Redox Targeting of Lithium-Ion Storage Material with Redox Mediators — from Microscale to Macroscale

Date: 10 December 2018 (Monday)
Time: 2:00pm to 5:00pm (1st hour of defense)
Venue: EA 02-11

Abstract

“Redox-targeting” reaction of battery materials is the chemical redox reaction between the battery materials and redox molecules. In redox-targeting-based flow batteries, redox-targeting reaction takes place as the redox molecules flow through the inter-macro-pores between the battery materials packed in the energy storage tank. The reaction is the key process that dictates the energy density and to a great extent the power density of the system and is in essence divided into three length-scales: microscopic charge transfer at material-electrolyte interface; mesoscopic charge transport in a single material granule including mass transport in the granule and charge transport (Li+, e-) in the crystal; and macroscopic charge transport in the tank including convection and diffusion of species and the integrated redox reaction. In this thesis, a systematic study was conducted on these three scales of the reaction of a lithium-ion storage material — LiFePO₄ as the starting point of a more comprehensive understanding of the reaction. A reliable approach was developed to quantify the interfacial charge transfer kinetics of the delithiation/lithiation of LiFePO₄/FePO₄ by redox mediators using scanning electrochemical microscopy. In the next step, LiFePO₄/FePO₄ were granulated into spherical pellets as the smallest material unit in the tank. Redox targeting of LiFePO₄/FePO₄ at the latter two scales were studied through in situ and Operando UV-Vis spectroscopy, which revealed the reaction kinetics throughout different conversion stages of LiFePO₄/FePO₄ pellet and reaction kinetics in the energy storage tank.

Biography

Ms. Yan Ruiting is a Ph.D. student in the Department of Materials Science and Engineering, National University of Singapore. She received her B.S. degree in the Department of Materials Science and Engineering from Shanghai Jiao Tong University. Her research interests include the study of the kinetics of heterogeneous electrochemical/chemical redox reactions at different length/time scales and the “redox-targeting” reaction in electrochromic applications, etc.

ALL ARE WELCOME!

Speaker Yan Ruiting

Prof Ding Jun Host