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Absorbing photonic crystals for silicon thin-film solar cells: Design, fabrication and experimental investigation

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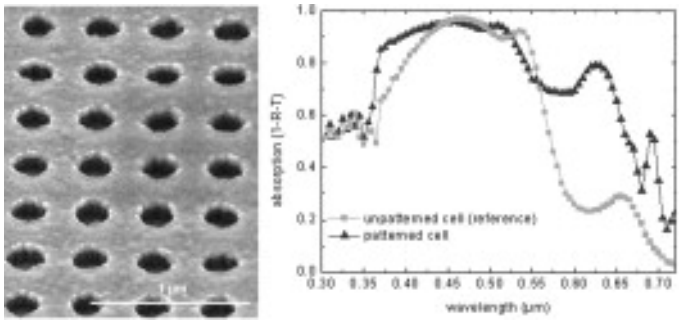
Abstract

In this paper, we present the integration of an absorbing photonic crystal within a thin-film photovoltaic solar cell. Optical simulations performed on a complete solar cell revealed that patterning the hydrogenated amorphous silicon active layer as a 2D photonic crystal membrane enabled to increase its integrated absorption by 28 % between 300 and 720Â nm, comparing to a similar but unpatterned stack. In order to fabricate such promising cells, we developed a high throughput process based on holographic lithography and reactive ion etching. The influences of the parameters taking part in those processes on the obtained patterns are discussed. Optical measurements performed on the resulting â€œphotonizedâ€ solar cell structures underline the regularity of the 2D pattern and a significant absorption increase above 550Â nm, similarly to what is observed on the simulated absorption spectra. Moreover, our

patterned cells are found to be robust with regards to the angle of incidence of the light.

Graphical Abstract



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Keywords

Photonic crystals; Thin-film devices and applications; Photovoltaics; Holographic lithography

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