Highly-stabilized Lithium Metal Anode

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With the fast-growing technology, demands for high energy density storage systems increase. For lithium ion battery industry, graphite/ silicon-based anode materials still used today will no longer meet the requirements. Unlike graphite stored energy with intercalation or silicon with metal alloying process, lithium metal, which poses the lowest potential (−3.04 V vs. standard hydrogen electrode), lightness (0.59 g cm^{-3}) and the highest theoretical specific capacity (3860 mAh g^{-1}), undergoes chemical redox process having the most potential for great energy density.

However, due to high activity of lithium metal, not only electrolyte but lithium are easily consumed leading to short cycle life; in addition, uneven deposition of lithium metal during charging process gradually forms dendritic dendrite which could puncture separators, touch the counter electrode and finally cause short circuit. Based on two main issues of lithium metal mentioned above, it is quite grand challenge to commercialize lithium metal battery.

Herein, our groups propose several strategies targeting lithium anode issues of safety and efficiency including formation of highly-stable solid electrolyte interphase (SEI), high-safety electrolyte system, functional-modified separators, and anode structures designed to obtain evenly electric field and solve volume expansion issue. In respect to anode structures, either conductive or non-conductive materials were used to distribute current density resulting in less dendritic dendrite as shown in Figure 1. In our study, lithium half cells were assembled into coins or visualization cells for electrochemical analysis and in-situ optical verification under current density of 1 mA cm^{-2}.

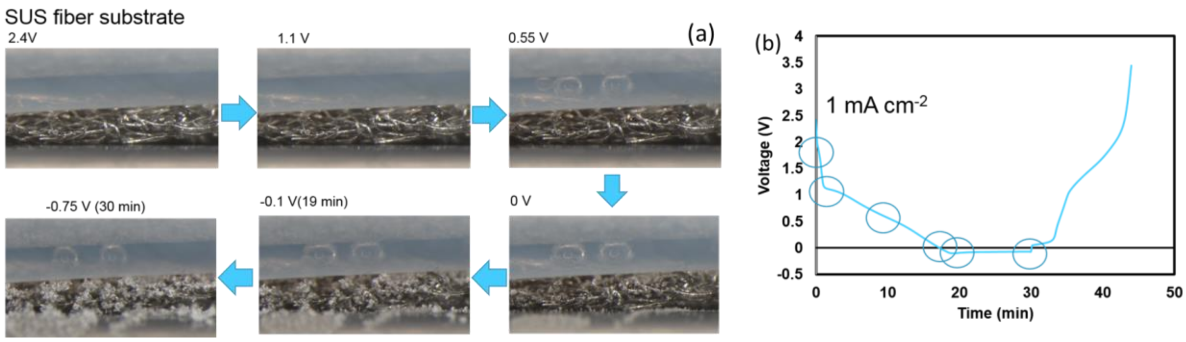

Figure 1. (a) lithium plating in stainless fiber substrate; (b) voltage profiles of lithium plating and stripping.

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