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Lithium Plating generation and in-operando detection approaches for lithium-ion batteries

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Executive Summary:

Lithium-ion batteries, essential for electric vehicle applications, face significant challenges in safety and performance due to degradation mechanisms such as lithium plating. This undesired reaction on the anode limits the battery's fast-charging capabilities, leading to a higher risk of Thermal Runaway. While material improvements in battery design provide some resilience, real-time control strategies are necessary to prevent lithium plating and mitigate Thermal Runaway risks. This study analyzes laboratory-scale lithium plating generation procedures and advanced in-operando detection methods to monitor and manage lithium plating. Methods include impedance analysis, Distributed Relaxation Times (DRT) analysis, voltage relaxation profiling, and incremental Capacity analysis (ICA). Findings from these studies can enhance battery management systems (BMS), offering improved fast-charging control protocols and State of Safety (SoS) monitoring