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Development of Simple Solvent Treating Methods to Enhance the Efficiency of Small-Molecule Organic Solar Cells

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The interface morphology of organic active layers is known to play a crucial role in the performance of organic photovoltaic (OPV) cells. Especially, a controlled nanostructure with a large contact area between electron donor (D) and acceptor (A) layers is necessary to improve the power conversion efficiency (PCE) of the cells since the short exciton diffusion lengths in organic semiconductors limit the charge (hole and electron) separation before excitons recombination. In this work, we developed simple solvent treating methods to fabricate a nanostructured DA interface and applied them to enhance the PCE of ZnPc/C60 based small molecule OPV cells. Interestingly, it was observed that the solvent treatment on the donor layer prior to the deposition of the acceptor layer resulted in a significant decrease in PCE, which was due to an existence of undesirable voids at the DA interface. Instead, the solvent vapor treatment after the DA bilayer formation led to densely packed and well dispersed DA contacts. Consequently, 3-fold enhancement of PCE as compared to the untreated bilayer cell was accomplished.

Keywords: ZnPc, C60, OPV, Solvent treatment