Docket #: S23-207

Mechanistic guidelines for suppressing dendrite formation in lithium-metal batteries

Stanford researchers have developed a mechanistic guideline for lithium metal battery electrolyte and separator design to mitigate lithium dendrite growth. Lithium dendrite growth is the leading cause of degradation and failure in lithium metal batteries, which has hindered the adoption of the lighter, faster charging, and high energy density batteries. Stanford researchers modelled the physics and chemistry of lithium dendrite formation and found that anisotropic electrolytes (electrolytes with anisotropic diffusion coefficients of the Li ions) and control of the local electric field can suppress dendritic growth in lithium-metal batteries. Electrolytes with electric field-dependent diffusion coefficients reduce dendritic growth in small batteries, while anisotropic electrolytes (or separators with anisotropic pore structures or columnized membranes) are appropriate for batteries of any size. Using these guidelines for the development of electrolytes and separators, can improve the safety and longevity of lithium metal batteries.

Stage of Development – Proof of Concept

Applications

- Lithium metal battery design

Advantages

- Safer batteries through mitigating dendrite growth
- Lithium-metal batteries with longer life span

- More cost-effective - avoids the need to explore & certify new electrolyte chemistries

Publications

- Li, W., Tchelepi, H. A., Ju, Y., & Tartakovsky, D. M. (2022). Stability-guided strategies to mitigate dendritic growth in lithium-metal batteries. *Journal of The Electrochemical Society, 169*(6), 060536. DOI 10.1149/1945-7111/ac7978 https://iopscience.iop.org/article/10.1149/1945-7111/ac7978/pdf
- New model offers potential solutions for next-generation battery challenges

Patents

- Published Application: 20240429464

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