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"Structure-Property Correlations in Efficient Fullerene-free Organic Solar Cells"

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Αίθουσα σεμιναρίων στο ισόγειο του ΕΙΕ

Structure-Property Correlations in Efficient Fullerene-free Organic Solar Cells

There is an increasing interest on the use of alternative n-type materials for substituting the commonly used fullerene-type electron acceptors in organic photovoltaic (OPV) devices [1]. Hitherto perylene diimide (PDI) derivatives have given OPV cells with power conversion efficiency (PCE) values of 2% - 4% [2]. It is not yet clear which factors limit the PCE values of PDI-based OPV devices below 5%.

In this seminar I will present the study of photovoltaic blend films of the monomeric ethylpropyl-substituted PDI derivative (PDI) after mixing it with the copolymer of poly[4,8-bis-substituted benzo[1,2-b:4,5-b']dithiophene-2,6-diyl-alt-4-substituted-thieno[3,4-b]thiophene-2,6-diyl] (PBDTTT). The inter-relation between the electro-optical properties of the PBDTTT:PDI system and the multi-length scale morphology features of the PBDTTT:PDI layers will be discussed. Valuable information concerning the hierarchical organization of the PDI domains in the molecular scale is provided by wide-angle X-ray scattering characterization measurements on macroscopically oriented (extruded) fibers. Optical microscopy and atomic force microscopy imaging studies corroborate the findings of the structural and electrical data.

By using commercially available materials, we achieve the realization of PBDTTT:PDI OPV cells that exhibit a PCEmax=3.7% (0.92 Suns, AM1.5G) and we propose simple guidelines for the fabrication of efficient PDI-based organic solar cells; short and partially disordered PDI columnar aggregates permit the dissociation of the slowly diffusive PDI excimers at the PDI/polymer interfaces and favour electron transport [3].

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