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Influence of nano-confinement on the crystallization of conjugated polymers P3HT and PffBT4T-2OD

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Control of n-type inorganic morphology, chain orientation and crystallization of the donor polymers is of significance in hybrid solar cells. Here, we use slot-die printing combined with wet chemistry to fabricate controllable mesoporous TiO2 nanostructures in large scale. Subsequently, the mesoporous TiO2 films with different pore size are backfilled with P3HT and PffBT4T-2OD, respectively, using two different ways of infiltration. TiO2 film morphology is investigated by scanning electron microscopy (SEM) and grazing incidence small-angle X-ray scattering (GISAXS). Particularly, GISAXS reveals the sizes of the nanostructures and pores of the printed TiO2 films. In order to investigate the effect of TiO2 pore size on the crystalline properties of the conjugated polymers P3HT and PffBT4T-2OD, e.g. lattice distance, crystal size or orientation, grazing incidence wide-angle X-ray scattering (GIWAXS) is applied to probe the hybrid films. Both, P3HT and PffBT4T-2OD crystals with a denser packing of polymer chains exist in the large pore size of TiO2 films. For backfilling with PffBT4T-2OD, a high face-on to edge-on ratio preferentially appears in the large TiO2 pores.

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