UNIVERSITY OF CALIFORNIA, IRVINE

THE DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

Is Proud to Host a Seminar by:

PROFESSOR JUCHEN GUO

Dept. of Chemical and Environmental Engineering

CHAIR, Materials Science and Engineering

University of California, Riverside

Thursday, November 10, 2022

2:00-3:20 PM

Location: McDonnell Douglas Engineering Auditorium

ELECTROLYTES FOR RECHARGEABLE ALUMINUM BATTERIES

Abstract: Reversible electrochemical reactions of aluminum (Al) is an intriguing topic from both scientific and technological perspectives. The centerpiece of reversible Al electrochemistry is the electrolyte. To date, the overwhelming majority of Al battery research activities utilize Lewis acidic chloroaluminate ionic liquids as the electrolytes. However, the complex nature of these electrolytes, such as corrosiveness, proneness to oxidation, and rich coordination, can lead to unintended parasitic reactions. We also investigated the chemical compatibility of $AlCl_3$-[EMIm]Cl electrolyte (mixture of aluminum chloride and 1-ethyl -3-methylimidazolium chloride) with V_2O_5, which is a common cathode material reported in the literature of Al battery. Our study indicates V_2O_5 chemically reacts to both Lewis neutral and Lewis acidic $AlCl_3$-[EMIm]Cl. By elucidating the reaction mechanisms, we conclude V_2O_5 is not a feasible Al storage material in the chloroaluminate ionic liquid electrolytes. To understand the formation mechanism of chloroaluminate anions on organic solvents, we studied the change of coordination structures of $AlCl_3$ in g-butyrolactone (GBL) as a function of molar ratio of $AlCl_3$/GBL. Finally, as an attempt to move beyond chloride-contain electrolytes, we for the first time synthesized and characterized an organic electrolyte based on Al salt with weekly coordinating anions, namely aluminum hexafluorophosphate ($Al(PF_6)_3$). These findings could provide guideline for design more reliable electrolytes for rechargeable Al batteries.

Bio: Juchen Guo is a Professor in the Department of Chemical and Environmental Engineering and the Chair of the Materials Science and Engineering Program at the University of California – Riverside. His research interests focus on the interfacial phenomena and material properties in electrochemical energy storage systems including lithium metal, lithium-sulfur, and multivalent-ion batteries such as magnesium and aluminum systems. Juchen Guo earned his Bachelor degree in chemical engineering from Zhejiang University in 1999 and his Ph.D. in chemical engineering from University of Maryland in 2007. He performed postdoctoral studies at University of Maryland from 2007 to 2011 and Cornell University from 2011 to 2012 prior to joining UC Riverside in 2012. He was the recipient of 2014 Hellman Fellowship and 2018 NSF CAREER Award.