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Step by step ex-situ compositional, structural and optical analysis of high efficiency coevaporated CIGS layers prepared by 3-stage process

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Abstract:

Chalcopyrite $Cu(In_{1-x}Ga_x)Se_2$ (CIGS) thin film solar cells present outstanding photovoltaic performances, with a 20.3 % record efficiency device obtained recently with using the co-evaporation process for the CIGS layer [1]. These performances are due to intrinsic quality of the CIGS layers, like a high absorption coefficient but also to the presence of composition gradients, especially the varying Ga/(Ga+In) atomic ratio, that are the results of complex physico-chemical transformations occuring during the so-called three stage process [2]. A better understanding of these phenomena is key to further improve the efficiency and optimize the growth procedure, not only for co-evaporation but also for other processes like electrodeposition [3]. This presentation will focus on the study of the transformations occurring during coevaporation process which has been started in our laboratory within the high efficiency CIGS project. First, cells have been prepared with efficiencies higher than 15 % (without AR). Then the growth process has been systematically studied by characterizing samples extracted at different times of the process, by XRD, Raman spectroscopy, XRF and SEM. These analyses have permitted to elucidate the multiple phases formed during the different steps of the process. Influence of initial substrate temperature has been investigated. These results will be discussed in relation with other studies carried out in this field in the literature [4]

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