ΠΑΡΟΥΣΙΑΣΗ ΜΕΤΑΠΤΥΧΙΑΚΟΥ ΔΙΠΛΩΜΑΤΟΣ ΕΙΔΙΚΕΥΣΗΣ

Τίτλος

«Ternary organic solar cells incorporating organic and two-dimensional materials»

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Επιβλέπων καθηγητής κ. Γ. Κιοσέογλου

Τετάρτη, 28/06/2017,

10:00 π.μ.,
Αίθουσα Α2,
Κτίριο Επιστήμης Υπολογιστών,

Πανεπιστήμιο Κρήτης

Περίληψη

Three different ternary bulk-heterojunction (BHJ) organic Photovoltaic (OPV) devices were systematically studied. First, a 2D-nanomaterial, (Tungsten Diselenide, WSe_2) and a small molecule (Compound T) were added into the PTB7:$PC_{71}BM$ binary device, forming a Ternary device. A maximum PCE of 8.78% was achieved upon the incorporation of M-WSe_2 flakes having lateral size in the 30-50 nm range, which is one of highest PCE reported for OPVs with PTB7 as the polymer donor. The enhancement is primarily attributed to the synergistic effect of complementary absorption and charge transfer processes. Excitons can be also generated inside the M-WSe_2 nanoflakes, increasing the overall exciton generation due to the complementary absorption bands of PTB7 and WSe_2. Next, a conjugated small molecule 4,7-dithienbenzothiadiazole (T) was incorporated as the third component, PCE was improved by 5.5% reaching a maximum value of 8.11%, due to cascade charge transfer. Finally, the photovoltaic parameters of six novel Low Band gap (LBG) polymers were determined for the first time. In this context, RGO nanoflakes were incorporated to dope the most efficient LBG polymer among these, resulting to conductivity increase by 60% and a PCE of 4.5%, improved by 8.5%, compared to the reference cell. The improved conductivity was the motivation for a future hybrid integrated solar cell fabrication, where this ternary active layer would be undoubtedly applied as a second active material onto the highly efficient perovskite wide band gap layer.