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Simple approach to growth and characterization of ZnO/GO/P3HT layered nanostructures for solar cell devices

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Poor performance of solar cell devices and low energy conversion brought great concern to researchers from different disciplines worldwide. As a result, various generations of solar cells have been implemented to tackle energy challenges. Within emerging generations of solar cells, layered devices are also gaining much interest due to charge transfer that takes place amongst the layers. In fact, for power conversion efficiency to be improved layered nanostructured materials need to be good electron donor and acceptor. Carbon containing nanomaterials offer the possibility of cooperative properties arising from interactions among the layered nanostructures. In the current study, simple and effective approach has been followed to prepare thin films of zinc oxide, graphene oxide (GO) and poly (3-hexylthiophene) (P3HT) in the form of layered structures for photovoltaic applications. Their structural, morphological and optical properties were investigated. The X-ray diffraction (XRD) studies revealed the interaction of layered structures through determination of the basal spacing and unit cell dimensions. As proof of concept of interaction, Field emission scanning electron microscopy (FE-SEM) images showed nanoflowers of ZnO and well defined graphene sheets upon growth of GO layer indicating that GO films were uniformly imbedded. FTIR confirmed the existence of C-O and C=C bonds. From UV/VIS/NIR we observed an enhanced absorption that validates the interaction with ZnO. Photoluminescence (PL) measurements showed quenching and shifting of emission spectra due to charge and energy transfer. Furthermore, an extensive study to probe effect of ZnO and GO on the optical constants of P3HT was conducted using Spectroscopic Ellipsometer (SE). Our work paves a way to fully understand interactions between ZnO/GO/P3HT layered structures using a simple and reproducible process for solar cell devices.

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PhD

Main supervisor (name and email)
and his / her institution

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Yes

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