

PES/XPS Studies of the Interface Chemistry in PEO-Based Polymer Electrolyte Lithium Ion Batteries

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The importance of the solid electrode/electrolyte interface (SEI) layer chemistry is well known for conventional carbonate-based liquid electrolyte Li-ion battery systems, and much research has therefore been directed towards understanding its structure and kinetics. However, less attention has so far been devoted to the investigation of the electrode/electrolyte interface chemistry in solid polymer electrolyte lithium-ion batteries. There are a number of questions which are yet unanswered: Is the SEI layer formation similar also in these solid polymer electrolyte systems? What is its composition? Can degradation processes of the battery components be found also on these interfaces?

This work focuses on PEO-based solid polymer electrolytes. Results from different PEO-based electrolytes cycled in graphite “half-cells” will be presented. Since the water content in the polymer electrolyte will greatly affect the electrochemical performance, the effect of water in interfacial chemistry is also interesting and has been studied in this work. Photoelectron Spectroscopy (PES) is an extremely surface sensitive technique and able to determine the local chemical and physical environment. As such, PES is a suitable technique to understand the interface chemistry, and the main focus of this work.

The results obtained for the polymer systems are significantly different as compared to conventional liquid electrolyte systems, in which most of the electrode/electrolyte interface compounds are solvent reduction products. Degradations of LiTFSI salt as well as of PEO, which are otherwise considered to be inert, were observed in the investigations. The S2p spectra shown in Fig. 1 demonstrate salt decomposition on the graphite surface; the sulfur-containing product is supposedly $\text{Li}_2\text{S}_2\text{O}_4$ [1].

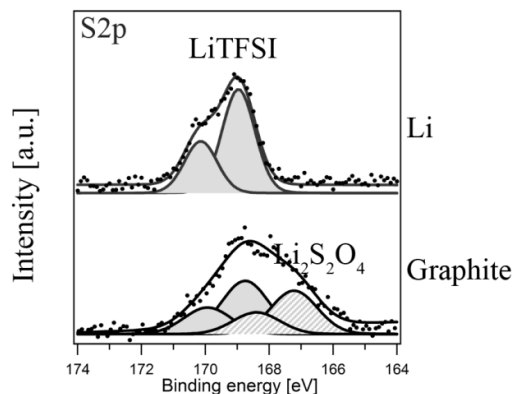


Fig. 1. S2p spectra for Li (top) and graphite electrode (bottom) cycled in a graphite “half-cell” using a solid polymer electrolyte.

- [1] C. Peng, L. Yang, S. Fang, J. Wang, Z. Zhang, K. Tachibana, Y. Yang, S. Zhao, *Journal of Applied Electrochemistry* **2010**, *40*, 653.