Enhanced interface stability of polymer electrolytes using organic cage-type cucurbit[6]uril for lithium metal batteries

Long Chen, Li-Zhen Fan*
Institute of Advanced Materials and Technology, University of Science and Technology Beijing, Beijing, 100083, China

E-mail: fanlizhen@ustb.edu.cn

Safety, high energy density and long cycling stability are believed to the most three urgent concerns to develop next-generation high-performance lithium ion batteries. Lithium metal anode is attractive owing to the extremely high theoretical specific capacity and the lowest negative electrochemical potential. However, the use of metallic lithium anode has been limited by the poor interface stability with the electrolyte along with the occurrence of dendrite growth. Here, we report a self-standing flexible composite polymer electrolyte (CPE) incorporated with organic robust cage-type cucurbit[6]uril (CB[6]). Poly(ethylene oxide)-Lithium bis(triuoromethanesulfonyl)imide with 35 wt. % CB[6] composite electrolyte exhibits a wide electrochemical window at 55 ºC (4.7 V vs. Li^+/Li) and sufficient thermal stability (380 ºC). The CPE could significantly suppress the growth of Lithium dendrites on the surface of lithium anodes due to the addition of CB[6]. At 0.5 C rate under operation temperature of 55 ºC, the $LiFePO_4$|CPE|Li battery demonstrates excellent cycling performance, which indicates that such CPE membranes can be applied to ambient–temperature all-solid-state lithium metal batteries.

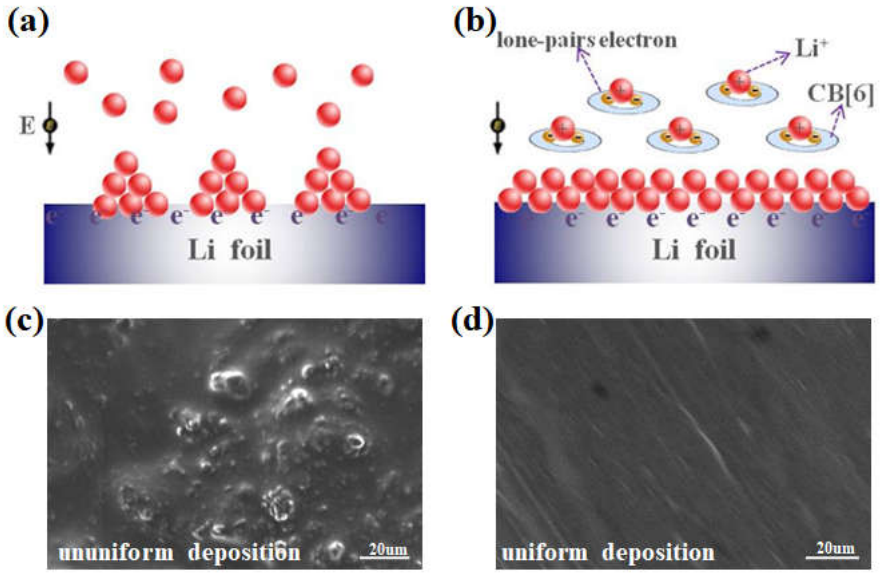

Figure 1: The model exhibitions of (a) ununiform deposition and (b) uniform deposition of Li metal on the surface of anodes. FE-SEM images for the surface of the Li electrodes obtained from (c) $LiFePO_4$|PEO_8-LiTFSI|Li cell after 100 cycles at 0.5 C; (d) $LiFePO_4$|PEO_8-LiTFSI-35% CB[6]|Li cell after 100 cycles at 0.5 C.

References:

[1] L. Chen, Y. C. Liu, L. Z. Fan, J. Electrochem. Soc. 164 (2017) A1834-A1840.