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Influence of surface morphology and thickness of molecular thin films on the performance of SubPc–C_{60} photovoltaic devices

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Over the past decades, organic semiconductors have been investigated intensely for their potential in a wide range of optoelectronic device applications since the organic materials have advantages for very light, flexible and low cost device fabrications. In this study, we fabricated small-molecule organic solar cells (OSCs) based on chloro[subphthalocyaninato]boron(III) (SubPc) as an electron donor and C_{60} as an electron acceptor material. Recently SubPc, a cone-shaped molecule with 14π -electrons in its aromatic system, has attracted growing attention in small-molecule OSC applications as an electron-donating material for its greater open-circuit voltage (V_{OC}), extinction coefficient and dielectric constant compared to conventional planar metal phthalocyanines. In spite of the power conversion efficiency (PCE) enhancement of small-molecule OSC using SubPc and C_{60}, however, the study on the interface between donor-acceptor heterojunction of this system is limited. In this work, SubPc thin films at various thicknesses were deposited by organic molecular beam deposition (OMBD) and the evolution of surface morphology was observed using atomic force microscopy (AFM) and field emission scanning electron microscopy (FE-SEM). We also investigated the influence of film thickness and surface morphology on the PCE of small-molecule OSC devices.

Keywords: SubPc small-molecule organic solar cell