Synthesis and Characterization of LiFeSO₄F as Novel Cathode Material for Lithium-ion Batteries

By
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Abstract

Lithium ion fluorosulfate (LiFeSO₄F) is a novel cathode material and also a strong contender for next generation lithium-ion batteries. However, the inability to consistently synthesize high-performance LiFeSO₄F hinders its fundamental research to date. In this thesis project, two experimental protocols concerning the ionothermal and solvothermal methods have been developed. Impacts of precursor morphology, reaction temperature, and reaction time on the phase purity and electrochemical performance of resultant LiFeSO₄F have been assessed. Detailed experiments revealed that precursor size played a determining role in synthesizing LiFeSO₄F with good phase purity. Specifically, owing to the low solubility of LiF in organic solvents, submicron-sized LiF powders were prepared by a precipitation reaction. LiFeSO₄F powders were successfully synthesized in ionic liquid and in tetraethylene glycol. Succeeding characterizations confirmed the crystallinity and phase purity. The electrochemical performance was assessed in both coin cell and Swagelok cell configurations. Ionothermally-synthesized samples had better electrochemical performances than the solvothermally-synthesized ones, thanks to the enhanced electronic conductivity. Under a current density of C/20 (charge or discharge 1 Li⁺ in 20 hours), the best sample delivered a reversible discharge capacity of 128 mA h g⁻¹.

Date: 06 August 2014 (Wednesday)
Time: 09:30 am
Venue: Room 6602 (Lift 31-32)

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