NANOHOUR

Wednesday, May 2, 2012 3:00 pm
Beckman Institute - Room 3269

Tunable Thermal Transport in Lithium-ion Battery Cathodes as Measured by Time-domain Thermal-reflectance

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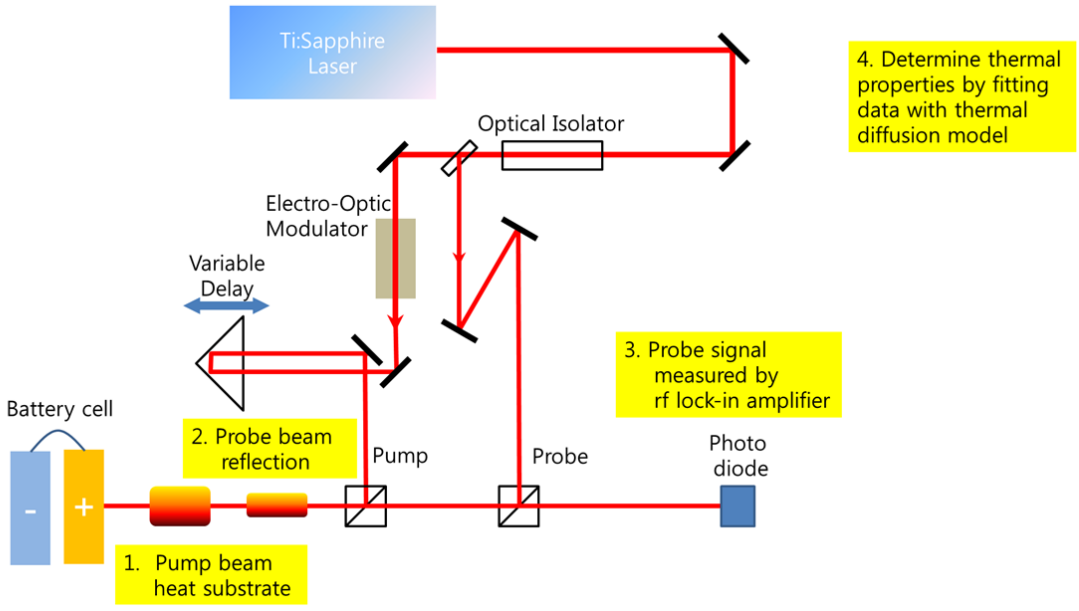
Lithiation and delithiation of the electrode materials in lithium-ion batteries can induce significant variations in the properties of the electrodes, including both mechanical strains and phase transitions in the host material. In some cases, this can even lead to plasticity, fracture and electrochemically driven solid-state amorphization. The thermal properties as a function of lithiation have not previously been measured, and may provide both an understanding of the fundamental behavior of battery electrodes, and if the change is significant, may provide a route to materials with tunable thermal properties. Here we present experimental thermal measurements of a lithium-ion cathode as a function of lithiation. We have constructed an electrochemical device consisting of a Li foil as an anode, a liquid electrolyte containing a Li salt, and a thin film $LiCoO_2$ cathode which enables direct real time measurements of thermal properties during electrochemical cycling. By applying an external electric current, Li ions can be intercalated or deintercalated within the host materials during discharge or charge, respectively. The thermal conductance changes significantly as a function of the charging level (degree of lithiation). The dependence of thermal transport properties on potential difference between cathode and anode may be explained by considering the effect of lithiation and delithiation on the electron carrier density; Li_xCoO_2 changes from a semiconductor to a metal as the degree of lithiation increases. Finally, we show that the thermal transport properties are reversible.



Coffee and cookies will be served

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