UCLA College | Physical Sciences Chemistry & Biochemistry

PHYSICAL CHEMISTRY SEMINAR

Prof. David Ginger

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University of Washington

Monday, February 6, 2023

4:00 PM | YH 4222

Mani L. Bhaumik Collaboratory -

Dongwon Yoo Seminar & Conference Hall

Probing Ion Injection and Transport in Conjugated Polymers: From Bioelectronic Brains to Energy Storage

Abstract: Ion injection and transport in conjugated polymers affects the performance of devices ranging from organic electrochemical transistors (OECT) for bioelectronic signal transduction, and from aqueous polymer batteries to next generation neuromorphic computing architectures. The performance of conjugated polymers in these applications is due to the ability of the polymer to accommodate ionic countercharge throughout the device volume during redox processes. For instance, in OECTs, the resulting volumetric capacitance allows for very large modulations of the charge density in the transistor channel and large transconductance values. Using OECTs as a testbed, we explore measurements on different polymers with different counterions. At the nanoscale, we use electrochemical strain microscopy (ESM) to probe local swelling resulting from ion uptake, and photoinduced force microscopy (PiFM) to probe the IR fingerprints of ion injection which we correlate with ensemble measurements such as electrochemical quartz crystal microbalance (eQCM), spectroelectrochemistry, and in operando synchrotron structure measurements. We correlate these methods to gain insight into how local polymer structure governs ion uptake and transport and how the chemical nature of the counterion and associated structural changes impact electronic charge transport. We show that the counterion polarizability strongly affects both ion injection kinetics, as well as the mechanism of charge compensation (contrasting counterion expulsion vs. and counterion injection). In the process we observe non-Fickian ion "diffusion" in a conjugated polymer which show can be explained as a propagating phase change front. We discuss microscopic insights into these processes and propose new material design rules.

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