Effects of butadiene sulfone as an electrolyte additive on the formation of solid electrolyte interphase on $Li_4Ti_5O_{12}$ anode in lithium-ion batteries

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Abstract

Graphite has been currently used as the commonly-used anode material in commercial lithium-ion batteries (LIBs). The low operating voltage of graphite in nature leads to the reduction of lithium metal on its surface (~0.2V vs. Li^+/Li) during discharging, thus possibly affecting the safety of LIBs. Spinel $Li_4Ti_5O_{12}$ (LTO) has been considered as a promising material to replace the graphite as anode material because of its high operating potential plateau (at 1.55V vs. Li^+/Li) and nearly zero volume change during charging/discharging process. It has been gradually evidenced that solid electrolyte interphase (SEI) could form on the LTO surface. Generally, the SEI film plays a crucial role in the cycling performance of LIBs, which can not only passivate anodes to prevent the continuous degradation of electrolyte species, but also ensure the Li^+ diffusion across it.

In this study, butadiene sulfone (BS) was employed as an electrolyte additive for the LTO-based LIBs. The effects of the BS additive on the formation of SEI film with LTO anodes and their corresponding electrochemical performance were systemically investigated. According to the results of galvanostatic charge/discharge tests, LTO electrode in the electrolyte containing 0.5 wt.% BS showed the superior electrochemical performance than that in the absence of BS. It was found that the use of BS as an additive could accelerate the growth and stabilize the SEI film on the LTO surface, and therefore improve the electrochemical stability of LTO electrodes. Additionally, XPS and ATR FT-IR studies revealed that sulfur containing electrolyte can provide Li_2SO_3 in the SEI film, it act as an accelerator to help SEI film formation of more stable and smooth, and contributes to build a more protective SEI film. Therefore, the introduction of BS as an electrolyte additive has promising potential application for the improved electrochemical performances of LTO-based anode materials in high-rate LIBs.