

Investigation of an in-situ chemically formed SEI from bis(fluorosulfonyl)imide based electrolyte on ordered mesoporous carbons

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The solid electrolyte interphase (SEI) and its growth is a primary driver of the capacity fade observed in lithium ion batteries. As a result, the electrolyte plays a critical role in the battery performance as the SEI that form is dependent on the electrolyte composition. Despite the widespread use of non-aqueous electrolytes, they are still plagued by numerous shortcomings. For example, the common LiPF₆ salt is a compromise salt amongst other commercially available Li salts. In regard to the solvents, these play a crucial role in terms of the ion conductivity and SEI formation. For example, ethylene carbonate (EC) has a relatively low melting point, which compromises the ionic conductivity of electrolytes at room temperature. It has recently been shown that ionic liquids (ILs) are suitable replacements for carbonate based electrolytes with increased safety, comparable ionic conductivity and slightly higher viscosity. However, the less commonly known relative of bis(trifluoromethane)sulfonimide (TFSI) that are widely used in IL solvents and battery electrolytes, is bis(fluorosulfonyl)imide (FSI) having outstanding chemical stability and low viscosity. In recent reports, the FSI salt based ILs has been shown to be a very promising battery electrolyte. Despite the great interest in understanding the SEI formation with typical widely used electrolytes, a detailed mechanism of the SEI formation is still lacking. Even more so with the FSI based ILs that forms an SEI to produce better performing battery performance. In this presentation we will show the formation of a chemically formed SEI, from an IL based electrolyte, 1-ethyl-3methylimidazolium (EMImFSI) with 0.5m LiFSI, by means of different complimentary techniques. We will show the SEI formation at mesopores and micropores as a function of discharge with operando SANS. The composition at specific discharge times are also probed by XPS. EIS is also employed to show the chemical formation of the SEI.