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Nanoscopic characterizations of photo-generated carriers in P3HT/Si hybrid nanostructures EUNAH KIM, YUNAE CHO, AHRUM SOHN, HEEWON HWANG, Y. U. LEE, KYUNGKON KIM, Ewha Womans Univerisity, HYEONG-HO PARK, Korea Advanced Nanofab Center (KANC), JOON-DONG KIM, J. W. WU, DONG-WOOK KIM, Ewha Womans Univerisity — The extremely short exciton diffusion lengths in organic semiconductors limit the photovoltaic performance of the organic solar cells. Therefore, organic/Si hybrid (OSH) nanostructured devices have been proposed. The Si nanostructures can provide pathways for efficient carrier transportation because of the high mobility of Si and the large junction area in such devices. In this work, we fabricated Si nanopillar (NP) arrays coated with poly(3-hexylthiophene-2,5-diyl) (P3HT) organic semiconductor layers. Optical reflection spectra and simulated optical generation rate distribution showed that Mie-like geometrical resonance significantly concentrated incident light in the NPs. We studied the surface photovoltage (SPV) characteristics of the OSH nanostructures using the Kevin probe force microscopy technique to investigate the spatial distributions of photo-generated carriers. Under red light, SPV value is much larger at the NP top surface than that of planar sample. Such SPV behavior directly revealed that the concentrated light produced numerous charge carriers in the NPs. This suggested that the optical resonance in OSH nanostructures benefits not only broad-band light trapping but also efficient carrier collection.

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