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Tuning Contact Recombination and Open-Circuit Voltage in Polymer Solar Cells via Self-Assembled Monolayer Adsorption HE WANG, ENRIQUE GOMEZ, Department of Chemical and Biological Engineering, Princeton University, ZELEI GUAN, Department of Electrical Engineering, Princeton University, CHERNO JAYE, DANIEL FISCHER, National Institute of Standards and Technology, ANTOINE KAHN, Department of Electrical Engineering, Princeton University, YUEH-LIN LOO, Department of Chemical and Biological Engineering, Princeton University — We adsorbed fluoro-alkyl and hydrogenated-alkyl phosphonic acid derivatives onto indium tin oxide (ITO) for forming self-assembled monolayers (FSAMs and HSAMs, respectively) to tune the open-circuit voltage (V_{oc}) of polymer solar cells. The adsorption of FSAM and HSAM alters the work function of ITO from 4.3 eV to 5.5 eV and 4.0 eV, respectively, as verified by ultraviolet photoemission spectroscopy. Polymer solar cells having FSAM-, HSAM-treated ITO, and bare ITO as anodes display V_{oc} of 0.58V, 0.48V, and 0.31V, respectively. Yet, the hole injection barrier from the anode to the active layer is the same for all three devices. Inverse photoemission spectroscopy measurements indicate that the energy barrier for minority carrier transport to the anode is largest for solar cells comprising FSAM-treated ITO and lowest for devices with bare ITO as anode. Since a high energy barrier for minority carrier transport results in lower contact recombination at the anode, it is this energy barrier that is responsible for differences in the V_{oc}s observed in polymer solar cells having anodes that have been pre-treated with SAMs.

He Wang
Princeton University

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