

SECM Dissolution Studies of Pasted Battery Cathodes in Ionic Liquid Electrolytes

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This work aims to detect the instability and consequent dissolution of cathode materials in alternate battery electrolytes known as room temperature ionic liquids. For this purpose, the scanning electrochemical microscope (SECM) has initially been used [1] to detect solubilisation of species leaving LiCoO₂ particles attached to a platinum electrode during charging and/or discharging in an ionic liquid electrolyte. A number of research groups, and ourselves, have reported extremely poor cycling of the cathode material, LiCoO₂ in ionic liquid electrolytes [2]. The dissolution of Co²⁺ and oxygen during over-charge and more so under deep discharge was detected by SECM.

The SECM studies have been extended [3] to LiCoO₂ / binder / conducting carbon pastes on aluminium foil current collectors to simulate the behaviour in a real battery system. Here similar results show dissolution of cobalt and oxygen at deep discharge and overcharge. The added complication is that at higher voltages the aluminium current collector becomes unstable and begins to corrode. Evidence for the combined dissolution of aluminium ions and cobalt ions is presented in this work.

The SECM technique is further utilised in examining alternate cathode materials, in particular high voltage cathode materials. The stability of these materials in the ionic liquid electrolytes (particularly at high positive voltages) is examined using this SECM technique.

The ultimate aim of this work is to employ strategies for dealing with the dissolution of the battery materials in ionic liquids, such as coating of electrode materials, using different electrolyte mixes, or use of alternate cathode materials. This SECM technique can then be used to assess the effectiveness of these dissolution mitigation strategies.

References

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[2] H. Sakaebe, H. Matsumoto (2003) *Electrochemistry Communications* 5, 594–598

[3] G.A. Snook, T.D. Huynh (2013) "Extension of SECM Dissolution Studies to Pasted LiCoO₂ Cathodes in an Ionic Liquid", submitting to *Electrochemistry Communications*