Engineering Electrode and Electrolytes Enhances Lithium Cycling Efficiency

Addisu Alemayehu Assegie[a], Ju-Hsiang Cheng[a], Li-Ming Kuo[a], Wei-Nien Su[b], Bing-Joe Hwang[a,c*]

[a]*Department of Chemical Engineering and* [b]*Graduate Institute of Applied Science Technology, National Taiwan University of Science and Technology, Taipei 10607, Taiwan.*

[c]*National Synchrotron Radiation Research Center (NSRRC), Hsinchu 30076, Taiwan.*

Email: bjh@mail.ntust.edu.tw

Abstract

Practical implementation of a lithium battery or an anode-free battery with promising high capacity is hampered by dendrite formation and low coulombic efficiency[1,2]. Most notably, these challenges stem from non-uniform lithium platting and unstable SEI layer formation. Here, we revealed a homogeneous lithium deposition and effective dendrite suppression with engineering electrode surface and electrolytes. Surface coating reinforces a thin and robust SEI layer film formation via hosting lithium and regulating the inevitable reaction of lithium with electrolyte. The engineered electrode showed stable cycling of lithium with an average coulombic efficiency of ~100% over 200 cycles and low voltage hysteresis (~30 mV) at current density of 0.5 mA cm^{-2}. Moreover, we have proved the anode-free battery experimentally by integrating it with the $LiFePO_4$ cathode into a full cell configuration. The new cell demonstrated stable cycling with average coulombic efficiency of 98.6% at 200^{th} cycle with 0.2 C rate. These impressive enhanced cycle life and capacity retention results from the synergy of electrode modification, high electrode-electrolyte interface compatibility, and stable SEI formation. Our result opens up a new route to realize the anode-free batteries by engineering electrode and electrolytes to achieve ever demanding yet safe interfacial chemistry and controlled dendrite formation.

References:

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