Towards p-i-n cells on AIC-based pc-Si on Aluminium substrates

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Thin film silicon solar cells on low cost foreign and flexible substrates could be attractive for low cost production of photovoltaic electricity. This work aims at the synthesis of high-quality continuous polycrystalline silicon (pc-Si) layers on cheap Aluminium substrates using the aluminium induced crystallization (AIC) process of amorphous silicon. To avoid uncontrolled exchange of Al/Si, an Al-doped ZnO diffusion barrier layer against impurities but still conducting has been used. For the AIC process, a 200 nm thick Al-layer acting as a source of Al, was first electron beam evaporated over the substrates. Amorphous silicon films with thicknesses ranging from 200 nm were deposited by ECR-PECVD on the substrates. The annealing temperature and time were the key parameters of the Al/Si exchange process. Here, the direct crystallization using a conventional furnace was carried out at T=480 °C and for a duration of 10h. After the removal of the aggregated impurities (Al and a-Si) and defects (grain boundaries) on the surface by selective etching. The resulting crystallized layers were characterized by Raman spectroscopy (Figure 1). The as-grown AIC polysilicon films were found to be continuous and densely packed without amorphous phase.

The AIC process was followed by (1) 10 µm thick a-Si deposition by ECR-PECVD and (2) by n-type a-Si deposition using PVD. These layers were crystallized using solid phase epitaxy. Properties of the crystallized layers for different thermal budgets (1h, 2h, 5h, 10h and 12h at 600° C are further studied with Raman spectroscopy and X-ray ray diffraction technique. p-i-n cells structures were fabricated and basic characteristics were measured.

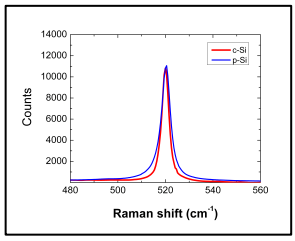

Figure 1 : Raman analysis of the AIC-Si layer formed on Al substrate

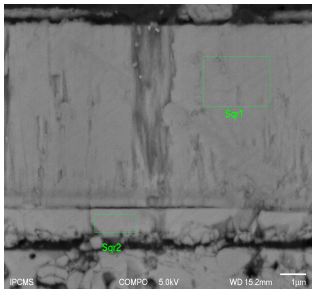

Figure 2 : Cross-section SEM micrograph of grown silicon on Al substrate

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