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

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In spite of the high electron mobility of n-type inorganic semiconductors, hybrid organic/inorganic solar cells have not reached to their potential because of poor interfacial properties. We have examined 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 6 different types of molecules: 1-Pyrenecarboxylic acid (PCA), 1-Pyrenesulfonic acid sodium salt (PSA), 3-Thiophenecarboxylic acid (TCA), 5-Hexyl-2-thiophenecarboxylic acid (HTCA), Sunset Yellow FCF (SY) and Fast Green FCF (FG). The functionalized surfaces were characterized using water contact angle measurements 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. Samples modified with FG via spin coating showed highest PCEs, 0.4018% which it was more than 6 times higher than un-modified device.