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Mechanisms of transport and electron transfer at conductive polymer/liquid interfaces

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Organic semiconductors (OSCs) have incredible prospects for next-generation, flexible electronic devices including bioelectronics, thermoelectrics, opto-electronics, and energy storage and conversion devices. Yet many fundamental challenges still exist. First, solution processing prohibits definitive control over microstructure, which is fundamental for controlling electrical, ionic, and thermal transport properties. Second, OSCs generally suffer from poor electrical conductivities due to a combination of low carriers and low mobility. Third, polymeric semiconductors have potential-dependent, dynamically evolving electronic and chemical states, leading to complex interfacial charge transfer properties in contact with liquids. This talk will focus on the use of alternative synthetic strategies of oxidative chemical vapor deposition and electrochemical deposition to control physical, electronic, and chemical structure. We couple our synthetic efforts with energy-, time-, and spatially resolved spectroelectrochemical and microscopy techniques to understand the critical interfacial chemistry-microstructure-property relationships: first at the macroscale, and then moving towards the nanoscale. In particular, approaches to better understand electron transfer events at polymer/liquid interfaces as a function of: 1.) chemical composition; 2.) electronic density of states (DOS); and 3.) crystallinity and microstructure will be discussed.