Chemical & Biomolecular Seminar Series

Yueh-Lin (Lynn) Loo

Director, Andlinger Center for Energy & the Environment

Theodora D. '78 & William H. Walton III '74 Professor

Chemical & Biological Engineering

Princeton University

Friday, April 28, 2017

10:00—11:00 a.m.

102 Colburn Lab

Yueh-Lin (Lynn) Loo is the Theodora D. '78 & William H. Walton III '74 Professor in Engineering and Director of the Andlinger Center for Energy and the Environment at Princeton University.

Lynn's research focuses on the processing and development of materials for low-cost, lightweight and flexible solar cells and circuits, the combination of which is being explored for the creation of "smart" windows to increase building and energy efficiencies.

Lynn received her BSE from the University of Pennsylvania and her PhD from Princeton University. After a year at Bell Laboratories, and five years at the University of Texas at Austin, she returned to teach at Princeton in 2007. She was the Associate Director of External Partnerships at the Andlinger Center from 2011 to 2015. She served as Acting Vice Dean of the School of Engineering and Applied Science in spring of 2016 and was appointed Director of the Andlinger Center in July 2016. With over 100 affiliated faculty members, the Andlinger Center is developing solutions for sustainable energy production and protection of the environment.

Lynn is a fellow of the American Physical Society, and received its John H. Dillon Medal. A Young Global Leader of the World Economic Forum, she has also been recognized by Sloan and Beckman Fellowships, the Peter and Edith O'Donnell Award in Engineering from the Texas Academy of Medicine, Science and Engineering, and the Alan P. Colburn Award from the American Institute of Chemical Engineers for her scholarship.

Small Molecules for Large-Area Applications

Energy use in residential and commercial buildings comprises about 40% of energy demand today and 30% of energy-related carbon emissions in the United States, with heating accounting for nearly twice the energy required for cooling and lighting combined. Increasing building energy efficiency will shave peak demands for electricity. In my talk, I will highlight our development of solar-powered electrochromic windows that can be integrated into windows to reduce electricity consumption.

The solar-powered electrochromic window comprises a polyelectrochromic conducting polymer that is optically transparent in its reduced state and dark blue in its oxidized state. Integration with a semitransparent organic solar cell provides the necessary power to switch between its transparent and colored states. Unique to this approach is our use of a single-junction organic solar cell. By designing and using materials that absorb exclusively in the ultra-violet and near-visible as the photoactive layers in our solar cells, the resulting devices exhibit open-circuit voltages that are unprecedented for single-junction organic devices (> 1.4 V). As such, we are able to drive switching of the electrochromic window without the need to construct solar cells with complex tandem architectures. Importantly, the active layers of our devices are pinhole- and defect-free. Coupled with inherently low resistive power losses, the photocurrents are scalable with the footprint of solar cells while our devices retain high fill factors. Whereas device optimization of typical solar cells to increase photovoltage has almost always come at the expense of decreasing photocurrents, the scalability of photocurrents in our devices has enabled us to break this paradigm. We can tune device photovoltage per application needs through judicious selection of the donor/acceptor materials pair whose optoelectronic properties can be tuned *via* molecular design, and access the necessary photocurrents by fabricating arbitrarily large devices.