Development of wide band gap Cu (In, Ga)S_2 absorber as top cell for tandem application

Karima Bouras[1], Damien Coutancier[2], Romain Bodeux[1,2,3] and Daniel Lincot[1,2]

[1]Institut Photovoltaïque Ile de France (IPVF), 8 rue de la renaissance-92160, Antony France

[2]Institut de recherche et développement sur l'énergie photovoltaïque (IRDEP) EDF-UMR7174- CNRS-Chimie Paristech IRDEP, 6 Quai Watier, 78400 Chatou Cedex, France

[3]EDF R&D, IRDEP, 6 Quai Watier, 78400 Chatou Cedex, France

Crystalline silicon solar cells, dominating the PV market with a share exceeding 90%, are closely approaching their theoretical limit of 29% with world record of 26.6%. To further increase the conversion efficiency over 30%, high efficiency Si solar cells can be combined with other absorbers with energy band gap >1.5 eV. The candidates that have proven their selfs are III-V and perovskites with Si-tandem conversion efficiency of 32% and 26%, respectively. Herein we investigate the potential of wide gap CIGS material for use as top cell in tandem devices. Wide band gap CIGS with energy gap ranging from 1.4 to 1.7 eV has been successfully fabricated using two steps process. First, the CIG metallic precursor is deposited in different stack configurations by magnetron sputtering, followed by sulfurization step using H_2S-feeled atmosphere. We show that the crystalline structure strongly depends on the annealing parameters and H_2S concentration. The increase of the Ga at the surface was found to play an important role in the increase of the band gap of the material, V_{oc} as high as 720 mV was recorded. Finally we will discuss the limiting factors for such technology and report the key ingredients to reach the world record of 18% conversion efficiency of 1.5 eV CIGS leaded by Solar Frontier.

*Karima.bouras@ipvf.fr