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器件制备及器件物理

基于光栅结构的砷化镓高效率吸收层设计

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摘要： 设计了一种具有光栅结构砷化镓吸收层的薄膜太阳能电池,利用严格耦合波方法对矩形光栅和三角形光栅结构砷化镓吸收层在300~900 nm入射波长范围内的吸收效率进行了分析。结果表明:相比于平坦吸收层,两种光栅结构在TE和TM偏振光条件下吸收效率均有提高,峰值吸收率可提高55.9%。并对矩形光栅、三角形光栅结构参数进行了优化设计,对两种光栅吸收层的角度依赖性做了分析,得出在填充比和厚度相同的情况下,正三角形光栅吸收层的角度依赖性最优。最后利用有限元法对入射光在电池吸收层的吸收增强效应进行了理论模拟,通过与平坦结构吸收层的电场分布对比,可以直观地看出入射光在光栅结构吸收层的吸收增强效应。该研究结果为制备高效率、高性能太阳能电池结构提供了参考依据。

关键词： 砷化镓 吸收层 光栅 吸收效率

Grating Based Absorption Layer for Enhanced Absorption in Gallium Arsenide Solar Cells

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Abstract: A design is proposed to significantly increase the absorption of gallium arsenide thin-film layer. This is achieved by patterning a grating in the layer. By using rigorous coupled wave method, the absorption efficiency in the range of 300~900 nm has been analyzed for GaAs layer with rectangular and triangle gratings. The results show that the absorption efficiency of the two structures can be improved relative to the flat absorption layer and the peak absorption rate can be increased by 55.9%. And the structural parameters of the two structures have been also optimized. By analyzing the incident angular dependence of the two structures, it is concluded that solar cells with the triangular absorption layer have better characteristics in the same condition of thickness and filling factor. On the other hand, the finite element method is used to calculate the field distribution for different absorption layers. Good absorption enhancement can be observed directly from the absorption layer with gratings. The research provides a reference for the preparation of solar cell structures with high performance.

Keywords: GaAs absorption layer grating absorption
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