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High conductivity polymer electrode for flexible electronic devices

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Conducting polymers hold the great advantages of light weight, excellent mechanical flexibility, easy-processing, controllable physical and chemical properties, have been attracting tremendous attention for the application in electronic devices. Among them, poly(3,4- ethylenedioxythiophene (PEDOT)-based materials have been extensively studied due to its excellent air, thermal stability, and high transparency in the visible spectral region and tunable conductivity from 10-4 to 103 S/cm.The commercially available PEDOT- based aqueous formulation, PEDOT:PSS, has been widely used in organic electronic devices as the electrodes to replace expensive and brittle indium tin oxide (ITO) or metals because of the easy processing. Recently, we performed studies on the wetting property, conductivity and novel film fabrication methods of PEDOT:PSS and their applications on energy conversion and storage devices. Research achievements are listed partly as following: (1) a nonionic surfactant (PEG-TmDD) was reported to improve the wetting property and conductivity of PEDOT:PSS. Vacuum-free organic solar cells with the PEDOT:PSS solution doped with 4.0% PEG-TmDD as an efficient top electrode demonstrate a fill factor of 60% and a power conversion efficiency of 4.1% using P3HT:ICBA as the active layer. (2) A novel scalable strategy is developed to prepare highly conductive thick polymer films (HCT-PEDOT:PSS).Organic solar cells with laminated HCT-PEDOT:PSS exhibit comparable performance to the Ag top electrodes. Flexible super-capacitors based on HCT-PEDOT:PSS display a high performance that greatly outperforms previous reported values. (3) Flexible transparent PEDOT:PSS electrode with a conductivity of 2673 S/cm was fabricated and applied to all-plastic organic solar cells and semi-transparent super-capacitors. (4) Vacuum free Integrated device based on organic solar cell and capacitor has been successfully fabricated in our recent work by employing highly conductive PEDOT:PSS electrode. Although many research results have been achieved in recent years, efforts need to be paid on enhancing its conductive properties in terms of the practical applications.

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