Simulation and fabrication study of porous silicon Bragg mirror for thin silicon solar cells application.

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Abstract
Porous silicon Bragg mirror (BM) is one-dimensional photonic crystal, characterized by its high reflectivity stop band. Several studies have used it as back reflector to enhance optic confinement of low energy photons in thin silicon solar cells. A theoretical model relying on the Bruggeman's effective medium approximation (BEMA) and stratified medium theory with its matrix representation was established to model the reflectance spectra and to choose the parameters of bi-layer periodically stacked (indexes of refraction, numbers of bi-layers and Bragg wavelength), that allow to improve photons reflection in wave range 800-1200 nm. Calculation results show that the bandwidth BM is widerfor layers having higher refractive index contrast. Optimum of the numbers of bi-layers contributes in improvement of the maximum reflectivity. The optimized BM with ten bi-layers was fabricated by electrochemical etching of crystalline silicon wafer using current density of 12 and 100mA/cm2 in HF-containing solution, corresponding to porosities of approximately 30-70 % respectively. Maximum measured reflectivity for the prepared BM achieves approximately 88% at Bragg wavelength λB=700nm.

Keywords: Porous silicon; Bragg mirror; Reflectivity; Porosity.