ID 37

Study On Battery Thermal Runaway Risks

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Thermal runaway in lithium-ion batteries (Li-ion) presents a significant safety concern due to their extensive use in mobile phones, laptops, and electric vehicles. It refers to an uncontrollable temperature rise in a battery, often resulting in fires, explosions, or releasing toxic gases. This phenomenon occurs when a series of chain reactions, triggered by factors like overcharging, physical damage, internal short circuits, or high ambient temperatures, lead to excessive heat generation within the battery. This paper delves into the theoretical mechanisms behind thermal runaway, focusing on the stages of heat buildup and the exothermic reactions that exacerbate the situation. Overcharging or rapid charging can cause the battery to generate heat faster than it can dissipate, creating the ideal conditions for thermal runaway. Physical damage, such as punctures or impacts, can compromise the battery's structural integrity, leading to short circuits. Internal short circuits, often due to manufacturing defects or degradation over time, are another major contributor to thermal runaway. External heat sources, including high ambient temperatures or exposure to fire, can further trigger these reactions. Existing theoretical models explain how these factors contribute to the thermal runaway process. These models typically involve heat transfer equations and electrochemical kinetics that describe how heat builds up and leads to a self-amplifying cycle of reactions within the battery. The paper also discusses potential preventive measures, including improved batterydesign, better charging protocols, and advanced thermal management systems.

Keywords: Catastopic failures, advanced thermal management system, charging protocols, safety protocols