Anti Reflection Coatings Embedded with Photoluminescence-Downshifting-Silicon-Nanocrystals for Efficiency Enhancement of Crystalline Silicon Solar Cells

William R. Taube*, A. Kumar, P. B. Agarwal, P. Kothari

CSIR-Central Electronics Engineering Research Institute (CEERI), Pilani, Rajasthan-333031, India

*Corresponding author. Tel: 01596-252298, Fax: 01596-242294
Email Address: williamtaube@gmail.com

Abstract

A double layer anti reflection coating (DLARC) has been developed, comprising stacked layers of silicon-rich-nitride (SRN) film embedded with silicon-nanocrystals and silicon oxide film. The thickness optimization of anti reflection coating (ARC) was done using Transfer Matrix Method (TMM). The double layer SiO_x/SRN stack was deposited by plasma enhanced chemical vapour deposition (PECVD) and thermally annealed to precipitate silicon nanocrystals within the SRN film. Such thermally annealed SRN film exhibited photoluminescence, having potential to convert higher energy photons near violet region, to lower energy photons near red region which are efficiently absorbed by crystalline solar cells. These films were integrated as a DLARC into a monocrystalline silicon solar cell fabricated using optimized fabrication process. A relative increase in power conversion efficiency of 22.8% was observed on the cell with DLARC compared to a reference cell with a normal PECVD silicon nitride single layer ARC.

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