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Analyzing uncertainties of the instability of the anode /electrolyte interface in solid state batteries

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Modern batteries must meet stringent performance standards to qualify for use in technological solutions that seek to address current global environmental challenges. Such batteries should exhibit high energy densities, fast charging, and long cycle lives while maintaining a high degree of safety. Solid-state batteries (SSBs) exploit high-capacity anode materials such as Lithium or Sodium metal and are expected to deliver high standards that meet the stringent needs of long-range electric vehicles and large-scale renewable energy storage. However, stability in these devices presents important challenges. The interface anode/electrolyte interface is home to structural imperfections that lead to heterogeneous stripping and plating during cell cycling, significantly reducing cell capacity and compromising cell safety. Although numerous studies have attempted to shed light on the root causes of inhomogeneous electrochemical processes at metals anodes in SSBs, the detailed atomistic processes that lead to ubiquitous dendrites growth in metal anodes are not well elucidated. Critically lacking is the detailed understanding of the thermodynamic driving forces that lead to such degradation at the atomistic level.
We analyze the forward propagation of the imperfection parameters that are susceptible to highly defeat the stability of the anode/electrolyte interface. The imperfections in inputs are parametrized as random variable and Monte Carlo method and sensitivity analysis approaches allow a better understanding of Lithium plating and stripping behaviors.

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