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Investigation of the Solid-Electrolyte Interphase and Conversion Mechanisms of Fe_2O_3 Composites Electrodes via Soft X-Ray Photoelectron Spectroscopy - Li *vs.* Na batteries

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The properties of the SEI layers formed on composite nanostructured iron oxide electrodes upon cycling in Li- and Na-half cells[1] containing analogous electrolytes (i.e. $LiClO_4$, $NaClO_4$) have been investigated by an advanced non-destructive analysis based on Soft X-ray Photoelectron Spectroscopy (PES). Using synchrotron radiation, this approach has enabled probing the corresponding SEI layers at different depths by varying the photon energy hν. This methodology has granted access to a careful study of both the intimate structure and the compositions of these passivation films formed upon initial lithiation/sodiation of the electrode.[2] In this respect, understanding the SEI features without causing any interference or damage during the PES measurement processes has proved crucial to obtain a deeper insight into the specific mechanisms that lead to the formation of such films. The latter have a crucial technological relevance, since they directly affect the electrochemical performances of the active materials undergoing a particular electrochemical reaction, e.g. in a Li or Na cell. The results of this study will be presented highlighting the differences and the similarities that exist between these two electrochemical systems. In particular, it will be shown that such step-by-step analysis conducted on various electrodes left in a defined state of charge upon reduction (i.e. Li^+ or Na^+ uptake) and oxidation (i.e. Li^+ or Na^+ release) has revealed interesting differences for the structure of their respective SEI layers, as well as different covering properties in both cases. Finally, the mechanisms of nanostructured iron oxide upon reaction with Li^+ and Na^+ ions will be discussed. Additional information will be provided on the conversion reaction occurring at low potentials *vs.* Li^+/Li and Na^+/Na when the thickness of the grown SEI layer was not critical and has allowed probing the underlying active material, its oxidation state and surrounding chemical environment.

References

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