Anode Solid Electrolyte Interphase (SEI) of Lithium Ion Battery Characterized by Microscopy and Spectroscopy

ABSTRACT

The surface reactions of electrolytes with the graphitic anode of lithium ion batteries have been investigated.[1-3] The investigation utilizes two novel techniques, which are enabled by the use of binder-free graphite anodes. The first method, transmission electron microscopy (TEM) with energy dispersive X-ray spectroscopy, allows straightforward analysis of the graphite solid electrolyte interphase (SEI). The second method utilizes multi-nuclear magnetic resonance (NMR) spectroscopy of D_2O extracts from the cycled anodes. The TEM and NMR data are complemented by XPS and FTIR data, which are routinely used for SEI studies. Cells were cycled with $LiPF_6$ and ethylene carbonate (EC), ethyl methyl carbonate (EMC), and EC/EMC blends. This unique combination of techniques establishes that for EC/$LiPF_6$ electrolytes, the graphite SEI is ~50 nm thick after the first full lithiation cycle, and predominantly contains lithium ethylene dicarbonate (LEDC) and LiF. In cells containing EMC/$LiPF_6$ electrolytes, the graphite SEI is nonuniform, ~10−20 nm thick, and contains lithium ethyl carbonate (LEC), lithium methyl carbonate (LMC), and LiF. In cells containing EC/EMC/$LiPF_6$ electrolytes, the graphite SEI is ~50 nm thick, and predominantly contains LEDC, LMC, and LiF.

Reference

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(3) Mengyun Nie, Daniel P. Abraham, Daniel M. Seo, Yanjing Chen, Arijit Bose, and Brett L Lucht. Role of Solution Structure in Solid Electrolyte Interphase (SEI) Formation on Graphite with LiPF6 in Propylene Carbonate (PC). *J. Phys. Chem. C.*