



器件制备及器件物理

稀释溶剂对PEDOT:PSS薄膜和有机太阳能电池性能的影响

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摘要： 采用喷涂技术制备聚3, 4-乙撑二噻吩：聚苯乙烯磺酸盐（PEDOT:PSS）有机层薄膜，系统研究了乙醇、去离子水、甲醇、异丙醇和乙二醇等稀释溶剂对PEDOT:PSS薄膜形貌、透过率及导电性能的影响。将PEDOT:PSS薄膜应用于有机太阳能电池器件的制备，研究了不同溶剂对器件性能的影响。实验结果表明：采用乙醇稀释PEDOT:PSS溶液，能有效抑制PEDOT:PSS颗粒团聚，降低薄膜粗糙度，提高薄膜的透过率和导电性。以其制备的太阳能电池器件的能量转换效率明显高于其他溶剂稀释，转换效率为2.66%。

关键词： PEDOT:PSS 喷涂 有机太阳能电池

Effect of Solvent Dilution on Preparation of PEDOT:PSS Transparent Conductive Films and Device Performance of Organic Solar Cells

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Abstract: Poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) films were prepared by using spray coating technique. The morphology, transmittance and conductivity of the film were studied by using ethanol, deionized water, methanol and isopropanol to dilute the origin PEDOT:PSS, respectively. The solvent-diluted PEDOT:PSS films were employed to fabricated organic solar cells. The effect of solvents dilution on the solar cells performance was studied. The results indicate that the introduction of ethanol can effectively inhibit the agglomeration of PEDOT:PSS particles, reduce the film roughness, and improve the transmittance and conductivity of the PEDOT:PSS film. The organic solar cell based on the PEDOT:PSS film diluted with ethanol exhibits a power conversion efficiency of 2.66%, which is higher than those with other diluting solvents.

Keywords: PEDOT:PSS spray coating organic solar cell

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参考文献:

- [1] Li J, Kim S, Edington S, *et al.* A study of stabilization of P3HT/PCBM organic solar cells by photochemical active TiO_x layer[J]. *Sol. Energy Mater. Sol. Cells*, 2011, 95(4):1123-1130.
- [2] Shaheen S E, Brabec C J, Sariciftci N S, *et al.* 25% efficient organic plastic solar cells[J]. *Appl. Phys. Lett.* 
- [3] Jeon S O, Lee J Y. Improved high temperature stability of organic solar cells using a phosphine oxide type cathode modification layer[J]. *Sol. Energy Mater. Sol. Cells*, 2011, 95(4):1102-1106.
- [4] Sun K, Xia Y, Ouyang J. Improvement in the photovoltaic efficiency of polymer solar cells by treating the poly (3, 4-ethylenedioxythiophene):Poly (styrenesulfonate) buffer layer with co-solvents of hydrophilic organic solvents and hydrophobic 1, 2-dichlorobenzene[J]. *Sol. Energy Mater. Sol. Cells*, 2012, 97(1):89-96.
- [5] Sefanc M A, Okyay A K, Demir H V. Plasmonic backcontact grating for P3HT/PCBM organic solar cells enabling strong optical absorption increased in all polarizations[J]. *Opt. Exp.*, 2011, 19(15):14200-14209.
- [6] Wang L J, Zhang W, Qin H T, *et al.* Influence of solution-processed conditions on polymer bulk heterojunction solar cell performance[J]. *Chin. J. Liq. Cryst. Disp.*(液晶与显示.2013, 28(4):521-526 
- [7] Vak D, Kim S S, Jo J, *et al.* Fabrication of organic bulk heterojunction solar cells by a spray deposition method for low-cost power generation[J]. *Appl. Phys. Lett.*, 2007, 91(8):081102-1-3.
- [8] Zhou Y, Cheun H, Choi S, *et al.* Optimization of a polymer top electrode for inverted semitransparent

- organic solar cells[J]. *Org. Electron.*, 2011, 12(5):827-831.
- [9] Weickert J, Sun H, Palumbiny C, *et al.* Spray-deposited PEDOT:PSS for inverted organic solar cells[J]. *Sol. Energy Mater. Sol. Cells*, 2010, 94(12):2371-2374.
- [10] Kopola P, Zimmermann B, Filipovic A, *et al.* Aerosol jet printed grid for ITO-free inverted organic solar cells [J]. *Sol. Energy Mater. Sol. Cells*, 2012, 107:252-258.
- [11] Kim K J, Kim Y S, Kang W S, *et al.* Inspection of substrate-heated modified PEDOT:PSS morphology for all spray deposited organic photovoltaics[J]. *Sol. Energy Mater. Sol. Cells*, 2010, 94(7):1303-1306.
- [12] Kim Y, Lee J, Kang H, *et al.* Controlled electro-spray deposition of highly conductive PEDOT:PSS films[J]. *Sol. Energy Mater. Sol. Cells*, 2012, 98:39-45.
- [13] Hoth C N, Steim R, Schilinsky P, *et al.* Topographical and morphological aspects of spray coated organic photovoltaics[J]. *Org. Electron.*, 2009, 10(4):587-593.
- [14] Kim Y, Kim G, Lee J, *et al.* Morphology controlled bulk-heterojunction layers of fully electro-spray coated organic solar cells[J]. *Sol. Energy Mater. Sol. Cells*, 2012, 105:272-279.
- [15] Steirer K X, Berry J J, Reese M O, *et al.* Ultrasonically sprayed and inkjet printed thin film electrodes for organic solar cells[J]. *Thin Solid Films*, 2009, 517(8):2781-2786.
- [16] Giroto C, Moia D, Rand B P, *et al.* High-performance organic solar cells with spray-coated hole-transport and active layers[J]. *Adv. Funct. Mater.*, 2011, 21(1):64-72.
- [17] Zhang F L, Gadisa A, Inganas O, *et al.* Influence of buffer layers on the performance of polymer solar cells [J]. *Acta Phys. Sinica (物理学报)*, 2004, 84(19):3906-3908 (in Chinese).
- [18] Xia Y, Zhang H, Ouyang J. Highly conductive PEDOT:PSS films prepared through a treatment with zwitterions and their application in polymer photovoltaic cells[J]. *J. Mater. Chem.*, 2010, 20(43):9740-9747.
- [19] Peng B, Guo X, Cui C, *et al.* Performance improvement of polymer solar cells by using a solvent-treated poly (3, 4-ethylenedioxythiophene):poly (styrenesulfonate) buffer layer[J]. *Appl. Phys. Lett.*, 2011, 98 (24):243308-1-3.
- [20] Crispin X, Marciniak S, Osikowicz W, *et al.* Conductivity, morphology, interfacial chemistry, and stability of poly (3, 4-ethylene dioxythiophene)-poly (styrene sulfonate): A photoelectron spectroscopy study[J]. *J. Polym. Sci. Part B: Polym. Phys.*, 2003, 41(21):2561-2583.
- [21] Wang H T, Zhang W F, Chen B X, *et al.* Enhancing power conversion efficiency of polymer solar cells via treatment of PEDOT:PSS anode buffer layer using DMF solvent[J]. *J. Univ. Sci. Technol. Chin.*(中国科学技术大学学报), 2012, 42(10):775-784 (in Chinese).
- [22] Yang C H, Tang A W, Teng F, *et al.* Preparation of highly conductive polymer PEDOT:PSS by post-treatment[J]. *Chin. J. Liq. Cryst. Disp.*(液晶与显示), 2013, 28(3):323-329 (in Chinese).