Enhanced Efficiency of Inverted Organic Solar Cells by using 3-Dimensional Electrode

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We demonstrated inverted organic solar cells in which nano-patterned ITO electrodes was extended deep within active layer, providing efficient electron transport pathway. The titanium oxide was uniformly deposited on the nano-patterned ITO electrodes fabricated by Second Scattering Lithography by using atomic layer deposition (ALD) characterized by excellent conformality on 3-dimensional structure. The seperated electrons in active layer can be easily transport to ITO electrode through TiO2 thin film because the conduction band of TiO2 is similar to that of PCBM. Moreover, the valence band of TiO2 is efficient to inhibit back electron or hole transfer with its high-energy barrier. The inverted organic photovoltaic cells with high aspect ratio ITO electrode, which are based on the regioregular poly(3-hexythiophene) and C61 butyric acid methyl ester bulk heterojunction, showed higher power conversion efficiency than on flat ITO substrate. The dramatically improved efficency using 3-dimensional ITO elctrode is interpreted with the enhanced-charge separation and collection by both increasing the interface area between TiO2 and active layer and shortening the traveling distance for electrons.