

LOW-TEMPERATURE XRD STUDIES OF LITHIUM BATTERY ELECTROLYTES BASED ON ETHYLENE CARBONATE – DIMETHYL CARBONATE MIXTURES

A. Drews, J. Adams, M. Karulkar, R. Kudla and C. Paik,

Ford Research and Advanced Engineering, Dearborn, Michigan, 48121, USA.

Batteries for electrification of vehicle power trains must be able to function over a wide range of environmental conditions. Poor low-temperature performance of lithium ion batteries severely limits their practicality in cold climates. Low temperature cycling experiments with a Li-ion cell built using an electrolyte made from a 3:7 (molar) mixture of ethylene carbonate (EC) – dimethyl carbonate (DMC) and LiPF_6 shows a severe loss of capacity below 5°C . Low temperature XRD vividly demonstrates that below $\sim 5^\circ\text{C}$, the electrolyte's equilibrium state is a two-phase mixture of frozen EC and DMC. We have examined several compositions of this common electrolyte used in lithium ion batteries using low-temperature XRD and report details of its phase stability and the thermal expansion of the individual phases. In addition, we propose a unit cell for DMC based on XRD results from multiple freezing experiments.