Comparison of the electron work function, hole concentration and exciton diffusion length for P3HT and PT prepared by thermal or acid cleavage - DTU Orbit (08/11/2017)

Comparison of the electron work function, hole concentration and exciton diffusion length for P3HT and PT prepared by thermal or acid cleavage

The electron work function, hole concentration and diffusion length were compared for poly(3-hexylthiophene) polymer (P3HT) that is commonly used for construction of solar cells, and two types of native polythiophene (PT) samples which are prospective candidates for this purpose. The polythiophene samples were prepared from 2 different precursors by thermal or chemical treatment at room temperature. Cyclic voltammetry and work function measurements were used for estimating the concentration of holes. The measured data were evaluated assuming the validity of band theory based on the tight-binding model. Published data on the valence bandwidth were used for calculating the value of the overlap integral which is related to the hole effective mass. Energy band diagrams were constructed for all 3 materials. Finally, the exciton diffusion length, which is a critical parameter for the application of conjugated polymer materials in solar cells, was measured by a modified surface photovoltage method. The approach allowed us to identify the differences in the material properties related to the processing method. Morphology of the samples determined by AFM was another tool showing these differences. It is stated that a native polythiophene prepared by treatment with acids is a prospective material for solar cells and shows a similar quality as that produced by a thermal process.

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