XXXII Panhellenic Conference on Solid State Physics and Materials Science
Conference Center "Carolos Papoulias", 18-21 September 2016, Ioannina, Greece

Study of structural characteristics of polycrystalline Si thin films, grown by Al metal induced crystallization of amorphous-Si, for solar cell applications by electron microscopy techniques

S. Kozakos[1], Ch. B. Lioutas[1], N. Vouroutzis[1], V. Gianneta[2] and A. G. Nassiopoulou[2]
[1] *Department of Physics, Aristotle University of Thessaloniki, GR-54124 Thessaloniki, Greece*
[2] *NCSR Demokritos/INN, Terma Patriarchou Grigoriou, Aghia Paraskevi, 15310 Athens, Greece*

The Al-induced crystallization and the simultaneous p-doping of amorphous Si thin films grown on n-type Si substrate have been investigated by transmission electron microscopy (TEM). This configuration is intended for use as the emitter in crystalline Si solar cells[1]. The initial structure consists of an amorphous Si layer, deposited by sputtering on n-type Si, on top of which a layer of Al is deposited. During the annealing in N_2 ambient for several hours and different temperatures, the a-Si starts to crystallize from the Al/a-Si interface and proceeds downwards. The crystallized Si layer is highly doped with Al. A combination of different deposited nominal thickness a-Si thin films–(10 and 20nm), annealing temperature (430 and 500^{o}C) and annealing time (6 and 10 hours), were used in order to grow a set of samples.

Cross section and plane view conventional and high resolution transmission electron microscopy (CTEM, HRTEM) were used for the structural characterization of these films. The nanocrystalline layer was of high crystalline quality, with thickness around 10nm in all cases and the <111> crystallization direction to be mainly parallel to [100] of Si substrate. However, the samples with nominal thickness of 20nm, show also nanocrystals in the amorphous layer, between the nano-Si layer and the Si-substrate with no preferential orientation. A thickness around 2-9 nm and lateral size around 4-26 nm were measured, with the maximum lateral dimensions observed for 500^{o}C and 10h annealing. Twins and other defects were observed in the Si nano-layer. Based on the TEM results, the crystallization mechanism will be discussed.

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