Role of Solvents and Salts in Sb/Na Batteries: An XPS Analysis

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Recent concern about critical resources of lithium and the increasing need for electrochemical energy storage technologies has recently renewed the interest of sodium-ion batteries.[1,2] Among the promising active materials identified within the last few years, alloy-based compounds such as Sb-based materials have shown unexpected electrochemical performance in Na-ion batteries (NIBs) compared to those in Li-ion batteries (LIBs).[3] Electrolyte degradation and SEI formation are, however, expected to be critical due to the large volume expansion of the alloy reaction and the large ionic radius of Na. Nonetheless, the higher working potential (versus NHE) of NIBs compared to LIBs could limit this electrolyte degradation. Despite the concern about the critical role of the SEI formation and evolution during cycling in NIBs, only few studies have been performed so far.[4]

In this work, the role of the salts and solvents in Sb/Na coin cells was investigated by correlating the electrochemical performance with an XPS analysis.[5] Three electrolyte blends were studied: 1 M $NaClO_4$ in PC + 5% FEC, 1 M $NaPF_6$ in PC + 5% FEC and 1 M $NaPF_6$ in EC:DMC + 5% FEC. XPS showed that the passivation layer formed during cycling is mainly constituted of carbonates, Na_2CO_3 and alkylcarbonates that appeared during discharge after the deposition of NaF from the degradation of FEC. A key role of the solvent on the SEI properties was observed and will be presented. Also, the best compromise in terms of performance, found for the $NaClO_4$/PC electrolyte despite its high solvent viscosity, will be discussed regarding the XPS analysis results.

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