Enhanced light harvesting in semiconducting nanoparticle/polymer composites

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Photoactive semi-conducting polymers have shown to be interesting candidates for photovoltaics due to their high absorption coefficient, easy processibility, mechanical flexibility and low costs. Nevertheless there are stringent constraints in device fabrication due to the short exciton diffusion length, i.e. the charge carrier separation has to occur in this length scale (on order of 10 nm). Therefore the structure of the polymer film is crucial. It was shown that the photophysical performance can be improved by increasing the interface area between electron acceptor and conjugated polymer as well as the lateral dimensions of the domains. One promising approach is the incorporation of conjugated polymers into block copolymers with conventional coil-like polymers. Block copolymers form highly ordered nanostructures due to micro-phase separation. These polymer nano-structures, acting as a template, enable a completely new arrangement of semiconducting nanoparticles which are embedded via a chemically controlled surface [1, 2]. From the presence of the semiconducting nanoparticles new optical properties arise.

The spatial arrangement in lateral and perpendicular direction of the nanoparticles in the polymer film is monitored by X-ray and neutron scattering techniques such as grazing incidence small angle scattering (GISAS) and reflectivity. The surface topography is imaged with atomic forces microscopy (AFM) and a structural model of the film is obtained. The absorption and conductivity are determined depending on the arrangement of the nanoparticles in the polymer matrix and compared to the pure polymer film.

1. M.M.Abul Kashem, J.Perlich, L.Schulz, S.V.Roth, W.Petry, P.Müller-Buschbaum; *Macromolecules* **40**, 5075 (2007)
2. M.M.Abul Kashem, J.Perlich, L.Schulz, S.V.Roth, P.Müller-Buschbaum; *Macromolecules* **41**, 2186-2194 (2008)