Materials Seminar

Thursday, April 26 at 12:15 pm in Room 1315 Chemistry

Prof. Shane Ardo

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"Protonic solar cells by sensitization of passive ion-selective polymers with photoacid dyes"

Most electrochemical technologies that operate under ambient conditions require ion-conducting polymer electrolytes. These polymers are *passive* in that electric bias drives ion migration in the thermodynamically favored direction. Recently, my group engineered two important features into passive ion-selective polymers to introduce the *active* function of photovoltaic action and demonstration of an ionic solar cell. These features were covalent bonding of photoacid dyes to the polymers such that absorption of visible light resulted in liberation of protons, and synthesis of polymer membranes with charge-selective contacts to facilitate separation and collection of H^+ and OH^-. Light excitation from either side of the polymer membranes resulted in H^+ dissociation followed by directional charge collection. The charge collection direction was dictated by the electrostatic asymmetry in the polymers, which was formed due to an external pH difference setup across the membrane.

Joining a monopolar cation-selective polymer to a monopolar anion-selective polymer forms a bipolar membrane, which mimics a rectifying semiconductor pn-junction diode in form and function (**Figure 1**), and is able to maintain pH differences across it. Using a photoacid-dye-modified bipolar membrane, we measured a photovoltage of ~120 mV under conditions of solar-simulated excitation.

Collectively, these photo-responsive polymers represent a new class of functional materials that use light to trigger changes in local ion concentration and electrostatic potential. These local changes can be used to affect macroscopic processes such as direct sunlight-driven redox chemistry or desalination of salt water (**Figure 2**), chemical catalysis, and triggering of cellular processes.

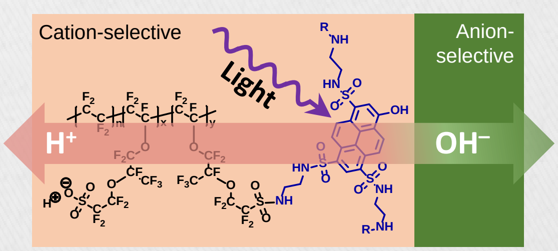

Figure 1. Proposed general structure and overall sensitization process for a photoacid-dye-modified bipolar membrane.

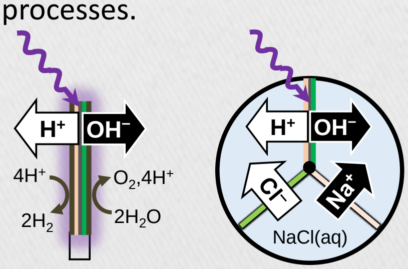

Figure 2. Proposed applications for photoacid-dye-modified bipolar membranes of light-driven redox chemistry and desalination of salt water.

Hosted by Prof. Kyoung-Shin Choi