UNIVERSITY OF RHODE ISLAND
Department of Chemistry
SEMINAR

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URI

"Exploration of additives for improving performance of high voltage $LiNi_{0.5}Mn_{1.5}O_4$/Graphite cells"

HOST

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Exploration of additives for improving performance of high voltage $LiNi_{0.5}Mn_{1.5}O_4$/Graphite cells

Yingnan Dong, URI Chemistry

Lithium ion batteries have been investigated extensively due to their widespread applications in portable electronic devices and electrical/hybrid vehicles. However, significant challenges still exist for an extended calendar life at a wide temperature range. Due to the intrinsic drawbacks of the commonly used $LiPF_6$-carbonate electrolyte systems, such as insufficient thermal stability at elevated temperature and unavoidable HF contaminants, much efforts have been paid to exploring novel additives. It is well known that the introduction of additives into electrolyte systems is one of the most effective and economic approaches to improve performances of lithium ion batteries.

In this presentation, novel class of borate compounds have been successfully synthesized and screened as additives for electrolyte of lithium ion battery. Nuclear magnetic resonance (NMR) spectroscopy was utilized to characterize compounds by dissolving additives into deuterated solvents. The cycling performance of these novel additives and other commercialized additives was compared by adding them into 1M $LiPF_6$ EC/EMC electrolyte, $LiNi_{0.5}Mn_{1.5}O_4$/Graphite cells are cycled under both room temperature and elevated temperature up to 4.8V. Electrochemical impedance spectroscopy (EIS) and Linear sweep voltammetry (LSV) were used to investigate electrochemical activity of additives. The investigation of the interrelationship of cycling performance, additive structure, and electrode surface film structure has been conducted by scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray photoelectron spectroscopy (XPS) and FT-IR. SEM and TEM images showed that novel additives can form uniform solid electrolyte interface (SEI) and cathode solid electrolyte interface (CEI). XPS and FT-IR spectra were acquired to analyze main components of SEI and CEI, and they are beneficial for further understanding how addition of additives changed surface chemistry of electrodes. The surface reactions of both additives and electrolytes with the graphitic anode and lithium nickel manganese oxide cathode of lithium ion batteries have been speculated. New additives can not only form more uniform SEI on surface of anode, but also beneficial for forming uniform CEI on surface of cathode.