Short Communication

Polyelectrolyte Self-assembled Modified Ceramic Membrane and its Application in Lithium-Sulfur Batteries

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As one of the candidates for lithium-ion batteries, lithium-sulfur (Li-S) batteries have received extensive research and attention. However, the shuttle effect of soluble lithium polysulfide has hindered the commercial application of Li-S batteries. Therefore, this paper proposes the use of a polyelectrolyte self-assembled modified ceramic separator to inhibit the shuttling of lithium polysulfide intermediates. First, a layer of silica was applied on the surface of a polyethylene (PE) separator. Then, polyethyleneimine (PEI), polyacrylic acid (PAA), polydiallyldimethylammonium chloride (PDDA) and sodium polystyrene sulfonate (PSSNa) were selected to synthesize two self-assembled cationic/anionic polyelectrolytes. Finally, layer-by-layer (LBL) self-assembly technology was used to grow the polyelectrolyte in situ on the ceramic separator to form a functional separator. Galvanostatic charge/discharge revealed that the LBL4-PEI-PAA separator and LBL4-PDDA-PSSNa separator have improved specific capacity and cycle performance compared to the PE separator, and there is no obvious overcharge phenomenon when using an electrolyte without a lithium nitrate additive. In particular, the LBL4-PDDA-PSSNa separator has a first-lap discharge specific capacity of 981.8 mAh/g. The capacity retention rate is 88.9% after 100 cycles, which effectively suppresses the lithium polysulfide shuttle effect.

Keywords: lithium-sulfur battery, shuttle effect, self-assembly, cation/anionic polyelectrolytes

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