SFB 595 Deutsche Forschungsgemeinschaft DFG

Sonderforschungsbereich 595
Elektrische Ermüdung in Funktionswerkstoffen

TECHNISCHE UNIVERSITÄT DARMSTADT

Kolloquium im SOMMERSEMESTER 2011

30.06. 2011

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Investigation of electrode processes in lithium ion batteries by X-ray photoelectron spectroscopy and time-of-flight secondary ion mass spectrometry

Understanding of electrode processes occurring at the electrode/electrolyte interface and in the bulk electrode material is necessary for development of Lithium Ion Batteries (LIBs) namely the electrochemical performances and safety issues. The principal electrode processes are insertion/extraction reactions of positive and negative electrodes with lithium ions which induces changes in the host material, accompanied with decomposition of the electrolyte, which leads to formation of a solid electrolyte interphase (SEI) layer.
To study the electrode processes two techniques have been used: X–ray photoelectron spectroscopy (XPS) and time-of-flight secondary ion mass spectrometry (ToF-SIMS). XPS has been applied to investigate the surface, chemical composition of electrode materials including the SEI layer formed on the positive or negative electrodes by analysis of the valence band region and the related core levels. ToF–SIMS has been applied to cycled electrode materials providing information about the SEI layer and the depth and lateral distribution of species in the bulk electrode materials.
Three types of electrode materials will be presented: the thin films of transition metal oxides (i.e. V2O5) as positive electrode materials which undergo the intercalation/deintercalation process, and two types of negative electrode materials which undergo the conversion/deconversion process like the thin films of transition metal oxides or sulfides (i.e. FeS, Cr2O3) or alloying /dealloying process like the tin-based alloys (i.e. Sn-Co, Sn-Ni) and silicon thin films and silicon nanowires. XPS data show severe surface modifications which occur on the surface of negative electrode material already after the first cycle of charge/discharge due to formation of the SEI layer by reductive decomposition of electrolyte. The formation of the SEI layer on the negative electrode material is irreversible and its thickness can increase with increasing the number of charge/discharge cycles. ToF-SIMS depth profiles data show volume variation and trapping of lithium in the bulk of negative electrode material. Significantly different and less pronounced surface and bulk modifications can be observed in a case of positive electrode materials.

Die Vortrag findet um **16:15 Uhr** im Gebäude der Materialwissenschaften, Lichtwiese, Petersenstr. 23, **Raum 228,** statt.