Controlling dendrite propagation in solid-state batteries with engineered stress

What causes dendrite failure in lithium metal solid-state batteries?

Analysis of dendrite initiation,owing to filling of pores with lithium by means of microcracks,and propagation,caused by wedge opening,shows that there are two separate processes during dendrite failure of lithium metal solid-state batteries.

Can a stress-based approach mitigate metal-dendrite-induced failure in solid-state batteries?

We propose a stress-based approach to mitigating metal-dendrite-induced failure in solid-state batteries. Using experiments and a fracture mechanics model,we show that metal dendrites growing through solid electrolytes can be deflected by an imposed stress.

Can electrolytes inhibit dendrite propagation?

While most previous electrolyte engineering efforts focus on increasing the current density at which dendrites initiate,our findings suggest a new paradigm: that electrolytes can be engineered to inhibit dendrite propagation. Based upon this principle,we outline design approaches suitable for deflecting metal dendrites in solid-state batteries.

Can lithium metal dendrites be propagated through a solid electrolyte?

We observe the propagationof lithium metal dendrites through a model solid electrolyte,Li6.6 La 3 Zr 1.6 Ta 0.4 O 12 (LLZTO),under sequential and simultaneous electrochemical and mechanical stimulation.

Can metal dendrites be deflected in solid-state batteries?

Based upon this principle,we outline design approaches suitable for deflecting metal dendrites in solid-state batteries. Metal-dendrite penetration is a mode of electrolyte failure that threatens the viability of metal-anode-based solid-state batteries.

Can compressive stresses mitigate dendrite propagation in electrolyte samples?

Growing dendrites deflected toward the loading axis (Figures 4 C-4E),with the crack-plane oriented normal to the page (Figure 4 F). This result shows that compressive stresses may be used to mitigate dendrite propagationin electrolyte samples of similar thickness to those commonly studied in literature.

Lower stack pressures suppress propagation, markedly extending the number of cycles before short circuit in cells in which dendrites have initiated.

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Using fracture mechanics, we quantify the impact of stack pressure and in-plane stresses on dendrite trajectory, chart the residual stresses required to prevent short-circuit failure, and ...

Here we describe a solid-state battery design with a hierarchy of interface stabilities (to lithium metal responses), to achieve an ultrahigh current density with no lithium dendrite...

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Strain data collected in real time, and the compressive stress was calculated as outlined in methods. Small changes in the compressive stress during loading (e.g., as that near 50 ...

Researchers have been working to overcome the challenge of dendrite formation in batteries, which can significantly affect their safety and performance. One of the approaches they have taken is to suppress dendrite ...

The comprehensive analysis further reveals that the designed bilayer SSE effectively harnesses the interface-generated pressure during battery cycling, achieving ...

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