話題提供

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Advanced 3D Imaging, Analysis and Characterisation of battery materials

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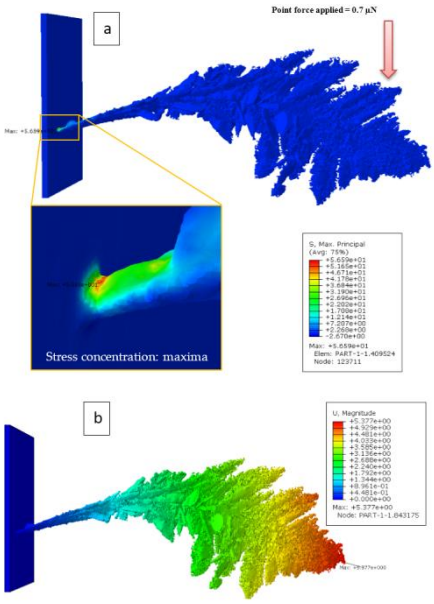
Rising global demand for energy supply, storage and portability in a sustainable manner needs significant improvements to be made in the next generation of batteries, both in terms of performance and lifetime. However, despite their importance, battery electrode microstructures remain relatively poorly understood.

The performance of the battery is dependent on the nano and micro-structure achieved during manufacture. Furthermore microstructural evolution during operation may degrade electrochemical performance. The growth of dendrites represents a limiting failure mechanism in some battery systems; in particular this can be a challenge in zinc-air batteries. Furthermore volume expansion during lithiation is another major failure mechanism. Tomographic techniques allow the direct 3D imaging and characterisation of complex microstructures, including the observation and quantification of dendrite growth and volume expansion.

Here we present results from 3D x-ray and FIB-SEM tomography of Zn dendrite formation in a zinc-air battery along in situ observation of volume expansion in a Si-Li battery, down to resolutions of tens of nanometers, enabling analysis of complex micro-structures.

This approach is shown to be effective in understanding how dendrites grow and how the Si anode is expended, and demonstrates that tomography coupled with modeling can provide new insights into degradation mechanisms associated with dendrite growth and volume expansion.



(a) Maximum principal stress (unit=100MPa), the maximum stress at the neck = 5.659*102MPa, which is just above the fracture strength (500 MPa). (b) Displacement (unit=0.1µm), the maximum displace is 0.538 µm at the top of the dendrite.