

Operando Small Angle Neutron Scattering and its Applications in Energy Storage Materials

Dr. Lilin He¹

¹*Oak Ridge National Laboratory*

hel3@ornl.gov

Rechargeable batteries and electrochemical supercapacitors show immense potential as power sources for mobile electronics, electric vehicles, and large-scale grid storage.

However, their widespread use is currently hindered by issues such as cost, safety, cycle life, energy and power density, especially in transportation and stationary electrical energy storage. To design the next generation of materials, a molecular-level understanding of transport and storage mechanisms of electrolyte ions in electrodes and electrolyte solutions under operating electrochemical conditions is essential. Small angle neutron scattering (SANS) has become an indispensable tool to provide key insights across length scales ranging from 1 to 200 nm and kinetics on a time resolution spanning from seconds to hours. This technique benefits from the adjustable contrast via deuteration of solvents or electrolytes and is non-destructive due to the high penetrating power of neutrons. It also provides statistically meaningful measurements over the total volumes of illumination within complex sample environments and functional devices under varying experimental conditions. In this talk, I will highlight the applications of SANS in the characterization of electrodes and electrolytes over the past decade, as well as discuss the limits and future development direction of this technique for operando characterization.

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