Field-Assisted Separations with Carbon Electrodes

Kelsey B. Hatzell

Electrochemical technologies are currently becoming competitive, low-energy alternatives, to membrane-based technologies for brackish water treatment and water re-use applications. Flow-electrode capacitive deionization is an example of an emerging scalable electrochemical technology that utilizes electrical energy (instead of pressure) to separate ions from a solution. This system utilizes the a flow architecture similar to that of flow batteries for grid energy storage to achieve scalable brackish water treatment. However, instead of flowing 'liquid' solutions through a charging cell, two biphasic flowable electrodes are used. These flowable electrodes are composed of a high surface area carbon material dispersed in an ionic solution and are examples of complex fluids that can display a reconfigurable microstructure or active material arrangement during flow. The deformation of the electrode material via flow can cause a decrease in material connectivity and electron percolation and limit material utilization in a suspension electrode. Typically, indirect characterization (rheology) methods are utilized to extract global information about the local structure of concentrated suspension systems. In this talk we will discuss a novel way to observe the underlying arrangement of a flowable electrode using synchrotron radiation x-ray tomography. We will discuss the role electrode structure plays on ion removal and discuss potential pathways toward selective separations.