The Effect of Oxidation and Charge/Discharge rates on Li Plating in All-Solid-State Batteries

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We fabricated a model SSLIB, which consists of LiCoO$_2$ cathode layer, LiPON as an electrolyte, and a model ultra-thin carbon anode. Using in operando scanning electron microscopy in conjunction with electrochemical measurements, we found that depending on ambient oxidizing conditions and charging rate, the morphology of plated lithium alternates between quasi-1D and 3D microstructures. In addition, we were able to use an electron beam as a virtual nano-electrode to selectively control the nucleation rate and Li growth structure during the SSLIB charging with high spatial resolution. Finally, we determined the conditions when lithium may be oxidized even during battery cycling under UHV conditions, leading to significant capacity losses. We foresee that our work will provide deeper insights into a safe SSLIB performance under real world operating conditions.