Contribution ID: **14** Type: **Invited Speaker Abstract**

Significance of Electrode-Electrolyte Interfaces for Energy Storage and Conversion Processes

Ionic Liquids (ILs) and deep eutectic solvents (DESs) received great attention as electrolytes in electrochemical processes due to their wide electrochemical window, low volatility, lack of flammability, good solvent strength, and task specific tunability. These electrolytes are concentrated and present different interfacial behavior, compared to dilute electrolytes, that depends on the structure of their constituents and the electrode material. In particular, ILs are described to undergo potential-dependent reorientations and restructuring while less is understood for DESs. The interfacial behavior has direct control over capacitive storage, solid-electrolyte interface evolution on reactive metals, electrodeposit morphology, and electrocatalytic reaction kinetics. However, probing the electrode-electrolyte interfaces of these liquids is challenged by the buried nature of the interface and the difficulty in decoupling the spectroscopic signal of the bulk and interface that is contained with the nm-length scales on the electrode surface. In this talk, I will provide a summary of our investigations utilizing Surface Enhanced Raman Spectroscopy (SERS), Neutron Reflectivity (NR), and Electrochemical Impedance Spectroscopy (EIS); highlighting capabilities and remaining needs. The specific examples on how the collective information obtained from these techniques helps us identify the important factors in controlling reaction outcomes will include electrochemical CO2 reduction and organic redox reactions relevant to flow batteries.

Topic

Energy Materials

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