Semi-Transparent Organic Photovoltaic Cells

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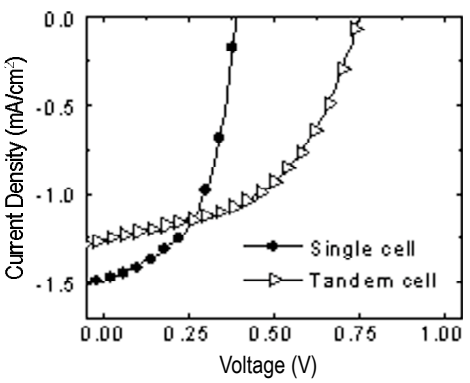
Semi-transparent solar cells can potentially be used as tinted and power-generating thin-film coatings on surfaces such as windows and walls. Transparent top electrodes also significantly simplify the design of tandem cells, since reflective cathodes introduce minima in optical field density that complicate the placement of different active absorbing materials. We have employed indium tin oxide sputtered on top of varying thickness layers of Ag as semi-transparent cathodes in small molecule organic photovoltaic devices. As the thickness of the Ag increases, power conversion efficiency increases, while transmission in the visible spectrum decreases. External quantum efficiency remains similarly shaped throughout the visible wavelengths, only peak magnitudes decrease with increasing transmission. Fill factor and open circuit voltage are minimally decreased as compared to reflective cathode control, which can be partially explained by the lower responsivity in the semi-transparent structures. A tandem cell demonstrating nearly double the open circuit voltage of the single cell without significant reduction in the short-circuit current density has also been demonstrated with a metal-free cathode. This project is being supported by the Department of the Air Force under award number FA9550-07-1-0364 and Global Photonic Energy Corp. (with University of Southern California) under award number Subcontract PO Number 111678.

a)

b)



a) Image of an organic photovoltaic double heterojunction structure on a glass substrate pre-coated with an indium tin oxide (ITO) anode layer. The sample has a sputter-deposited vertical stripe ITO cathode, which is not discernible due to the similar transmissivity with and without the ITO cathode, b) Current-voltage characteristics for a single metal-free heterojunction cell (filled circles), and a two-cell tandem stack (open triangles).