

***In situ* NMR Studies of Li Microstructure Formation**

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The lithium metal anode is an attractive component for next-generation, high-energy batteries but suffers from both capacity fading and safety problems. These are associated with an uneven electrodeposition of lithium ions on the Li anode that results in high surface area microstructures and ultimately dendrite growth. A detailed understanding of the fundamental processes that lead to Li microstructural growth is necessary to develop new and effective strategies to mitigate dendrite growth.

The Chazalviel model [1] describes how dendrites grow under diffusion-limitation, as the electrolyte concentration drops near the negative electrode at a characteristic time, known as Sand's time. Two different regimes are predicted: i) A low current regime where the concentration gradient in the electrolyte reaches a steady-state and no dendrite growth is expected. ii) A high-current regime where the concentration of anions drops to zero and a high space-charge leads to fractal dendritic growth. [1-2] Chang et al. [3] showed that dendrite growth on Li metal correlates well with Chazaviel's model in the high current regime but that it still occurs in the low current regime. This indicates a second mechanism for the initiation of dendrite growth.

Current research focuses on how the chemical and physical properties of the SEI (solid electrolyte interphase) result in different microstructural growth at low currents. Here we use *in situ* NMR (nuclear magnetic resonance) spectroscopy to quantify the amount of microstructures formed on Li metal in a range of electrolytes. Different electrochemical cycling parameters were explored, including ultra-fast pulsed plating as to ascertain the role of the concentration gradients in the SEI layer.

References:

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[3] H. J. Chang, A.J. Ilott, N. M. Trease, M. Mohammadi, A. Jerschow, C.P Grey, J. Am. Chem. Soc., 137 (2015), 15209–15216.