Studies on the TiO_2 Thin Film on the Silicon Nanowire Arrays using Taguchi - Grey Method for Heterojunction Solar Cell

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Abstract

In recent years, the problem of energy has become more and more serious, and renewable energy is the most important. Among the renewable energy sources, solar energy is the best developed. Many different materials have been applied to solar cells by scholars. One way to produce large-area, easy-to-process thin films is to use radio frequency magnetron sputtering. In this study, P-layer silicon nanowire arrays were prepared by electroless etching method to replace the previous multilayer films. TiO_2-SiNW Arrays heterojunctions were formed by preparing TiO_2 as N layer by magnetron sputtering method. In this paper, the Grey-Taguchi method was used to analyze and optimize PN heterojunctions with TiO_2 films. The effects of sputtering process parameters (RF power, process pressure, deposition temperature and deposition time) on surface morphology, material structure, photoelectric conversion efficiency and reflectivity were investigated. An AZO window layer is then added and annealed.

The gray correlation analysis shows that the reflectivity is reduced from 8.02225% to 7.72081%, and the photoelectric conversion efficiency is increased from 0.01915% to 0.082%. In the confirmation runs, the TiO_2 film was amorphous and wound around an array of silicon nanowires. After adding the AZO window layer, the reflectivity increased to 18.04712%, and the photoelectric conversion efficiency increased to 0.124%. Confirmation runs show that the AZO film is polymorphic. The experimental results demonstrate the effectiveness of the RF magnetron sputtering method, which provides good reflectivity and photoelectric conversion efficiency.

Key words: SiNW Arrays, P-N Heterogeneous Junction, RF Magnetron Sputtering

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