Dual-Layered Film Protected Lithium Metal Anode to Enable Dendrite-Free Lithium Deposition

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Lithium metal batteries (such as lithium–sulfur, lithium–air, solid state batteries with lithium metal anode) are highly considered as promising candidates for next-generation energy storage systems [1]. However, the unstable interfaces between lithium anode and electrolyte definitely induce the undesired and uncontrollable growth of lithium dendrites, which results in short-circuit and thermal runaway of the rechargeable batteries [2]. If a stable and controllable film can be built between Li metal and electrolyte, not only the growth of lithium dendrites can be suppressed, but also the continuous breakup and repair of solid electrolyte interphase film can be avoided during repeated cycles [3].

Herein, a dual-layered film is built on Li metal anode by the immersion of lithium plates into the fluoroethylene carbonate solvent (**Figure 1**). The ionic conductive film exhibited a compact dual-layered feature with organic components ($ROCO_2Li$ and ROLi) on the top and abundant inorganic components (Li_2CO_3 and LiF) in the bottom. The dual-layered interface can protect Li metal anode from the corrosion of electrolytes and regulate the uniform deposition of Li to achieve a dendrite-free Li metal anode [4].

When the Li metal with the dual-layered film is applied to pair with $LiNi_{0.5}Co_{0.2}Mn_{0.3}O_2$ cathode, a high discharging capacity of 157.8 mAh g^{-1} and a large capacity retention of 68.2% in 120 cycles are achieved, which is much higher than 151.7 mAh g^{-1} and 19.1% for Li metal batteries with a pristine Li anode, respectively.

This work demonstrates the concept of rational construction of dual-layered structured interfaces for safe rechargeable batteries through facile surface modification of Li metal anode. This is not only critically helpful to comprehensively understand the functional mechanism of fluoroethylene carbonate, but also affords a facile and efficient method to protect Li metal anode.

References:

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