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器件制备及器件物理

CdSe/ZnSe/ZnS量子点在单晶太阳能电池中的应用

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摘要： 将CdSe/ZnSe/ZnS量子点掺入到聚甲基丙烯酸甲酯(PMMA)中,研究了量子点的发光下转移特性。将420 nm长波滤光片盖在单晶电池上,使电池对300~420 nm波段光谱响应几乎为零,同时排除下转移层抗反射效应的影响,再在滤光片表面制备下转移层,观察到了外量子效率(EQE)值的提升,说明所用量子点可以应用于对300~420 nm波段光谱响应几乎为零的电池上实现频率的下转移,提高EQE。对量子点在太阳能电池中应用的可能性进行了分析,并根据本实验中测得电池的EQE数据,计算了该电池获得提升所需量子点最低的整体荧光量子效率值为87.8%。

关键词： 太阳能电池 光谱下转移层 CdSe/ZnSe/ZnS量子点 外量子效率 荧光量子效率

Application of CdSe/ZnSe/ZnS Quantum Dots in Monocrystalline Silicon Solar Cells

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Abstract: The luminescent down-shifting characteristics of CdSe/ZnSe/ZnS core/shell/shell quantum dots (QDs) were studied by incorporating the QDs as the down-shifting luminescent material into polymethyl-methacrylate (PMMA). Firstly, the optical high-pass filter with threshold 420 nm was used to cover the solar cell, so as to make the spectral response of the cell almost zero in the waveband range of 300~420 nm. Then the luminescent down-shifting (LD) layer of QDs was prepared on the external surface of the optical filters, we found the external quantum efficiency (EQE) of solar cell improved. This indicates that LD layer can realize the down-shifting of frequency spectra at 300~420 nm, which is out of the spectral response region of the normal cell. Finally, in order to analyze the possibility of applying quantum dots to solar cells, the minimum fluorescence quantum efficiency (FQE) of the quantum dots was calculated to be 87.8% according to the measured EQE of solar cell.

Keywords: solar cell luminescent down-shifting layer CdSe/ZnSe/ZnS quantum dots external quantum efficiency fluorescence quantum efficiency
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