High Conductivity Polymer Electrode for Flexible Electronic Devices

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Abstract (300 word limit)

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 10^{3} S/cm.(Fig.1) 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).[4] 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.

Image

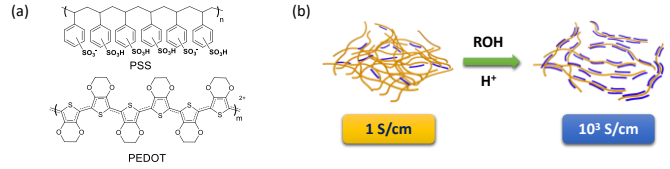
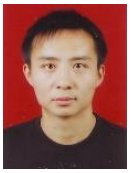


Fig.1 (a) Molecular structures of polymer PEDOT and PSS, (b) A schematic diagram for conductive enhancement of PEDOT:PSS.

Recent Publications (minimum 5)

1. Zaifang Li, Guoqiang Ma, Ru Ge, Fei Qin, Kaifu Huo*, Yinhua Zhou*,etc. Free-Standing Conducting Polymer Films for High-Performance Energy Devices. Angewandte Chemie International Edition, 2016, 128, 991-994. (Hot paper).
2. Zaifang Li, Wei Meng, Bin Hu, and Yinhua Zhou*, etc. A nonionic surfactant simultaneously enhancing wetting property and electrical conductivity of PEDOT:PSS for vacuum-free organic solar cells. Solar Energy Materials & Solar Cells, 2015, 137, 311-318.
3. Zaifang Li,* Ying Liang, Wenjing Tian*, etc. A low-work-function, high-conductivity PEDOT:PSS electrode for organic solar cells with a simple structure. Synthetic Metals, 2015, 210, 363-366.
4. Zaifang Li, Fei Qin, Yinhua Zhou*, etc. Optical properties and conductivity of PEDOT:PSS films treated by PEI solution for organic solar cells. Organic Electronics, 2015, 21, 144-148.
5. Zaifang Li*, Qingfeng Dong, Wenjing Tian*, etc. An efficient photovoltaic device based on novel D–A–D solution-processable small molecules. Journal of Materials Science, 2015 50, 937-947.
6. Zaifang Li,* Ji Bian, Yinhua Zhou, Wenjing Tian*, etc. Effect of alkyl chain length on the photovoltaic performance of oligothiophene-based small molecules. Solar Energy Materials & Solar Cells, 2014, 130, 336-346.
7. Zaifang Li, Qingfeng Dong, Bin Xu, Shiyu Yao, Shanpeng Wen, Hui Li, Yujie Dong, Weidong, Cheng, Wenjing Tian*. Novel solution processable small molecule containing new electron-withdrawing group and oligothiophene for photovoltaic applications. Solar Energy Materials & Solar Cells, 2012, 98, 343-350.



Biography (150 word limit)

Zaifang Li got a PHD degree in 2011 from Jilin University China. He got an associate professor position in 2013 in Hubei University of Arts and Science. At present, he is working in Linkoping University (SWE) as a Marie Curie Fellow cooperated with Prof. Fengling Zhang. His research mainly focus on highly conductive polymer electrodes for organic electronic devices, such as organic solar cells, perovskite solar cells, capacitor, thermoelectronic devices. Especially, his recent work on highly conductive free standing PEDOT:PSS film attracted great attends due to its high performance and wide applications. Furthermore, he has made a big progress on high conductivity transparent PEDOT:PSS electrode and its application on all plastic organic electronic devices.

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Notes/Comments: