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Webinar by Prof Lynn Loo, Andlinger Center for Energy and the Environment, Princeton University

MAKING SMART WINDOWS SMARTER: SYMBIOTIC PAIRING OF NEAR-UV SOLAR CELLS WITH ELECTROCHROMIC WINDOWS FOR VISIBLE LIGHT + HEAT MANAGEMENT IN ARCHITECTURAL APPLICATIONS



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ABSTRACT
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, wireless electrochromic windows that can be integrated into windows to reduce electricity consumption and simultaneously increase occupant comfort (1).

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 semi-transparent organic solar cell provides onboard power to switch between its transparent and colored states. By designing and using materials that absorb exclusively in the ultra-violet and near-visible as the photoactive layers in our single-junction solar cells, the resulting devices exhibit open-circuit voltages > 1.4 V to directly drive switching of the electrochromic windows with high contrast. 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. We can thus tune device photovoltage per application needs through judicious selection of the donor/acceptor materials pair, and access the necessary photocurrents by fabricating arbitrarily large devices.

(1) N.C. Davy, M. Sezen-Edmonds, J. Gao, X. Lin, A. Liu, N. Yao, A. Kahn, Y.-L. Loo, "Near-UV Organic Solar Cells Paired with Electrochromic Windows for Smart Management of the Solar Spectrum" Nature Energy 2, 17104 (2017).

ABOUT THE SPEAKER
An American engineer, Yueh-Lin (Lynn) Loo was born and raised in Kuala Lumpur, Malaysia. She is presently 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 received her BSE in Chemical Engineering and in Materials Science and Engineering from the University of Pennsylvania in 1996 and her PhD from Princeton University in 2001. She spent a year at Bell Laboratories, Lucent Technologies before joining the faculty in the Chemical Engineering Department at the University of Texas at Austin. She returned to Princeton University in 2007. She is an international expert on organic and plastic electronics; she and her team focus on the development and processing of materials for low-cost, lightweight and flexible solar cells and circuits, the combination of which has resulted in see-through solar cells that could be embedded in windows that change color in response to electrical signals. Such "smart" windows will decrease energy use associated with the heating, cooling and lighting needs of buildings while simultaneously increasing occupant comfort. This technology is being further developed by Andluca Technologies, a startup that Lynn co-founded in 2017. With >185 publications, Lynn has delivered >250 invited and plenary lectures globally and she serves on numerous international advisory boards of peer academic institutions, journals and private companies. She is a fellow of the American Physical Society, a fellow of the Materials Research Society, and a Young Global Leader of the World Economic Forum. She has been recognized with Sloan and Beckman Fellowships, the John H. Dillon Medal from the American Physical Society, 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.

Lynn was the Associate Director of External Partnerships at the Andlinger Center from 2011 to 2015, during which she launched and led Princeton E-ffiliates Partnership, a corporate partner program to promote teacher-student-practitioner interactions and foster collaboration with the private sector. She served as Acting Vice Dean of the School of Engineering and Applied Science in the spring of 2016, and was appointed Director of the Andlinger Center in July 2016. In July of 2017, she founded Princeton's first executive education module in partnership with the World Economic Forum to contextualize the complexities of the energy challenge and its impact on our environment for business leaders, government officials, investors and other key decision makers. With > 115 associated faculty members spanning science and engineering disciplines and social sciences, the Andlinger Center is developing solutions to ensure our energy and environmental future.

Outside the University, she is a member of Class of 2020-2021 Defense Science Study Group. Brought on board to expand its scope, she is an associate editor of Nano Letters. Lynn currently serves on advisory boards of numerous companies, national laboratories, academic units at peer institutions, and journals. She served as program chair, representing the Division of Polymers for the March Meeting of the American Physical Society, and chaired the Materials Engineering and Science Division of the American Institute for Chemical Engineers.

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