Project Summary 14

Controlled morphologies by molecular design and nano-embossing

Up to now the efficiencies of organic solar cells cannot compete with conventional semiconductor photovoltaics. One major challenge is the control of the interfacial area between donor-acceptor materials. In this project, organic semiconductors will be tailored which enables embossing to achieve highly crystalline nanostructured films. Embossing technique – feasible in principle also for large scale roll-to-roll production – will be used to fabricate photovoltaic devices with controlled and large interface between donor and acceptor materials with high charge carrier mobility. One organic layer (e.g. the hole acceptor) will be nanostructured via embossing achieving a nano-pillar array with high aspect ratio and short pillar to pillar distance. The second layer (e.g. the electron acceptor) will be deposited on top via orthogonal solvents to fill the gaps between the pillars without dissolving the nanostructure leading to a controlled high interfacial area between hole- and electron acceptor. Target of this approach are nanostructures with dimensions of less than 25 nm, which is close to the typical exciton diffusion length of used organic materials. Synchrotron radiation based advanced scattering experiments such as grazing incidence wide- and small-angle X-ray scattering together with x-ray reflectivity will give full details about alignment and crystallization
of the organic materials inside the nanostructures from the molecular to the mesoscopic structural level. This full control and knowledge about the structure will allow a systematic investigation of the dependence of device performance on the thin film morphology.