Yale Institute for Nanoscience and Quantum Engineering

Friday-April 28, 2017

12:00-1:00 PM

BECTON SEMINAR ROOM
Light lunch will be served at 11:45 a.m.

Professor Owen Miller
Applied Physics Department, Yale University

Photonic Design: Reaching the Limits of Light-Matter Interactions

Nanoscience is developing at a rapid pace, with ever more materials, form factors, and structural degrees of freedom now available. To confront these large design spaces, and leverage them for transformative technologies, new theoretical tools are needed. Across a range of photonics applications, I will demonstrate that the combination of large-scale computational optimization with new analytical frameworks enables rapid identification of superior designs, and spurs discovery of fundamental limits to wave-matter interactions.

Professor Shu Hu
Department of Chemical & Environmental Engineering, Yale University

Stabilization of Semiconductor/Liquid Interfaces and Operando Spectroscopy

An artificial photosynthetic device, or called artificial leaf, mimics nature's photosynthesis, takes sunlight and splits water into H_2 and O_2. Once abundant and low-cost solar fuels of H_2 is produced as a universal energy carrier, we can use it to convert synthetic fuels, upgrade bio-fuel feedstock, improve combustion and produce ammonia. However, achieving such an efficient and flexible artificial leaf is not trivial, particularly due to the instability of efficient semiconductor/liquid interfaces: All technologically important semiconductors so far like Si and GaAs photocorrode. Although protective coatings are not prevalent in solid-state materials research, they are essential in the field of (photo-)electrochemistry.
In this talk, I will first discuss recent breakthroughs in protective coatings as a stabilization strategy. With protective coating strategies, a 10% efficient water-splitting artificial leaf has been demonstrated. With modeling-inspired materials design, I will show a viable pathway beyond 20% efficiencies. Finally, I will discuss needs for basic understanding of photocatalytic processes at solid/liquid interfaces, particularly using operando spectroscopy. Understanding the change-transfer rates and selectivity of solid/liquid interfaces promise cost-effective particle-based photocatalyst devices. We call them artificial chloroplast as the next-generation artificial leaf.

Host: Professor Eric Altman