Colloquium on Advanced Materials

Manipulation of Semiconducting Polymer Thin Films on the Molecular and Mesoscopic Scale

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This talk will give an overview over current activities of my research team on the manipulation of semiconducting polymers on the molecular and mesoscopic scale and correlations to optical, electrochemical and electrical properties.

On the molecular scale, different chemical routes and electropolymerization have been introduced by us to synthesize branched polythiophenes.\(^1\)\(^2\) Relationships between the molecular architecture and functional properties such as absorption behavior and energy levels will be discussed and highlighted.

On the mesoscopic scale, our latest results on controlled crystallization of semiconducting polymer thin films will be presented. While our first studies had focused on the work-horse poly(3-hexylthiophene)\(^3\), we nowadays work on two high-performance donor-acceptor copolymers: the p-type low bandgap (poly([4,4-bis(2-ethylhexyl)-cyclopenta-(2,1-b:3,4-b')dithiophene]-2,6-diyl)-alt-(2,1,3-benzo-thiadiazol)-4,7-diyl}) (PCPDTBT)\(^4\) and the n-type poly([N,N'-bis(2-octyldodecyl)-1,4,5,8-naphthalene-dicarboximide-2,6-diyl]-alt-5,5'-(2,2'-bithiophene}) (PNDI2OD-T2)\(^5\). We show that methods such as solvent-vapor crystallization or shear alignment allow us to induce and control crystalline order over large areas in thin films of both polymers. We find that changes in morphology are closely related to changes in absorption spectra. Furthermore, the impact of differently crystallized films on charge transport and solar cell performance is discussed.
References


