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Design of porous silicon /PECVD SiO_x antireflection coatings for silicon solar cells

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Abstract. The meso-poreux porous silicon layer (PS) has become an interesting material owing to its potential applications in many fields including optoelectronics and photovoltaics [1]. PS layers were grown on the front surface emitter n^+ of n^+-p mono-crystalline Si junction. The thickness of the PS formed and the porosity were measured by an ellipsometer as a function of time duration of anodization, and the variation law of the PS growth kinetics is established. Single layers PS antireflection coating (ARC) achieved around 9% effective reflectivity in the wavelength range between 400 and 1000nm on junction n^+-p solar cells. However, strong surface recombination related to the roughness of the surface after porous silicon layers formation on n^+ doped emitter of conventional solar cells [2], The optical properties of PS layers may also degrade in time when no further treatment is used [3]. Several treatments have been attempted (rapid thermal oxidation (RTO), nitridation, anodic oxidation, thermal carbonization). In this context silicon oxide (SiO_x) films deposited by RF-PECVD on porous silicon surface are of interest, since they have good properties: (i) high chemical stability, (ii) acceptable passivation (iii) good antireflection coating (iv) and easy deposition process by PECVD on PS, without deteriorating the optical and structural properties of the underlying PS [4]. This work aims to reduce the reflectivity and improve the stability and passivation properties of PS ARC, the design of PECVD oxide silicon layers were investigated. SiO_x layers of thickness of 105nm deposited on PS ARC showed a decrease of ~3.8% in the effective reflectivity, compared to the single layer PS ARC, improve the reflectivity of 55%. V_{oc} measurements were carried out on all the samples by suns-Voc method and showed an improvement of the quality of the passivation brought by the oxide layer. Using the experimental reflectivity results and taking into account the passivation quality of the samples, the PC1D simulations predict an enhancement of the photogenerated current exceeding 49%.

Keyewords: Porous silicon, Silicon dioxide, Antireflection coating, Photocurrent

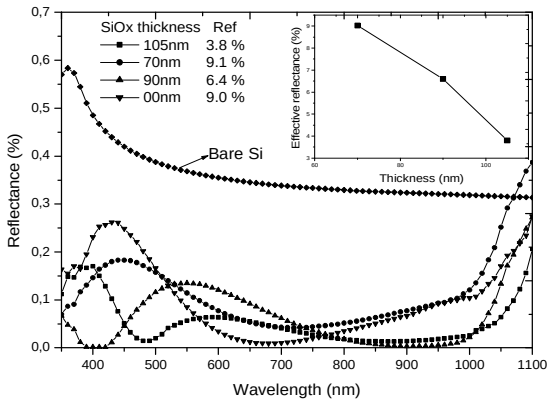

Fig. 1. Reflectance spectra of SiO_x/ PS films on n^+/p junction for various thickness SiO_x (inset of plot : effective reflectance versus different SiO_x layers thicknesses).

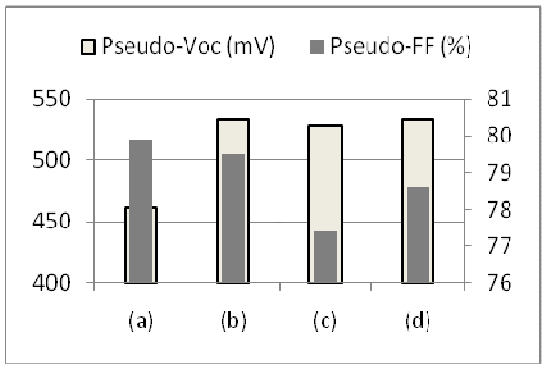

Fig. 2. Parameters suns-Voc obtained in a junction n+/p with : (a) PS, (b) PS/SiO_x(105nm),(c) PS/SiO_x (90nm), (d) PS/SiO_x (70nm).

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