Investigations of organic molecules and oligomers in lithium-ion battery

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Lithium-ion battery (LIB), the most popular secondary battery used in the past three decades. To satisfy the requirements of electric vehicle, drone, and energy storage, the developments on cathode, anode, and electrolyte are going fast. For more detail, such as safety, high energy density, fast charging, long cycle life, and low cost are the necessaries for next generation design. To precisely control the electrochemical reactions in LIB, put more efforts on the improvements of the interfacial reaction is essential. In case of traditional battery, vinylene carbonate and fluoro ethylene carbonate are the common electrolyte compositions used to modify the solid electrolyte interface (SEI) on graphite or Si anodes, which lowers the impedance of battery. On the cathode side, transition metal oxide such as Al_2O3 or LIPON are also the common methods to prevent electrolyte decomposition, typically on Ni-rich materials.

In this talk, the interfacial reaction on both anode and cathode are disclosed. Several organic molecules are picked up for satisfying the possibility in LIB. For examples, the maleimides had been selected to form new SEI formation [1, 2], safety application [3, 4], Li_2CO_3 decomposition [5, 6], new cathode electrolyte interphase formation [7, 8] and Li metal deposition [9, 10]. By controlling the molecule structure from maleimides and its derivatives, we found the spontaneous reaction of Ni ion is performed as well as a new formation Li^+ solvation with carbonates.

How to improve the battery performance for next generation of LIB? I would like to say it is the ionic transfer of interface in between active and electrolyte, no matter the purposes to fast charging or extend cycle life or safety issue.

Reference

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