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"Effect of electric field on the growth of organic electronic thin-films and devices"

π-Conjugated polymers (π-CPs) have garnered great interest since their discovery. In contrast to inorganic semiconductors, these materials are well known for their semi-crystalline or amorphous nature. Structural disorder in π-CPs, coupled with the insulating alkyl chains - responsible for dissolving the polymer in organic solvents - severely hinder the carrier mobility. To alleviate this problem, we reported on the effect of electric field (E-field) on the structural and optoelectronic properties of solution-processed π-CPs films and devices. In addition to control (C), wet polymer films were subjected to an E-field at three different orientations - horizontal (H), tilted (T) and vertical (V) with respect to the film surface. While grazing incidence wide-angle x-ray scattering (GIWAXS) shows an increased edge-on stacking for the vertically applied E-field, the conductive force microscopy (c-AFM) current maps of the tilted and vertical films manifest highly conductive domains. Furthermore, unipolar hole-only devices and organic field-effect transistors (OFETs) exhibit an enhancement of the mobility by ~144% and ~70% at tilted and horizontal E-field, respectively. Remarkably, organic solar cells (OPVs) recorded 17% power conversion (PCE) enhancement, and organic light-emitting diodes (OLEDs) achieved a 460% increase in the electroluminescence efficiency (EL_η). The advantage of our approach lies in its universality and simplicity, and in capability for anisotropic control of morphology and properties, tailorable for different families of organic electronic devices.