SPECIAL MATERIALS SEMINAR

XIAOLIANG WEI

Pacific Northwest National Lab
Richmond, Washington

"Materials Development for Organics-based Redox Flow Batteries to Enable Durable Grid Energy Storage"

Monday

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1:30 pm

Room 9341

Chemistry Bldg.

Redox flow batteries have been considered as one of the most promising grid energy storage technologies. In flow battery design, energy-bearing electroactive materials are dissolved in liquid electrolytes stored in external tanks, which are pumped through the electrode compartments for electrochemical energy conversion. Such a cell structure allows independent scaling of electrolyte volume and electrode size, decoupling the energy and the power. This advantage offers excellent scalability, modular manufacturing, and great design flexibility to meet different energy-driven or power-oriented grid applications. The electroactive materials are the core of flow batteries, which dominates the energy density (i.e., solubility), redox potential, and durability. Recently, there is a gradual shift from traditional metallic compounds to organic compounds. The former generally suffer from limited solubility, low electrochemical reactivity, and/or high cost. On the contrary, organic compounds may offer exceeding material candidates because of their structural diversity, molecular tailorability, natural abundance, and potentially low cost.

This talk will introduce our success in materials development to enable durable organics-based flow batteries to push the boundaries of grid storage. The topics will cover our strategies to improve the relevant parameters of selected organic electroactive materials. Electrochemistry of organic compounds usually involves chemically reactive radical ions. How to minimize parasitic side reactions for these radical species is the main focus of this research. Rational molecular design and engineering are demonstrated to be a generally promising methodology to produce highly soluble and stable organic redox compounds. Moreover, demonstrating identified flow chemistries under flow battery-relevant conditions is a challenging task, which has little success among reported literature. Our strategy to overcome current limitations and achieve record-breaking cell cyclability will be introduced.