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Improved solar cell efficiency of titanium dioxide on porous silicon using pulsed laser deposition at different laser wavelengths

Abstract

In this study, a Q-switched Nd:YAG laser with specific parameters, including a pulse repetition rate of 6 Hz, a pulse duration of 10 nm, a wavelength of 532 nm, and a laser fluence of 237.47 J cm^{-12}, was employed to fabricate highly crystalline TiO_2 nano-films. These nano-films exhibited a narrow energy band gap of 3.24 eV and showcased favorable surface morphology, characterized by a roughness of 2.38 nm. A solar cell device was produced by creating porous silicon (PSi) and applying titanium dioxide films onto the PSi, achieving a notable conversion efficiency of 8.733%. To investigate the impact of different parameters on the resulting TiO_2 nano-films, a range of laser fluences (ranging from 131.93 to 263.85 J cm^{-12}) and three distinct laser wavelengths (1064 nm, 532 nm, and 355 nm) were employed during the pulsed laser deposition (PLD) process. These experiments aimed to grow TiO_2 films on both quartz and silicon (Si) substrates.

Keywords

Porous silicon; Pulsed laser deposition; Solar cells; TiO_2 nano-films; Titanium dioxide