

A Comprehensive Review on Recent Progress and Perspective in Li-ion Battery Researches

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Recent advances in rechargeable lithium-ion battery (LIB) technologies have been driven by the demand for higher energy density, improved safety, and reduced environmental impact. This presentation reviews current research trends in LIB development, with particular focus on three emerging directions. First, the electrochemical performance and stability of LiNiO_2 -based cathodes in aqueous battery systems are examined, highlighting their potential for safer, cost-effective energy storage while addressing inherent challenges such as structural degradation and electrolyte compatibility. Second, electrolyte engineering for anode-free lithium metal batteries is explored, emphasizing the role of magnesium additives in stabilizing lithium deposition, suppressing dendrite formation, and enhancing Coulombic efficiency. Third, a thin-film NCM ($\text{LiNi}_x\text{Co}_y\text{Mn}_z\text{O}_2$) model cathode platform is utilized to systematically investigate surface reaction mechanisms under controlled conditions, providing insights into interfacial phenomena that govern cycle life and performance. By integrating these research perspectives, this work underscores the importance of advanced material design, interface control, and electrolyte optimization in shaping the next generation of high-performance and sustainable rechargeable batteries.