Cathode-related “SEI” phenomena in the Li-ion battery

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While much effort has been made in recent years to characterize the composition and properties of the so-called Solid Electrolyte Interphase (SEI) layer formed at the graphite-anode/electrolyte interface of a Li-ion battery [1], the same cannot be said of interface phenomena occurring on the cathode side of the cell, in spite of the fact that such phenomena can indeed be critical to the overall viability of the entire battery concept being considered; *e.g.,* corrosion at a $LiMn_2O_4$-electrolyte interface [2]. The very validity of the SEI-layer concept is even somewhat tenuous in a “cathode” context. For example; we do not actually know whether the interface phenomena involved are chemical or electrochemical in origin. It is at least clear that the overall character of the SEI-layer formed on either side of the cell is dramatically different for the cases studied. This is well exemplified by the much larger irreversible capacity loss and the higher mechanical stability of the layer formed on the graphite-anode side.

In this work, we focus on probing SEI-related phenomena at the cathode-electrolyte interface for $LiMn_2O_4$[3]; $LiCoO_2$ and $LiNi_{0.8}Co_{0.2}O_2$[4]; and $LiFePO_4$ (carbon coated) [5]. The various types of layers formed have been analysed systematically for different choices of salt, solvent, cycling mode, storage time, temperature, *etc.,* using Photoelectron Spectroscopy (PES) - exploiting both synchrotron and AlK_α radiation. The synchrotron studies were made on the I411 at the Swedish National Synchrotron Radiation Laboratory (MAX) in Lund. Depth-profiling of the layers was achieved for the case of AlK_α radiation using Ar-ion sputtering. Non-destructive depth-profiling by variation of the incident photon energy was possible using the synchrotron.

We will try to identify any general trends which emerge from the studies. Results will, in all cases, be related to the more familiar SEI-layer formed on graphite.

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