

Time-Resolved Ion Dynamics in Carbon Supercapacitor
Electrodes Using *In Situ* Infrared Spectroscopy

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Ion transport in energy storage devices (e.g., batteries, supercapacitors) is the fundamental process that dictates charge/discharge rates. However, there are few experimental techniques that can measure molecular level ion transport in response to an input voltage. In this study, we apply a novel *in situ* infrared spectroscopy measurement technique to investigate ion transport in carbon electrodes of electrochemical double layer supercapacitors. Ion transport properties of porous nano-sized carbide derived carbons (CDC) were compared to non-porous carbon onions for both pure ionic liquid electrolytes and mixtures of propylene carbonate and ionic liquid.

Results from these experiments showed that the transport of cations and anions of the ionic liquid remain in an aggregated state during charging and discharging. We observed that the change in infrared absorbance is directly correlated with electrochemically-driven transport of ions into and out of the pores of the nano-sized CDC particles. Due to the absence of internal porosity of onion-like carbons, the measured infrared absorbances for these systems exhibited lower ion concentration fluctuations. This result supported the experimental theory that the spectra were collected from ion media surrounding the particles, instead of the CDC-based internal pore architecture that screens the IR signal with its carbon walls. Additional results will demonstrate differences between neat ionic liquid and solvated ion systems, indicating that ions enter endohedral porous carbons in a desolvated state.