Project Summary 10

Organic solar cells from optimized self-assembling block copolymers with controlled nanoscale morphology

The project aims at the design, synthesis and study of donoracceptor block copolymers for bulk heterojunction solar cells with stable equilibrium nanoscale morphology, guaranteeing a domain size in the same range as exciton diffusion lengths. During the first two periods, this joint project has intensively contributed to solve the intricacies in the complex synthesis, towards understanding the morphology of corresponding homopolymers and block copolymers and their influence on device performance. Furthermore an optimal donor-acceptor block ratio and the need for an increased overall molecular weight have been identified to obtain the desired microphase separation and to yield improved solar cell device performance. Additionally, initial grazing-incident x-ray studies of thin films (GID) of block copolymer, single blocks and model compounds show strong orientation effects. However, currently a charge carrier mobility imbalance and corresponding space charge limited currents as well as bimolecular recombination control the device performance by a large extent and limit the photocurrent severely. Therefore, the main tasks in the next period are i) Investigation of order and morphology in thin films as a function of processing conditions and substrate (e.g., oriented crystallization, alignment in external fields etc.), ii) combined studies of structure/morphology and optoelectronic properties/ transport properties to understand and later control the relation between transport properties and structure/morphology in devices and iii) variation of chemical structures and scaling up of synthesis via optimized methods to integrate balanced and improved charge transport blocks including fullerene blocks.