A Stable Solid Electrolyte Interface-Forming Additive for High-Voltage $LiNi_{0.5}Mn_{1.5}O_4$ Material

Satish Bolloju [a], Jyh-Tsung Lee [a]

[a] *Department of Chemistry, National Sun Yat-sen University, Kaohsiung 80424, Taiwan*

E-mail: bollojusatish@gmail.com

Electrode/electrolyte interface (EEI) is one of the key parameters that affect the cycle life and safety of lithium-ion batteries. The use of additives can significantly stabilize the EEI and improve the cycleability and cycle life of batteries.[1] (Pentafluorophenyl)diphenylphosphine (PFPDPP) has been used as an electrolyte additive for high-voltage $LiNi_{0.5}Mn_{1.5}O_4$ (LNMO) cathode material. Different quantities of additives (0.2 wt% and 0.5 wt%) were incorporated into the electrolyte solution containing 1M lithium hexafluorophosphate in a 1:1 (v/v) volume ratio of EC/DEC. Transmission electron microscopy images reveal that PFPDPP forms a solid electrolyte interface (SEI) film on the LNMO surface. Powder X-ray diffraction patterns demonstrate that although all the characteristic reflections of the spinel LNMO weaken after 300 cycles in the electrolyte without additive, they retain their peak intensities to a significant extent in the 0.2 wt% PFPDPP additive-containing electrolyte. The charge–discharge experiments indicate that even after 300 cycles of prolonged cycling from 3–5 V, the additive-containing cell maintains 71% capacity retention at a high C-rate of 2C. X-ray photoelectron spectra reveal that PFPDPP addition minimizes the formation of resistive LiF on the LNMO surface at such high operating potentials. From cyclic voltammetry measurements, a new peak has been identified for the additive-added electrolyte battery at ~3.45 V. The additive gets preferentially oxidized before the decomposition of the electrolyte under high potentials and forms a stable SEI, thereby significantly enhancing the cycle life of the cathode material.

References:

[1] S. S. Zhang, J. Power Sources. 162 (2006) 1379–1394.