Surface Functionalization of Planar ZnO in Hybrid Organic/Inorganic Solar Cells

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Despite the high electron mobility of n-type inorganic semiconductors, hybrid organic/inorganic solar cells have not lived up to their potential because of poor interfacial properties. We have studied a prototypical system involving poly(3-hexylthiophene) (P3HT) on planar zinc oxide (ZnO) films that have been modified via deep and spin coating and with 5 different types of molecules: 1-Pyrenecarboxylic acid (PCA), 1-Pyrenesulfonic acid sodium salt (PSA), 3-Thiophenecarboxylic acid (TCA), 5-Hexyl-2-thiophenecarboxylic acid (HTCA) and Sunset Yellow FCF (SY). The functionalized surfaces were characterized using water contact angle measurements, infrared absorbance spectroscopy, and atomic force microscopy. Inverted hybrid solar cell devices fabricated with these modified interfaces performed very differently regarding to modifier molecule and coating method. For all of the modifiers, the short circuit current (JSC), open circuit voltage (VOC), and power conversion efficiency (PCE) were higher for spin coated samples. Between all samples, spin coated PSA and SY showed highest PCEs, 0.143% and 0.128%, respectively.