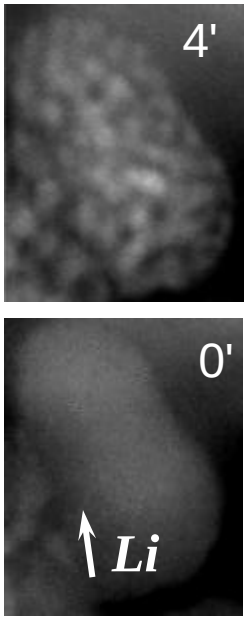
Tracking lithium transport and reaction in single nanoparticles

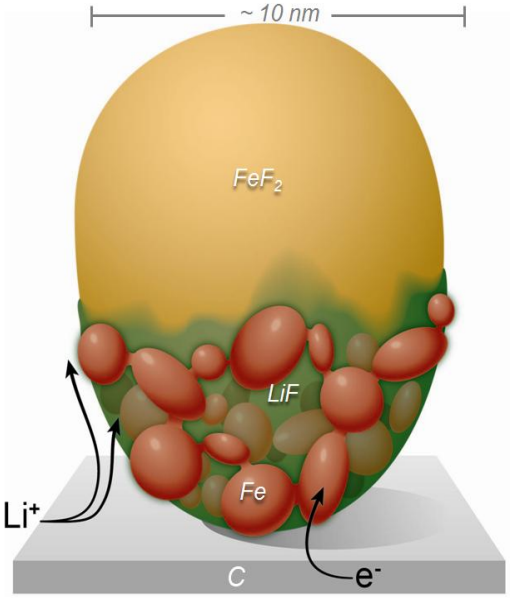
Scientific Achievement

An *in-situ* electrochemical cell was developed to perform nanoelectrochemical measurements in the transmission electron microscope (TEM) and used to track the lithium conversion reaction in FeF_2 nanoparticles by imaging, diffraction and spectroscopy.

Significance and Impact

The electrochemical lithiation of single nanoparticles was investigated with unprecedented spatial resolution and analytical capability. The *real-time* observation, supported by computation, revealed new insights into the inter- and intra-particle Li transport and reaction kinetics of lithium conversion, which may help to pave the way to develop high-energy conversion electrodes for lithium-ion batteries.





TEM imaging and spectroscopy can now be used to track intra/inter-particle flow of lithium in electrodes using an in-situ cell constructed for the TEM.

Research Details

- An *in-situ* electrochemical cell was constructed for the TEM, and used to monitor morphological, structural and chemical evolution of10 nm FeF_2 nanoparticles during the lithium conversion process;
- Lithium conversion is initiated at the surface, sweeping rapidly across the FeF_2 particles, followed by a gradual phase transformation in the bulk, resulting in 1-3 nm Fe crystallites mixed with amorphous LiF;
- The real time imaging revealed a surprisingly fast conversion process in individual particles (complete in a few minutes), with a morphological evolution resembling spontaneous spinodal decomposition.

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