Facile tuning the detection spectrum of Organic Thin Film Photodiode via Selective Exciton Activation

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Here, we introduce a method of facile tuning the high-detectivity spectra of the organic photodiode (OPD) to fabricate a thin-film filter-less full-color image sensor. The PIN junction enables a selective activation of excitons generated from the photons with low extinction coefficient in the active layer such that the exciton-dissociation to holes/electrons can contribute to the external current, while the excitons from photons with high extinction coefficient are immediately deactivated. In order to achieve a color-selective PIN junction with a thin active, precisely controlled layer-by-layer depositions of p-type polymers and n-type [6,6]-phenyl C_{61} butyric acid methyl ester were conducted, which efficiently realized selective exciton activation. In addition, we demonstrate that a well-defined PIN junction blocks the injection of non-allowed charge carriers with an effective barrier height higher than 0.69 eV under the reverse bias, leading to very low dark current and semi-ideal diode characteristics. Consequently, the high specific detectivity over 1.0×10^{12} Jones are observed for R/G/B full color detection with thin-film OPDs.