

Buried interfaces in the graphite negative electrode of a Li-ion battery studied by HAXPES

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Graphite is commonly used as the negative electrode material in a commercial Li-ion battery. During the first insertion of lithium-ions into the graphite a Solid Electrolyte Interphase (SEI) is formed. This SEI is protecting the graphite electrode from unwanted side reaction such as, e.g. co-intercalation of solvent molecules, but its formation also leads to irreversible loss of battery capacity. The

composition of the SEI is complex including both organic and inorganic compounds. The content is dependent on the chemistry in the electrolyte. We have earlier shown that especially the anion in the lithium salt in the electrolyte influence the thermal stability of the SEI. There is still a debate going on if there is a depth gradient formed in the SEI or not and discussion about the “real” chemical content. The ambiguities shown in literature are based on the difficulty to really characterize these thin layers (in the range 5-20 nm). So far all published studies are based on ex situ studies done in post mortem by ripping the battery apart and depth profiles have mainly been obtained using Ar⁺ etching. In this presentation we will show how the combination of soft X-ray PES and HAXPES can give more reliable depth profiling results. We will even show, for the first time, that we can “see” the interface between the SEI and the lithium intercalated graphite. Depth profiling of the C1s, F1s, O1s, P2p peak are seen in the Figure 1.

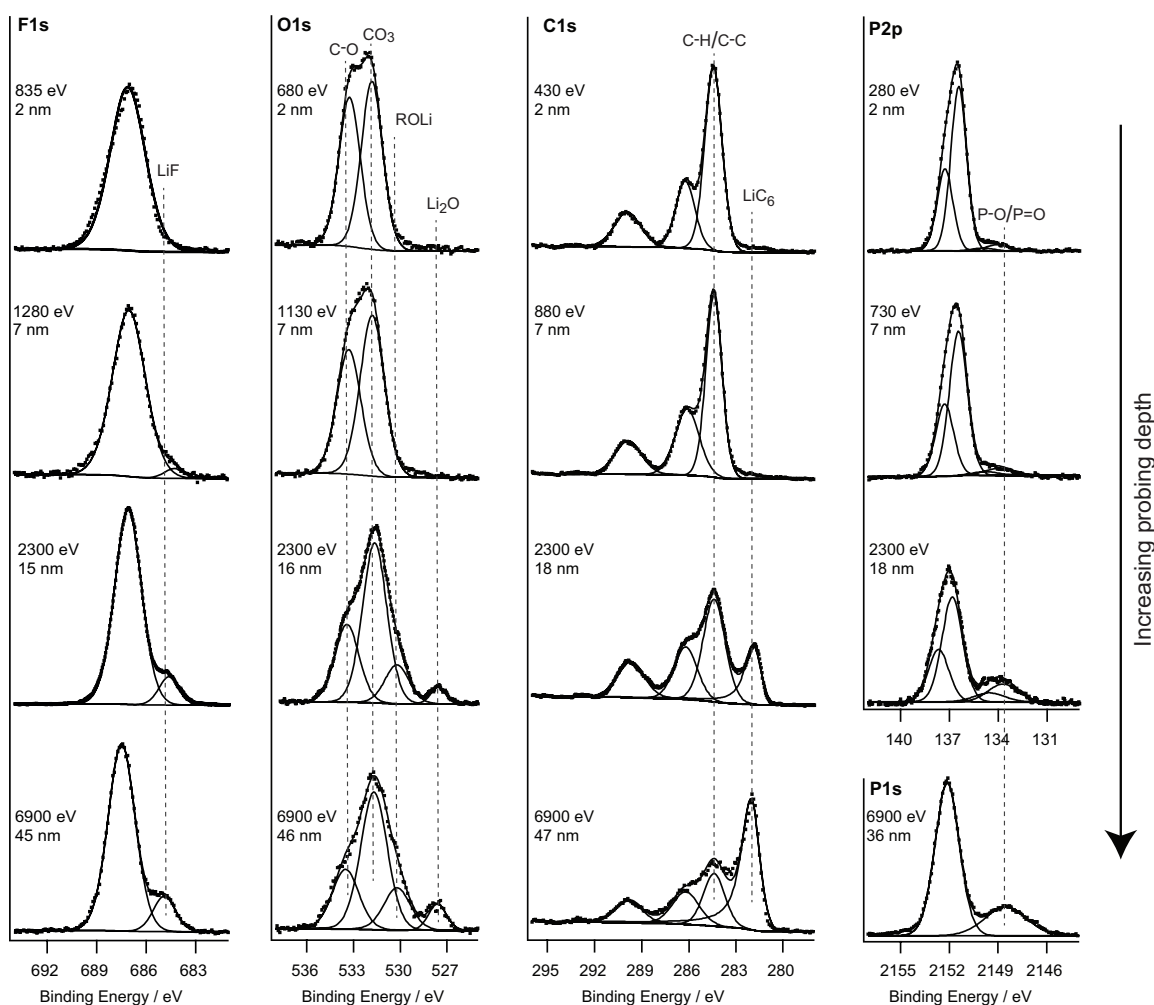


Fig. 1 Spectra of a graphite electrode cycled three times to intercalated and deintercalated states. The spectra were measured with photon energies of 2300 and 6900 eV at the Helmholtz Zentrum Bessy in Berlin, Germany.