Making smart windows smarter with near-UV organic solar cells providing onboard power

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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 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 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 whose optoelectronic properties can be tuned *via* molecular design, and access the necessary photocurrents by fabricating arbitrarily large devices.