In Situ Raman Diagnostics of Intercalation Batteries

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Project B8

Motivation and experimental setup

In situ Raman experiments are performed in 180° backscattering geometry using a transmission spectrometer equipped with a CCD detector. The excitation laser (532 nm unless noted otherwise) is focused onto the sample through a confocal microscope coupled with a x-y-z-stage, allowing measurements with high lateral resolution (spot size is approximately 2.5 μm).

Spatially-resolved Raman analysis

Raman mapping of a LiCoO₂ composite electrode. Individual Raman spectra show the heterogeneity of chemical composition across the surface (1) (below).

Resonant enhancement

Resonant enhancement of LiCoO₂ A₁g mode when exciting the sample with 514.5 or 532 nm in contrast to non-resonant excitation with 632.8 nm (below).

Summary:
- Raman spectroscopy enables in situ studies on positive and negative electrodes with lateral resolution (~2.5 μm).
- Wavelength-dependent studies elucidate the presence of a Resonance Raman enhancement for LiCoO₂ materials.
- Raman mapping demonstrates the chemical heterogeneity in composition across LiCoO₂ composite electrodes.
- Mappings of initial and cycled electrode suggest chemical redistribution induced by electrochemical cycling.

Publications last funding period

2) T. Gross, C. Hess, Raman diagnostics of LiCoO₂ electrodes for lithium-ion batteries, J. Power Sources 256, (2014), 220

The Li₁₀CoO₉ composite cathode (84% active material, 8% PVDF, 8% carbon black) was used with commercial electrolyte (LP90, 1M LiPF₆ in EC:DMC 1:1 (wt), Merck) and metallic Li as counter-electrode.