An ionic liquid based electrolyte for a stable SEI on Si anodes

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Battery technology plays a key role as we transition from fossil energy to electric energy from renewable sources. The Li-ion battery is the state of the art technology leading this transition, but the current performance, safety and price is not good enough to enable full implementation in transportation and grid applications. Replacing the currently used graphite anode with silicon allows for a theoretical tenfold improvement in charge capacity. However, the large volume expansion of silicon upon lithiation makes it incompatible with conventional electrolytes due to continuous electrolyte decomposition and excessive solid electrolyte interphase (SEI) formation[1]. Ionic liquid (IL) based electrolytes may be a solution to this problem, one that will have the added benefit of increased safety due to their higher thermal and electrochemical stability and nonflammability[2, 3].

Room temperature ionic liquid (RTIL) based electrolytes were prepared with lithium bis(fluorosulfonyl)imide (LiFSI) salt and tested electrochemically in a half-cell configuration with a 73 % Si composite electrode vs Li metal. Post mortem characterization of the cycled Si electrode was conducted using FTIR as well as FIB-SEM in combination with EDX to examine the extent and composition of SEI formation.

A RTIL electrolyte with an ionic conductivity comparable to conventional carbonate based electrolytes shows promise in the initial electrochemical testing, forming a strong SEI layer that enables a long cycle life of the silicon electrode even at higher rates.

References:

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