

## **Improved performance of liquid- and gel-state electrolytes by using borate-based salts and ionic liquids**

**Akiko Tsurumaki**, Mario Branchi, Stefania Panero, and Maria Assunta Navarra  
Department of Chemistry, Sapienza University of Rome

For development of safe and high capacity lithium ion batteries (LIBs), improvements of electrolytes in terms of safety and reliability are necessary. In this study, cheap borate-based salts and ionic liquids have been used as an additive for commercially available liquid electrolytes in order to enhance thermal stability and the ability to form stable solid-electrolyte interphase (SEI) between electrolytes and high voltage electrodes. The electrolyte mixtures were tested in Li|LiNi<sub>0.5</sub>Mn<sub>1.5</sub>O<sub>4</sub> cells. The capacity retention rate of the cell was improved to 99.5% at most. By means of impedance spectroscopy, cyclic voltammetry, and infrared spectroscopy, it was confirmed that borate compounds form stable SEI and enable longer cycle life of LIBs. The electrolyte mixtures were also used to form gel-state electrolytes.