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In-situ Neutron Reflectometry Investigations for Redox-Mediated Electrochemical Separations

Innovations in separation technologies are critical to guarantee our supply-chain security, the availability of chemical and materials resources, and clean air and water at a global scale. Electrochemical separations provide a modular, reversible, and energy-efficient separations that can be integrated with renewable energy, and eliminates secondary waste. Core to this process is understanding the ion-interface interactions during electrochemical control. Here, we discuss recent advances from our group on the design of redox-(co)polymers for imparting selectivity towards a range of ion-selective separations, and the role of neutron reflectometry (NR) in understanding the ion binding and release phenomena. Through redox-electron transfer, we can impart remarkable selectivity and reversibility to the ion binding process. We discuss how in-situ neutron reflectometry, ellipsometry, and electrochemical quartz-crystal microbalance can discriminate ion-selective ingression onto redox-polymer films, and the effect of solvation on the electrosorption process. We also present recent investigations on controlling solvation through copolymer design, and how NR can provide detailed insights into spatiotemporal solvation profiles. We expect that a deeper understanding of solvation and valency effects through NR will greatly expedite the development of targeted selective ion-electrosorption systems.

Topic

Separation

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