Improved performances of surface modified lithium metal anodes

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Due to the highest theoretical specific capacity and low redox potential, lithium (Li) metal battery could meet the demand of high energy density. However, high reactive and dendrite issues of Li anode restrict the development of Li metal battery. Inhibition of Li dendrite and reducing side reaction between Li anode and electrolyte are two key points to improve the performance. The modification of Li surface is of significance for its practical application. We designed a multifunctional electrolyte additive, where KNO3 is applied to in situ modify metallic Li surface in a chemical method. The K+ cation could form a positively charged electrostatic shield to suppress Li dendrite, and simultaneously NO3− anion can be profitable to the reinforcement of SEI, thus the average coulombic efficiency was improved significantly from 13 to 97% as shown in Figure 1a.[1] Since the in-situ chemical treating method is able to stabilize SEI successfully for expanded cycling lifetime, it is very reasonable to expect that a facial physical/chemical means can ex-situ modify metallic Li surface effectively. To verify this speculation, we used a chemical means ex-situ to build an effective artificial SEI by immersing Li anode in HIO3 solution. By using the modified Li anode in Li-S batteries, the satisfactory discharge capacities were obtained from Figure 1b. [2] In addition, the physical coating method via magnetron sputtering is also appropriate to tune Li surface condition. As shown in Figure 1c-d, amorphous Li3PO4 and Al2O3 coating layer can uniform the distribution of electric field on Li surface, resulting in even Li deposition.[3] [4]

In summary, either in-situ or ex-situ chemical/physical methods modified Li surface was verified to be effective to suppress Li dendrite for advanced performance.

Figure 1. (a) Coulombic efficiency of Li-Cu cells of different KNO3 concentrations. (c) Long-cycle profiles of Li-S cells with pristine Li and HIO3-treated Li. (c) Comparison of symmetric Li-Li cells with pristine Li and Li@Li3PO4. (d) Voltage profiles of the symmetric Li-Li cells with different thickness Al2O3 film as artificial SEI layer.

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