



ICAMM 2024

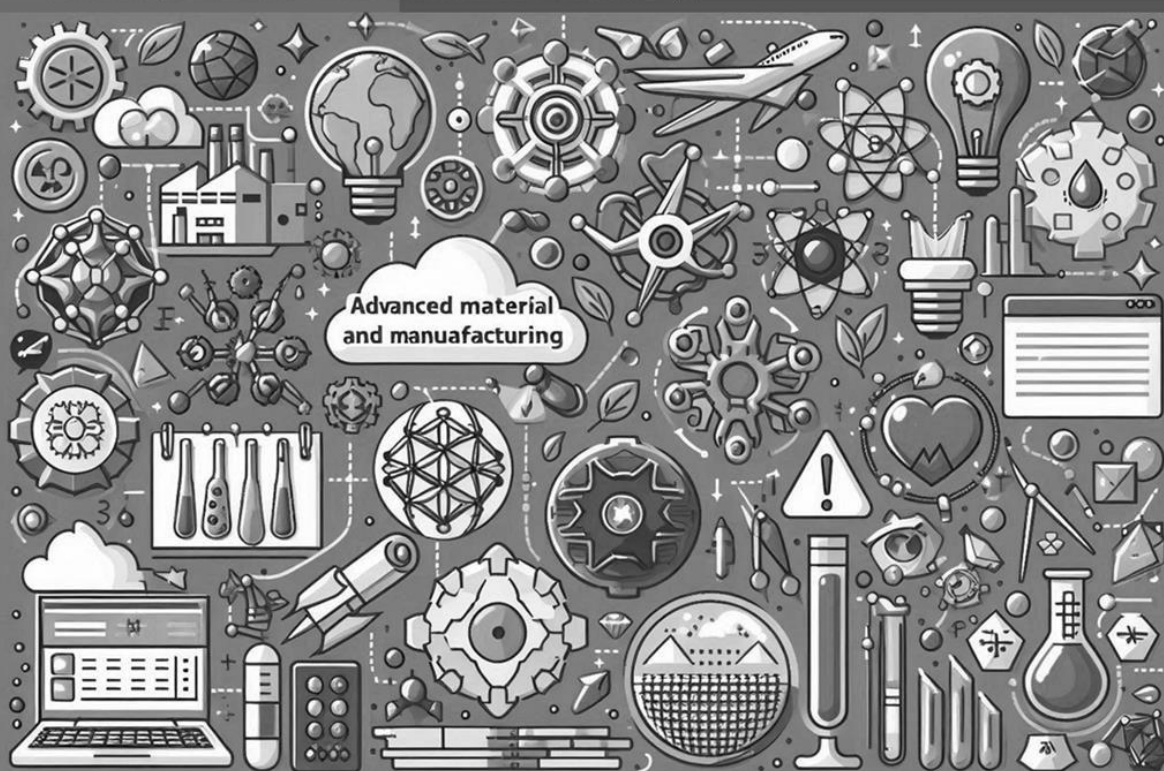
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Book of ABSTRACTS



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Exploring Electrical and Functional Properties in a MoS₂-Graphene Floating Gate FET for

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Exploring Electrical and Functional Properties in a MoS₂-Graphene Floating Gate FET for Advanced Memory Applications

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Abstract:

In this paper, we discussed the electrical functionality of a floating gate field-effect transistor made from monolayer MoS₂ and graphene [1]. The device was modelled comprising a p++ Si substrate, SiO₂ for the gate insulator as well as the bottom portion of the layered device for the gate electrode, one monolayer MoS₂ channel, a SiO₂ gate insulator film, and an HfO₂ dielectric layer above the gate, covered on top by a Cr/Au gate. The motivation was to find the potential of such an FET structure in applications that demand tunable electronic properties, such as non-volatile memory devices. As the electrical characteristics were distinct for the selected layers of MoS₂ and graphene, these two layers were used. MoS₂ had a variable bandgap whereas the layer of graphene provided a high mobility of carriers [2]. HfO₂ acted as a high-k dielectric; therefore, gate control over the channel was improved. It is the floating gate that had been used for charge storage that enabled non-volatile memory operations. Major parameters like drain current (I_d) and drain voltage (V_d) were measured in order to determine the retention characteristics and switching of the device. The I-V characteristics showed different responses to different gate voltages. At a gate voltage of -6 V, it had shown a significant increase in drain current, signifying strong channel conductivity at high negative bias. It contrasted with positive gate biases of +2 V to quench the current, thereby showing the possibility of its enhancement and depletion mode of operation. Thus, low-power switching and a good on/off current ratio is possibly achievable for the device. This FET structure based on the heterostructure MoS₂/graphene and floating gate mechanism presents efficient charge storage for memory with high sensitivity to environmental changes, making it applicable for high retention memory applications.

References:

- [1] N. T. Duong et al., "Gate-controlled MoTe₂ homojunction for sub-thermionic subthreshold swing tunnel field-effect transistor," *Nano Today*, vol. 40, p. 101263, Oct. 2021.
- [2] V. P. Tayade and S. L. Lahudkar, "Implementation of 20 nm Graphene Channel Field Effect Transistors Using Silvaco TCAD Tool to Improve Short Channel Effects over Conventional MOSFETs," *Advances in Technology Innovation*, vol. 7, no. 1, pp. 18–29, Oct. 2021.

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