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材料物理和化学

溶液加工条件对聚合物体相异质结太阳能电池性能的影响

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摘要: 由于有机太阳能电池具有成本低、易加工、可以制作在柔性衬底上等优点备受人们关注。文中采用了溶液旋涂的加工方法,研究了基于聚3-乙基噻吩(P3HT)与富勒烯衍生物(PCBM)共混的有机聚合物体相异质结太阳能电池。在大气条件下完成了器件的制备与测试,通过旋涂条件、质量分数、退火条件等优化提升了器件的光电特性,获得开路电压(V_{oc})为0.62 V,短路电流密度(J_{sc})为14.97 mA/cm²,填充因子(FF)为42.21%,电池效率(PCE)为3.92%的高效聚合物体相异质结太阳能电池。因此,通过对溶液加工条件的优化,可以提高薄膜质量,促进载流子传输和分离的能力。不仅可以提升有机聚合物体相异质结太阳能电池的效率,也为推进有机太阳能电池的量产化奠定了基础。

关键词: P3HT:PCBM聚合物 体相异质结 太阳能电池 溶液加工

Influence of Solution-Processed Conditions on Polymer Bulk Heterojunction Solar Cell Performance

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Abstract: The organic solar cells have been extensively studied due to low fabricated cost, easy processability and compatibility with flexible substrates. The bulk heterojunction solar cells based on poly(3-hexylthiophene) (P3HT) and phenyl-C₆₁-butyric acid methyl ester (PCBM) blends has been prepared with the solution-processed method. Influence of processing conditions on the performance of P3HT:PCBM solar cells were investigated under ambient atmosphere, such as heated-up time of P3HT:PCBM solution on water bath, P3HT:PCBM weight percent, spin-coating speed, and solvent annealing of P3HT:PCBM thin film. P3HT:PCBM solar cells with open circuit voltage of 0.62 V, short circuit current density of 14.97 mA/cm², fill factor of 42.21% and an efficiency of 3.92% were obtained by using the optimum condition. This improvement in the efficiency is possibly due to the homogeneous mixture and higher ordering P3HT:PCBM thin films, which enhanced carrier carrying ability as well as enlarged contact area of the polymer molecules rearrangement. The efficiency of the organic polymer bulk heterojunction solar cells was also improved. The good fabricated environment under ambient atmosphere was benefit to their commercialization.

Keywords: P3HT:PCBM polymer bulk heterojunction solar cell solution processing

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