Deposition monitoring of rare earths doped silicon rich oxide films by grazing incidence X-ray fluorescence and reflectivity analysis.

G. Pepponi[1], M. Morales[2], K. R. Dey[2], F. Gourbilleau[2] and D. Chateigner[3]

[1] MiNALab, CMM – irst, Fondazione Bruno Kessler, Via Sommarive 18, 38123 Povo, Trento, Italy
[2] CIMAP, ENSICAEN, IUFM-Caen, Université de Caen Basse-Normandie, 6 Boulevard du Maréchal Juin, 14050 Caen, France
[3] CRISMAT, ENSICAEN, IUT-Caen, Université de Caen Basse-Normandie, 6 Boulevard du Maréchal Juin, 14050 Caen, France

The efficiency of thin film solar cells can be improved with the addition of a down-conversion top layer. In this down converter layer, incident photons with energy larger than twice the band gap will give rise to two photons with lower energy, and then a solar cell efficiency of around 40% can be achieved.

Pr ad Yb co-doped silicon rich oxide (SRO) thin films were investigated for their suitability as a down-converter layer. Films were deposited on single crystalline [100]-Si substrates using reactive radiofrequency magnetron co-sputtering of a SiO_2 target covered by a given number of Pr_20_3 and Yb_2O_3 chips. The effect of Pr_2O_3 to SiO_2 sputtered area ratio, Ar and H_2 partial pressure, sputtering power and deposition temperature on the film properties has been studied. For monitoring the deposition, X-ray reflectivity (XRR) and X-ray fluorescence (XRF) measurements have been coupled. A Panalytical Xpert-MRD diffractometer equipped with a Cu anode tube source and a scintillation counter with a back graphite monochromator. The white incident beam was attenuated with a Ni filter. An SDD detector was mounted to look in the middle of the sample aligned in the centre of rotation of the theta-theta goniometer at an angle chi=22º and an angle phi=0º. XRF has allowed to put in evidence the presence of impurities that could potentially kill the film photoluminescence, to estimate the Pr dopant concentration and to gain information on the depth profile of dopant and contaminants.