Fluorinated Electrolyte design for High Voltage Lithium Metal Battery

Tesfaye Teka Hagos[1], Wei-Nien Su[1,*],Shuo-Feng Chiu[2], Chen-Jui Huang[2], Balamurugan Thirumalraj[2], Jim Cherng[4], Bing-Joe Hwang[2,3,*]

[1]*Nano-electrochemistry Laboratory, Graduate Institute of Applied Science and Technology, National Taiwan University of Science and Technology, Taipei 106, Taiwan*
[2]*Nano-electrochemistry Laboratory, Department of Chemical Engineering, National Taiwan University of Science and Technology, Taipei 106, Taiwan*
[3]*National Synchrotron Radiation Research Center, Hsin-Chu, Taiwan*
[4]Amita Technologies Inc., Taoyuan County 33349, Taiwan
Corresponding Authors: wsu@mail.ntust.edu.tw; bjh@mail.ntust.edu.tw

Abstract

Rechargeable lithium-metal batteries are considered as the most viable future technology, with higher energy density than existing technology. However, realizing these batteries in practical applications is still handicapped. The major reason for the failure of such batteries is absence of stable electrolyte with high voltage cathodes. To mitigate this issue developing a functional electrolyte is therefore the key solution to bring it into practical application. Therefore, here we developed cost effective, highly fluorinated interphases forming new electrolyte solution of carbonate-ether mixed fluorinated electrolyte design with the standardized commercial salt $LiPF_6$ which is stable at wider potential (2.5-4.5 V). The designed electrolyte suppresses dendrite growth, form conductive and stable LiF dominated solid electrolyte interface (SEI) and anode-free lithium metal battery using Cu‖$LiNi_{0.3}Mn_{0.3}Co_{0.3}O_2$ is used as optimizing tool. Best performance with high average Coulombic efficiency (98.7%) and high retention capacity for long cycles with 0.5 mA/cm^2 current density both in the anode free system and NMC/MCMB full cell was achieved. The enhanced cycle life and well retained in capacity using the as-prepared electrolyte is mainly because of the stable solid electrolyte interphases (SEI) as confirmed from the XPS results. This is electrolyte combination is new and the best electrolyte ever reported for anode-free lithium metal battery to our knowledge.

Keywords: *Fluorinated Interphase; High voltage electrolyte; carbonate-ether mixed solvent; copper foil,*