The Intra-4f shell transitions shielded by rare earth ions provide effective and recognisable emissions across a variety of wavelengths. The combustion synthesis method was used in this work to produce nanophosphor Li_2NaPO_4 doped with Dy^{3+}. The phosphor's structural and optical properties were investigated to ascertain whether it was appropriate for usage in white LEDs. This study provides the synthesis of undoped and Dy^{3+} doped Li_2NaPO_4 with different concentrations at 650°C. The elements were analysed by using EDS along with SEM technique to acquire the morphology. The XRD peaks confirmed that the

synthesized $Li_2NaPO_4:Dy^{3+}$ were stable in the orthorhombic phase with the space group Pmnb. In UV-Vis spectra, the tuning of the band gap occurs with inculcation of dopant ions. In the PL spectra, the Dy^{3+} ion's 4f-4f transition in the excitation spectrum results in the appearance of the three main peaks. Due to the improved properties of the manufactured rare-earth doped inorganic nanoparticles, it is now possible to develop brand-new materials for use in various plasma display panels, light-emitting diodes (LEDs), cathode ray tubes, optoelectronic devices, field emission displays and other optical materials.

Keywords: Phosphors, XRD, UV-VIS, PL spectroscopy

[223] **Transparent Solar Cells: Manufacturing, functioning and wide range of advanced applications including BIPV and Space**

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Abstract: Transparent devices are emerging as a promising solution to seamlessly integrate technology into our surroundings while maintaining both functionality and aesthetic appeal. This invited talk will explore advancements in transparent electrodes, with a particular focus on transparent electronics. The discussion will cover the performance of various transparent conductive materials—including multilayered structures, metal oxides, and metal meshes—under diverse and challenging environmental conditions, from low to high energetic ion exposure. A key highlight will be the potential of newly developed semi-transparent solar cells, which can capture sunlight without compromising transparency, offering transformative possibilities for renewable energy generation. The session will examine innovations in transparent electrode materials, novel cell architectures, and engineering strategies to enhance charge transport and light absorption. Special attention will be given to optimizing transparency and energy conversion efficiency through the integration of transparent components such as conductive oxides, thin-film semiconductors, charge transport layers, and transparent electrodes. Additionally, micrometric optical holes will be introduced as a means of achieving digitally controlled semi-transparency in these structures. The talk will cover a range of transparent solar cell technologies, including perovskite solar cells, organic solar cells, and emerging perovskite-Si tandem systems, on both rigid and flexible substrates. Furthermore, the discussion will extend to industry-compatible printing techniques for large scale manufacturing and the potential applications of transparent solar cells in smart windows, building-integrated photovoltaics (BIPV), and space-based solar power systems.

Keywords: Transparent Electrode; Semi-transparent Cells; Irradiation; Tandem

[224] **Tailoring Properties of MOS by Ion Beam Irradiation and its Application for Hydrogen Gas Sensing**

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Abstract: Swift Heavy Ion (SHI) beam irradiation techniques is being utilized to tailor physical, chemical and optical properties of the materials. A study carried by our research group provides a way to modify the physical and electronic properties of WO_3 thin films by high-energy ion beam irradiation of 120 MeV Ni^{7+}. The spin-coated thin films were exposed to 5×10^{12}, 1×10^{13}, and 3×10^{13} ions/cm^2 fluences. Characterizations such as XRD, FTIR, AFM, SEM, and UV-visible spectroscopy were used to identify structural, spectroscopic, morphological, and optical properties. The XRD spectra of the pristine and irradiated thin films revealed the monoclinic structure for all the films with variations in the intensity of the peaks. After ion beam irradiation, the intensity of the Raman peaks decreased due to the onset of defects, and reduction in crystallinity. The AFM analysis revealed changes in grain size and surface roughness of ion-irradiated films compared to the pristine thin films. The absorption spectra showed a reduction in the optical band gap subsequent to irradiations. The irradiated WO_3 film was studied for hydrogen gas sensing at different temperatures. Irradiation of the beam on the film induced lattice imperfections or point defects such as vacancies, interstitials, etc. The decrease in band gap of the film has the potential to enhance the hydrogen gas sensing because it provides higher surface reactivity, lower operating temperature, better charge carrier dynamics, and wider operating spectral ranges. The relative sensing response for irradiated film compared to pristine film improved from 45.02% to 67.70% with exposure to the 75-ppm hydrogen gas concentration at 100 °C°C. The results indicate that ion beam irradiation is a feasible method for enhancing WO_3-based hydrogen sensors, paving the way for the development of next-generation gas sensing systems with improved performance.

Keywords: Ion-Beam, SHI, MOS, Defects, Sensor, Hydrogen.

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[225] NANOTECHNOLOGY DRIVEN ADVANCES IN THE GLOBAL TEXTILE AND FIBER PRODUCT INDUSTRIES

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Abstract

This paper covers the recent advances in the quality, performance and sustainability behavior of fiber and polymer products, attributes that are enabled by nanomaterial infusion. It reveals how integration of nanotechnology in fiber-based products has led to a new generation of intelligent textiles that monitor the functioning of human body in medical and sports-performance applications. It reveals how piezoelectric nanomaterials embedded in fibers generate and store electricity to drive a range of wearable devices. It talks of nano-enhanced products that are used in life-saving and life-enhancing applications. It gives an over-view of light-weight products that provide improved durability, flame resistance, water repellency, UV protection, biocompatibility, antibacterial performance, self-cleaning and self-repairing performance, shape memory performance, protection from toxic emissions, recyclability, etc. It concludes with a review of current challenges and expected future directions. In short, this paper helps to understand how

nanotechnology has expanded the scope and usefulness of the global textile manufacturing industry.

[226] **Spin current: A potential tool in DNA biosensing**

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Abstract:DNA biosensors are powerful tools for the early-stage detection of various viruses and diseases. Traditional sensing approaches rely on electric charge current, where any interaction with DNA is reflected by a change in current. In this work, we propose a spin current-based DNA biosensor as an alternative to electric charge current-based detection. The spin current approach is based on the chiral-induced spin selectivity (CISS) effect, which describes the spin filtering capabilities of chiral molecules. It has been observed that when electrons transfer through chiral molecules, one spin orientation preferentially passes through, depending on the molecule's chirality. Leveraging the CISS effect, we have developed a spin-controlled DNA sensor. To achieve this, we employ electrochemical and fluorescence-based techniques, including differential pulse voltammetry (DPV) and time-correlated single-photon counting (TCSPC). Our results pave the way for the next generation of spin-controlled DNA biosensors.

Keywords: DNA, CISS effect, Chirality, spin current, Biosensor

[227] **Alloy Based Schottky Contacts on Silicon**

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Abstract: Schottky diodes have attracted a lot of attention lately because of their low operating voltages, high sensitivity, and affordability. They are perfect for usage in detector diodes, solar panels, power rectifiers, radio frequency mixers, voltage clamping devices, and switched-mode power supplies due to their low operating voltages, high sensitivity, and affordability. These characteristics make them ideal for a wide variety of applications where high efficiency, fast switching speeds, and low power loss are crucial. Metals and their silicides have been extensively studied as potential materials for Schottky diodes. Nevertheless, there remains a significant void in the alloys' investigation for this purpose. The creation and analysis of a silicon-based Schottky diode that makes use of a nichrome alloy is the main objective of this work. The process of electron beam deposition is highly effective for depositing metal alloys like nichrome with precise control over the deposition rate and film thickness. Using EDS analysis, the composition of the depositing material was examined. Capacitance-voltage and current-

voltage measurements are crucial for characterizing the electrical properties of the Schottky junction and hence nichrome alloy has proven to be compatible with standard silicon production methods. This compatibility is a crucial step toward integrating nichrome-based Schottky diodes into existing manufacturing processes. To clarify the current conduction process within the constructed diode, a thorough examination of the device parameters, including ideality factors, barrier height, etc. was carried out. By shedding new light on the possibilities of alloys more especially, nichrome - as workable materials for Schottky diodes, this study expands the range of materials that can be applied to cutting-edge semiconductor devices.

Keywords: Schottky Contacts, Schottky diodes, Silicon

[228] **Enhanced Magnetic Properties of Aluminium-doped Calcium Strontium M-Type Hexaferrites for Data Storage Application.**

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Abstract: This study explores aluminium-doped calcium strontium M-type hexaferrites, Ca 0.5 Sr 0.5 Fe 10 Al 2 O 19 , synthesized via a modified polyol-mediated route for data storage applications Structural analysis using X-ray diffraction, field-emission scanning electron microscopy, energy-dispersive X-ray spectroscopy, Fourier transform infrared spectroscopy, and Raman spectroscopy confirms the successful formation of the M-type hexaferrite phase with a well-defined crystal structure (space group $P6_3/mmc$). Magnetic measurements reveal a significant increase in coercivity from 0.50 kOe (pristine) to 7.6 kOe for Al-doped composition with a reduction in saturation magnetization. The Al-substituted hexaferrite also exhibits a high squareness ratio (0.59), a giant maximum energy product (3.76 MGOe), and enhanced magnetocrystalline anisotropy (9.50×10^5 erg/cm^3). Switching field distribution curves indicate a higher value of switching field in Al-doped hexaferrites, suggesting improved magnetic ordering and stability, making them promising for high-performance magnetic applications. Additionally, optical characterization using UV–Vis spectroscopy and current-voltage (I–V) measurements shows variations in band gap and conductivity, reflecting changes in electronic structure.

Keywords: Hexaferrites; Polyol synthesis, Magnetic properties; Switching field distribution

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[229] Effect of Nd^{3+} ions on the electrical properties of Mg-Mn nanoferrites

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ABSTRACT

In this work, $Mg_{0.9}Mn_{0.1}Nd_xFe_{2-x}O_4$ (x=0.1, 0.2, 0.3) nanoferrites are synthesized by solution combustion (SC) method and examined for electric and dielectric properties. The dc resistivity has been found to rise with the adding up of Nd ions while the dc resistivity has been found to decrease with rise in temperature. The dielectric constant is found to decrease with the increase in frequency. The Maxwell-Wagner model has been utilized to explain the dielectric behaviour of the prepared nanoferrites.

Keywords: Spinel ferrites; TEM; Resistivity; Dielectric constant.

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[230] CVD-Grown Wafer-Scale MoS_2 Films: Efficient Transfer and Integration for Flexible Optoelectronic Applications

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Abstract:

A high-quality, large-area wafer scale MoS_2 film was synthesized using the chemical vapor deposition (CVD) method, ensuring uniform growth and scalability. The as-grown MoS_2 film on a SiO_2/Si substrate was successfully transferred onto interdigitated electrode (IDE) structures fabricated on a flexible polyimide substrate through a wet etching process employing hydrogen fluoride (HF) solution. This rapid and efficient transfer preserved the structural and optoelectronic integrity of the MoS_2 film, making it suitable for flexible device applications.

The quality of the CVD-grown MoS_2 film was confirmed using Raman and photoluminescence (PL) spectroscopy. Raman spectroscopy revealed the characteristic $E^1{}_2g$ and A_1g peaks, indicating the presence of high-quality MoS_2. PL spectroscopy showed strong excitonic emission, confirming the direct bandgap properties of monolayer MoS_2.

The successful integration of MoS_2 films onto flexible substrates highlights their potential for next-generation wearable and bendable optoelectronic devices. This scalable and reliable fabrication process opens new possibilities for flexible photodetectors, sensors, and other advanced applications in wearable electronics, where lightweight and mechanically resilient components are crucial.

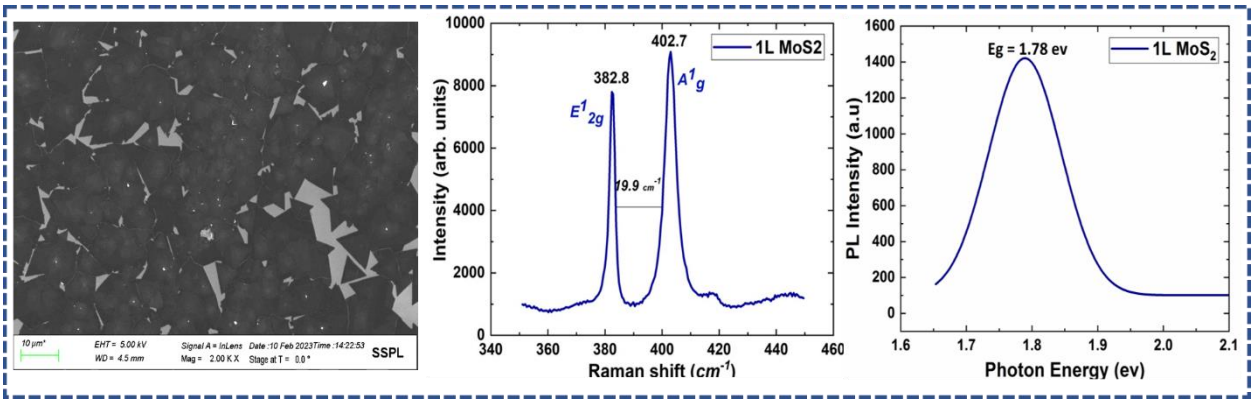

Fig.1 (a) SEM image of MoS_2 film (b) Raman spectra of MoS_2 (c) Photoluminescence spectra of MoS_2

[231] Implantation of Ni^{+1} in Tin oxide thin film by low energy ion beam

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ABSTRACT

Tin oxide (SnO_2) is an optimistic semiconducting oxide with large optical band gap (3.6eV) and higher resistivity. In recent decade, the SnO_2 has been doped with various elements belonging to group VA and VB. In many findings, it has been reported that Ni-doped SnO_2 exhibits desirable enhanced electrical and optical properties. In this view thin films of SnO_2 have been deposited by RF sputtering on quartz substrate followed by annealing at 600^oC for 6 hour. Instead of inert gas, the Nitrogen gas has been used to eject the atom from target prepared by SnO_2 powder. The film of SnO_2 was implanted with Nickel ions at low energy ion beam (70keV). SRIM (Stopping and Ranging in Matter) software was used to precisely measured the doping percentage. The phases of SnO2 and its small crystallite size were confirmed by x-ray diffraction (XRD) technique. The optical and electrical properties were analyzed by UV-Vis and resistance variations with temperature were analyzed by two probe method.

The changes in optical properties have been observed due to the shifting of absorption edge. The conductivity has been increased after implantation of Nickel in the host material (SnO_2). These changes in electrical and optical properties have been occurred due to the shift in position of conduction band minimum and Fermi level.

Keywords: SnO_2 Thin Film; Implantation; Absorption.

[232] Green reducing agent-based simplified synthesis of reduced graphene oxide using extract from *Costus igneus* leaf and its structural characterization

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Using plant-based reducing agents to create next-generation nanomaterials has become more environmentally benign in recent years because of sustainable green chemistry. One prospective biocompatible nanomaterial for use in biomedical applications is reduced graphene oxide (rGO). By reducing graphene oxide (GO) with leaf extract from *Costus igneus*, this study investigates the simple synthesis of reduced graphene oxide (CIrGO) without the use of hazardous reducing chemicals. The removal of oxygen-containing groups from GO and the stability of the resulting rGO are strongly confirmed by the results of several characterization approaches comparing graphene oxide and *Costus igneus*-reduced graphene oxide. By inhibiting aggregation, functionalizing reduced graphene oxide with oxidized polyphenols contributes to its stability. Transmission electron microscopy (TEM), Fourier-transform infrared spectroscopy (FT-IR), ultraviolet-visible (UV-Vis) spectroscopy, X-ray diffraction (XRD), and Raman spectroscopy were used to establish that *Costus igneus* bioreduced GO to rGO. UV-Vis and FT-IR confirmed that oxygen-containing groups had been removed from GO, while XRD and Raman results further supported the formation of CIrGO. The synthetic CIrGO sheet-like structure was seen in TEM images. These results suggest that the phytochemicals included in the leaf extract of *Costus igneus* are very effective reducing agents.

Keywords: *Costus igneus*, reduced Graphene oxide, Green Synthesis, Characterization, Graphene oxide

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About Rajdhani College

Rajdhani college is a constituent college of University of Delhi established in 1964. The college complex includes an airconditioned Seminar/Seminar Room, an Auditorium, and a well-stocked Library with computer and internet facilities offering access to over one lac scholarly books and eBooks. Furthermore, the college is equipped with state of-the-art Science Laboratories, as well as Math and Computer Laboratories.

The Department of Physics of Rajdhani college was established in 1966. It was the first off campus which offered B.Sc.(H) Physics Course to undergraduate students. Later B.Sc.(Prog) Electronics course was introduced for the students. The Department comprises highly qualified faculty of 29 members who are actively involved in research work along with teaching. Dept. has 5 well equipped and maintained labs with latest equipment like DSO, spectrometer etc. It also has two dedicated research labs namely Radio, Atmospheric and Laser Plasma to promote research and inculcate scientific temperament among students. The Dept. has one student society URJA which conducts various events, national and International conferences etc.

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