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# Solid Electrolyte Interphase (SEI) Formation in Sodium-Based Electrolytes

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Sodium-ion batteries (SIBs) have the potential to be more cost-effective and environmental friendly alternatives to their counterpart lithium-ion batteries (LIBs). One challenging obstacle is however the electrolyte decomposition at the negative electrode, due to the low electrode potential of common anode materials in SIBs (*i.e.* below 1 V vs. Na<sup>+</sup>/Na which is equal to about -1.7 vs. H<sup>+</sup>/H<sub>2</sub>). Hence, in order to obtain kinetically stable SIBs, formation of a passivation layer -known as the solid electrolyte interphase (SEI)- is crucial. In this regard, investigations on the electrolyte stability and the SEI formation are necessary.<sup>1,2</sup> In an ideal scenario, SEI forms during the initial discharging/charging cycle with minimum consumption of charge, stays intact, and acts like as an efficient passivating layer which is ionically conductive and electronically insulating. Compared to its Li-counterpart, SEI in Na<sup>+</sup>-based electrolyte systems is reported to be more soluble.<sup>3</sup> As a consequence, studies on SEI formation and dissolution trends in different Na<sup>+</sup>-based electrolyte systems have become vital.<sup>4,5</sup>

In this context, we broadened current knowledge about the SEI formation and its stability trends in different Na<sup>+</sup>-based electrolyte systems -with comparative experiments of Li<sup>+</sup>-based analogues. Via electrochemical techniques such as potentiometry and chronoamperometry tests on gold and platinum substrates, we have studied the electrochemical window of different electrolytes and the SEI dissolution during different relaxation times after certain discharging/charging cycles. In Li<sup>+</sup>-based electrolyte systems a stable SEI is maintained over a certain relaxation time, whereas the Na<sup>+</sup>-system shows SEI-dissolution after much shorter relaxation times. Composition and changes of the SEI over different relaxation times in Na<sup>+</sup>-electrolytes are evaluated by using synchrotron-based hard X-ray photoelectron spectroscopy (HAXPES) measurements. With the aim to understand the dissolution of SEI in Na-systems, the solubility of the SEI components has been analysed via inductively coupled plasma optical emission spectroscopy (ICP-OES).

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