# Dead lithium: The culprit of low Coulombic efficiency with LIBs

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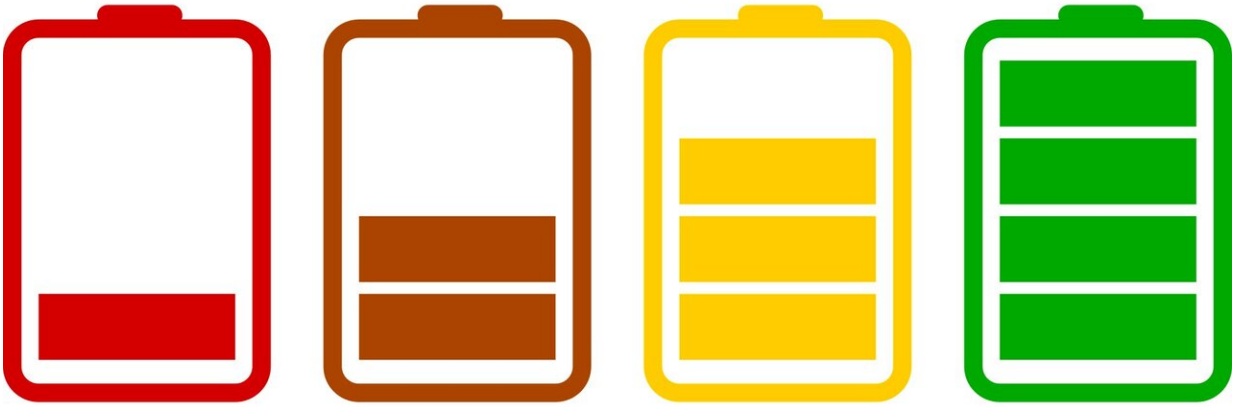

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The target of carbon-neutral and net-zero emissions is the development and utilization of renewable energy. High-energy-density energy storage systems are critical technologies for the integration of renewable energy.

Li metal is highly recognized as a promising alternative anode for next-generation rechargeable batteries due to its high theoretical capacity of 3860 mAh $g^{-1}$ and ultralow electrode potential of -3.04 V compared to

the standard hydrogen electrode.

However, Li metal batteries' (LMBs) main issue is their low Coulombic efficiency (CE), which limits batteries' cycle life. The low CE in LMBs occurs because active Li turns into inactive Li, comprising Li components in the solid-electrolyte interphase (SEI) and SEI-wrapped metallic Li (dead $Li^0$). Dead $Li^0$ is the primary reason inactive Li results in a low CE. Therefore, determining the formation and evolution of dead $Li^0$ is essential to fundamentally enhance the CE for longer-lifespan LMBs.

Recently, a group led by Prof. Qiang Zhang from the Tsinghua University reported new insights into dead $Li^0$ during LMB stripping. The dead $Li^0$ directly forms during the stripping process because the partial metallic Li cannot immediately convert into $Li^+$ but is wrapped by insulated SEI. The stripping processes involve the following stages: electron transfer in the solid phase and Li atom conversion to $Li^+$ and $Li^+$ diffusion through SEI.

They investigated the formation and evaluation of dead $Li^0$ systematically and meticulously during the stripping process from electron transfer, the oxidation of $Li^0$ into $Li^+$, and the diffusion of $Li^+$ through SEI. These processes were regulated by adjusting the contact sites of electron channels, the dynamic rate of conversion from $Li^0$ to $Li^+$, and the SEI structure and components. The design principles for achieving less dead $Li^0$ and higher CE are proposed as a proof of concept in LMBs.

"This work describes the comprehensive understanding of dead $Li^0$ formation, providing guidance to reduce dead $Li^0$ for developing future LMBs with higher CE," said Prof. Zhang.

The results were published in *Journal of Energy Chemistry*.

**More information:** Xiao-Ru Chen et al, New insights into "dead lithium" during stripping in lithium metal batteries, *Journal of Energy Chemistry* (2021). DOI: 10.1016/j.jechem.2021.03.048

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