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Kelvin Probe Microscopy Study of Donor-Acceptor Blends for Organic Solar Cells

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The organic solar cells (OSCs) based on conjugated polymer-fullerene composites have been attracting interest due to the advantages such as cheap production cost, light weight, simple fabrication process, and flexible mechanical property against the Si based solar cells. The study of interface property between metal electrode and organic layer among the most important issues for the OSCs is an essential point for controlling the charge carrier injection into the organic active layer. Recently, the Kelvin Probe Microscopy (KPM) technique has been interestingbecause it was very useful analytical method to investigate the structural and electrical properties without damage and charging effect at the surface. In this work, the KPM analysis as a function of scan mode and applied voltage was applied for investigate the morphology, the composition crystals, and the electrical properties of Poly(2-hexylthiophene) (P3HT, donor):[6,6]-phenyl C_{61} butyric acid methyl ester (PCBM, acceptor) blend film as an active layer in the OSCs. For the formation of the active layer, 2 wt.% P3HT:PCBM solution in chlorobenzene was deposited with 90 nm thickness onto conventionalITO/PEDOT:PSS (40 nm) film by spin-coating. To determine the surface potential and work functions for each material(P3HT, PCBM), we have employed the KPM on the surface of pristine-layer deposited by spin-coating in a routine-step. In order to find the cause of efficiency improvement in the OSCs, the P3HT crystallization at P3HT:PCBM composition, the dispersion of the amorphous P3HT:PCBM matrix, and the redistribution of PCBM cluster as a function of annealing condition were respectively measured using KPM. In conclusion, we believed that the efficient separation or collection of the photogenerated excitons at donor-acceptor interface from measuring the surface potential difference between the donor and acceptor materials in the KPM results can be ambiguous explained.