**Polymer solar cells based on bulk heterojunction P3HT : PCBM active layer constructed over plastic substrates**

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**Objectives-** In this study some crucial parameters of PVs prepared from active layer blend of P3HT and PCBM in 1:1 mass ratio and deposited from chlorobenzene solution by spin-coating over either polyethylene terephthalate (PET) or standard glass substrates were determined. In order to control the active layer morphology, the films were subjected to post-deposition treatment (annealing) at different temperatures. Additionally, the effect of electron transport layer (ETL) prepared from ZnO nanoparticles on PVs performance was investigated. Test devices with above architecture and Ag back electrodes deposited by magnetron sputtering were constructed.

**Optical absorption**

![Optical absorption graph](image)

Optical properties of: A) neat P3HT and P3HT:PCBM mixture over glass and PET substrates, and B) thermally annealed P3HT:PCBM active layer films for polymer-organic PVs.

**Current density-voltage (V-J) characteristics**

![Current density-voltage graph](image)

The J-V characteristics of polymer solar cells constructed in environmental conditions based on P3HT:PCBM active layer: A) without ETL and B) with ETL prepared from ZnO nanoparticles over PET plastic substrates, and for comparison, C) without ETL and D) with ETL prepared from ZnO nanoparticles over glass class substrates, respectively.

**Conclusions-**

Polymer-organic photovoltaics based on bulk heterojunction P3HT:PCBM active layer were successfully constructed over plastic PET substrates. It was found that mass ratio of donor (P3HT) : acceptor (PCBM) = 1:1 in the active layer, chlorobenzene as a solvent, ITO anode, PEDOT/PSS as hole transport layer and sputtered Ag cathode were the most appropriate circumstances for fabrication of plastic PVs. They showed current density-voltage (J-V) characteristics and PCE similar to the PVs constructed over classic glass substrates. Post-deposition thermal annealing at 100-120 °C increased the PCE, whereas incorporation of ZnO nanoparticles as ETL spin-coated on the top of active layer caused more pronounced impact on the FF value and improved the J-V characteristics eliminating the S-shape, usually typical for not annealed samples.

**Quantum efficiency and impedance spectra of polymer-organic PVs**

![Quantum efficiency and impedance spectra](image)

Polymer solar cells composed of the layers: ITO/PEDOT:PSS/P3HT:PCBM/Ag and ITO/PEDOT:PSS/P3HT:PCBM/ZnO/Ag over PET substrates, and over glass substrates for comparison were prepared, and their quantum efficiency and impedance spectra were measured. On the quantum efficiency spectrum A) is well visible that PVs over PET substrates possess broader quantum efficiency than PVs over glass substrates in the range 400-450 nm. The impedance spectra B) were taken as a function of applied bias under illumination and they were successfully fitted with an equivalent circuit with two R|CPE groups.

Acknowledgement: The authors are grateful to the National scientific program EPLUS (Agreement No. D01-214/2018 and D01-321/2019) for the financial support.