

Conquering Corrosion of Aluminum Current Collector in Commercial Lithium-Ion Battery Via 2D Conductive Nanosheets Assembled films

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Abstract Elevating operating voltage is a consequential approach to increasing the energy density of lithium-ion batteries (LIBs). Unfortunately, the corrosion of cathode aluminum (Al) current collector at high voltage limits the application of high-voltage LIBs. And this report describes the corrosion inhibition on the Al current collector in commercial LiPF₆-ester electrolyte (LB-092) by constructing conductive barrier layers. MXene-Ti₃C₂T_x nanosheets are proposed as an armored layer for Al. The Ti₃C₂T_x layer is fabricated via a self-assembly procedure, which exhibits ultra-thinness less than 100 nm, attaches to Al substrate homogeneously, and ensures the electron conduction by virtue of outstanding conductivity. Ti₃C₂T_x-Al can comprehensively enhance the cyclic and rate performance of Li|NMC333 battery at a cut-off voltage of 4.5 V and delay the trend of self-discharge. However, the preparation and storage of Ti₃C₂T_x-Al rely on an inert argon atmosphere in a glove box. To further enhance the industrial feasibility, MXene-Mo₂CT_x with greater chemical stability is firmly deposited on the Al surface through electrophoretic deposition. And to broaden the electrochemical stability of Mo₂CT_x-Al, a mild tactic of potentiostatic polarization is applied to tailor Mo₂CT_x terminal at around 5.3 V vs. Li/Li⁺ for 60 s. After electrochemical tailoring, the -F terminal ratio is significantly increased. The obtained Mo₂CF_x-Al exhibits uniform electrical conductivity similar to bare Al and outstanding antioxidation over 5 V vs. Li/Li⁺. As a consequence, Li|NMC333 using Mo₂CF_x-Al demonstrates superior electrochemical performance at a higher cut-off voltage of 4.6 V. The discharge capacity retention is increased from 7.0% to 62.3% after 500 cycles at 0.5 C. And the rate performance at 3 C is also improved by about 300 %. This report contributes to the surface engineering and application of MXene nanosheets, as well as provides an effective strategy for developing stable high-voltage LIBs.

Keywords Aluminum current collector, Pitting corrosion, Ti₃C₂T_x MXene, Mo₂CT_x MXene, Fluorinated functionalization, Lithium-ion battery

Reference

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