Thin films of conducting polymers, Carbon Nanotubes and Graphene oxide: their use in electronic devices

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Research efforts on thin film mixtures of conducting polymers and carbon nanostructures have created new possibilities for electronic devices. Several materials and, combinations of materials, have been presented in many device configurations along the last years. Here, we present our studies on optical, morphological and electrical properties of thin nanostructured films active layers used for different purposes, such as, electrodes of Organic Photovoltaics (OPVs), active layers for OPVs and active layers in gas sensors. The films are obtained by (i) simple mixture in a common solvent, (ii) miniemulsion technique or (iii) generated by interfacial synthesis. (i) Using simple mixture between graphene oxide (GO) and PEDOT:PSS with different content ratios was possible to achieve an environmentally friendly, conductive, transparent and flexible thin film in which the composite features are betters than the compounds separately used as transparent electrodes in organic solar cells. (ii) The miniemulsion technique allows the nanostructuring of polymers in aqueous solution and offers significant potential advantages and we present an easy method to synthesize polymer nanoparticles using graphene oxide as an alternative to the traditional insulating surfactants, using the Pickering emulsions concept. (iii) The interfacial polymerization method to synthesize carbon nanotubes/polyaniline composites, in which the final material is obtained as a thin film at the liquid-liquid (water/oil) interface; according the ratio between polyaniline and carbon nanotubes, the film morphology is represented by a continuum of polymer containing CNTs embedded in it, or by touched CNTs individually capped by a thin polymer shell. Here is presented the electrical characteristics of these films as well as their use as transparent electrodes in ITO-free organic photovoltaic devices and gas sensors. In addition, regarding our efforts in developing OPVs with environmental friendly solvents we present a bulk heterojunction system based on semiconducting polymer and non fullerene acceptor films obtained from green solvent and its similarities with devices made using ordinary aromatic solvents.