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Study of Energy Level Alignment at the Interface of P3HT and PCBM Bilayer Deposited by Electropray Vacuum Deposition

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We investigated the interface of poly (3-hexylthiophene) (P3HT) and C61-butyric acid methylester (PCBM) by using photoelectron spectroscopy (PES). These are the most widely used materials for bulk heterojunction (BHJ) organic solar cells due to their high efficiency. Study of the BHJ interfaces is difficult because the organic films are typically prepared by spin coating in ambient conditions. This is incompatible with the interface electronic structure probes such as PES, which requires ultrahigh vacuum conditions. Study of interface requires gradual deposition of thin films that is also incompatible with the spin coating process. In this work, we used electropray vacuum deposition (EVD) technique to deposit P3HT and PCBM in high vacuum conditions. EVD allows us to form polymer thin films onto ITO substrate in a step-wise manner directly from solutions and to use PES without exposing the sample to the ambient condition. Although the morphology of the EVD deposited P3HT films observed by optical and atomic force microscopes is quite different from that of the spin coated ones, the valence region spectra were similar. PCBM was deposited on the P3HT film in a similar manner and the energy level alignment between these two materials was studied. We discuss the relation between Voc of P3HT:PCBM solar cell and HOMO-LUMO energy offset obtained in this study.

Keywords: UPS, P3HT, PCBM, SolarCell, XPS