The Sources of the Large Charge-Storage Capacities Seen in Metal Oxide Li-ion Battery Electrodes

Scientific Achievement

Determined the source of the extra-large charge-storage capacities in metal oxide lithium-ion battery electrodes

Significance and Impact

Results help resolve a long-standing debate in the literature; the methodology developed may yield longer-lasting batteries

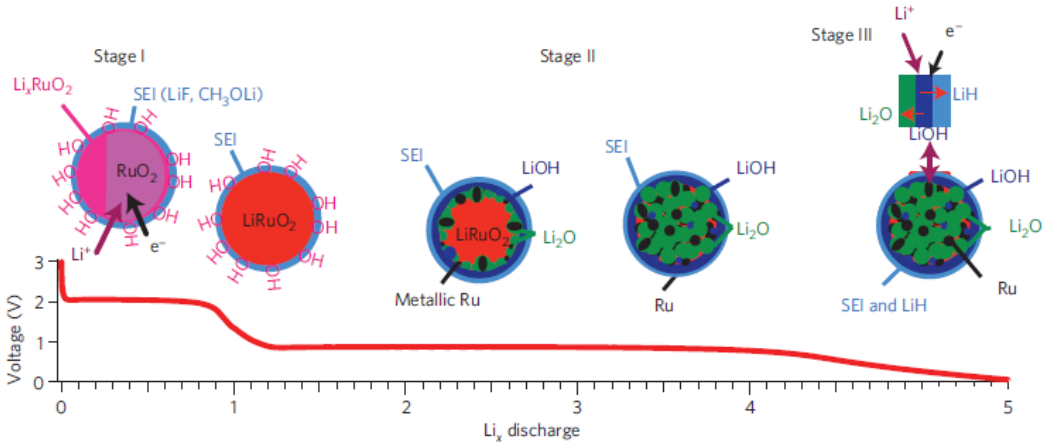

Figure: A summary of the three-stage reaction pathway of the RuO_2/Li battery system. The schematics represent the phase distribution at each stage of discharge. Surface reactions occurring in the solid electrolyte interphase (SEI), which grows on essentially all electrode materials on cycling, are the major source of the additional capacity.

Research Details

- Investigated the origin of the charge-storage capacity of ruthenium oxide (RuO_2), which reacts with Li ions, reversibly forming Ru nanoparticles and Li_2O salts.
- Phases of the reaction studied with nuclear magnetic resonance (NMR) and x-ray techniques, including x-ray absorption near-edge structure (XANES) and extended x-ray absorption fine structure (EXAFS) at NSLS beamlines X18A and X18B, to discover why the capacity exceeds theoretical predictions.
- The major contributor is the formation of LiOH, which reversibly converts to Li_2O and LiH; minor sources include Li storage on the Ru nanoparticles.

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Work was performed at Cambridge University, Brookhaven National Laboratory, Argonne National Laboratory, and Stony Brook University

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