Structural characterization of Al-induced crystallized amorphous Si thin films for photovoltaic applications

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We present the structural characterization of p-doped polycrystalline Si films, formed by Al-induced crystallization and doping of amorphous Si thin films. The initial test structure consists of a bilayer of Al and α-Si, deposited on SiO_2/Si. The Al layer was deposited by electron gun evaporation, while the α-Si layer by sputtering. After extended annealing at 450^{o}C for several hours, α-Si crystallization and layer reversal takes place. The crystallized Si layer is highly doped with Al. The obtained structure is adequate for use in high efficiency solar cell devices[1]. Two different samples were used, namely sample D2001 and sample F2001. In both of them the nominal thickness of the SiO_2 layer was 100nm, while that of the Al and the α-Si layers was 200nm. Annealing was performed in N_2 ambient at 450^{o}C for 7.5 h in sample F2001 and for 10h in sample D2001. The structural characterization of these films was performed by using conventional and high resolution transmission electron microscopy (TEM). In both cases, full layer reversal took place, so as the Al layer was fully situated on top of the polycrystalline Si layer, of thickness in the range of 200-250 nm. The polycrystalline layer was of high crystalline quality, with grains having size between: a) 150nm and 2.2 μm for D2001 and b) 100 nm and 800 nm for sample F2001. The difference in crystal size is attributed to the different annealing time. Twins and other defects are observed in the Si grains and they are analysed. [1]

Figure 1: Combination of Bright Field TEM images showing the structure of the sample D2001

Figure 2: Bright Field TEM image showing the structure of the sample F2001

References

[1] S. Gardelis, A. G. Nassiopoulou, P. Manoussiadis, N. Vouroutzis, and N. Frangis, Appl. Phys. Lett. **103, 241114, 2013**

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