Ultra-high performance all-solid-state Li-S cells: Effect of Salt anion's chemistry and functional additives

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Amid lithium metal (Li°)-based rechargeable batteries, lithium-sulfur (Li-S) batteries are considered as the most promising and possibly enabling next generation energy storage technologies. This is attributed to their overwhelming advantageous features such as high theoretical energy density (2600Wh kg^{-1}), abundance of sulfur cathode resources, low cost, and environmental benignancy.[1,2] However, despite the above benefits, their practical deployment is hampered by several seemingly intrinsic technological challenges such as the complex cell chemistry, dendrite growth resulting in short life span, electronically insulating nature of S_8 ($\sigma \sim 1*10^{-30}$ S m^{-1}) and its lower order reduction products (i.e., Li_2S, $\sigma \sim 1*10^{-14}$ S m^{-1}), polysulfide (PS) shuttling effect between anode and cathode electrodes, deleterious electrochemically induced large volume expansion from S_8 to Li_2S (~ 80%) etc.

With the aim of overcoming such inter-linking challenges, we embarked on a detailed investigation on the effect of functional electrolytes constituents, enlisting additives, salt anions, fillers etc., for applications in all-solid-state Li-S cells.
After a screening of a large number of salt anions and additives, an ultra-high performance all solid-state Li-S batteries with robust SEI layer, excellent discharge/areal capacity, stable long-term cyclability, high coulombic/energy efficiency have been achieved.

Hence, in this presentation, the role of salt's anion chemistry, and functional additives on the overall performance of solid polymer electrolytes (SPEs)-based Li-S batteries and their escorting working mechanisms are detailed.

References:

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