

## CHAIN ORIENTATION IN BULK HETEROJUNCTION PHOTOVOLTAIC THIN FILMS AS REVEALED BY NEAR EDGE X-RAY ABSORPTION FINE STRUCTURE

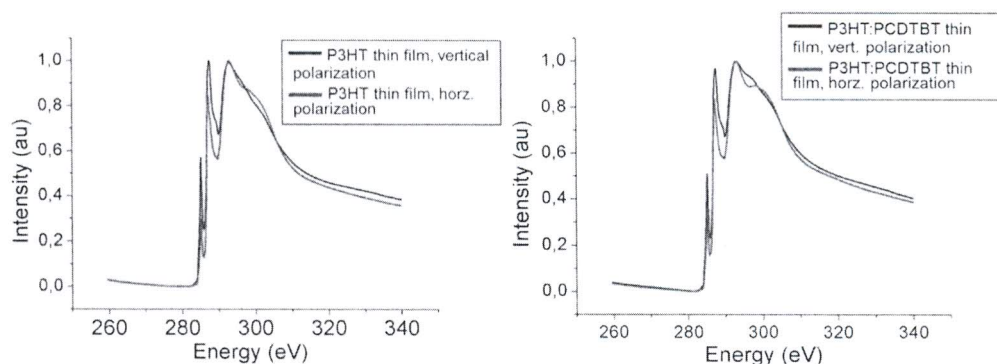
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Organic photovoltaics (OPVs) are one class of solar energy conversion devices, offering the advantages of low cost, light weight, solution processability and mechanical flexibility over existing photovoltaic technologies. Efficient organic solar cells typically employ a bulk heterojunction (BHJ) photoactive layer, where an electron-donating (p-type) material and an electron-accepting (n-type) material form a nanosized phase-separated interpenetrating network<sup>1</sup>. Due to the macromolecular nature of conjugated polymers, the orientation and assembly of molecular chains in these materials affect their charge transport properties. Therefore, investigation of chain orientation and  $\pi$ -stacking in homopolymer and polymer blend thin films is highly important. Near Edge X-Ray Absorption Fine Structure (NEXAFS) is very sensitive to the detailed chemical structure of the sample and to the molecular orientation when using a polarized X-Ray beam. Polymers as organic components are widely studied in the carbon K-edge. NEXAFS in the Total Electron Yield mode (TEY) is surface sensitive with a depth resolution of about 10 nanometers. We have measured TEY at the carbon K-edge (280-320 eV) of semiconducting polymers (poly(3-hexylthiophene-2,5-diyl) (P3HT) and poly[N-9'-heptadecanyl-2,7-carbazole-alt-5,5-(4',7'-di-2-thienyl-2',1',3'-benzothiadiazole)] (PCDTBT)), the fullerene derivative ([6,6]-phenyl C71 butyric acid methyl ester (PC<sub>70</sub>BM)) and blends of them. The preliminary TEY results indicate that both homopolymer and blend thin films show linear dichroism (Fig.1), indicating a preferential orientation of molecular chains. The experiments were performed in the BOREAS beamline at ALBA synchrotron.



**Figure 1.** TEY NEXAFS of a) P3HT thin film and b) P3HT:PCDTBT (1:1) thin film.

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<sup>1</sup> A. Rodríguez-Rodríguez et al, "Competition between phase separation and structure confinement in P3HT/PCDTBT heterojunctions: Influence on nanoscale charge transport", *Polymer*, **2015**, *77*, 70-78.