Electrodeposition routes for the synthesis of wide-gap CIGS on silicon

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$Cu(In,Ga)(Se,S)_2$ (CIGS) is a very good candidate for tandem solar cell applications, thanks to its bandgap which can be tuned by changing the ratios In/Ga and Se/S. In particular, wide-gap CIGS is well suited to be implemented into tandem solar cells with Silicon, the CIGS acting as the top semi-transparent solar cell. Pure sulfide 1.55eV CIGS already reached efficiencies of 16,9 % via a two-step route consisting of the deposition of metals followed by a reactive sulfur annealing[1].

In this work, we report on the direct deposition of CIGS onto silicon, via two routes : a metallic approach where only metals are deposited, and a second one where $CuInSe_2$ (CISe) is deposited, both approaches being followed by a reactive S/Se annealing. The layers are electrodeposited either directly on silicon substrates, or on a precursor metallic layer (Cu or Ag). We will report on the investigation of the effects of electrodeposition conditions, precursor layer thickness and substrate morphology, aiming at optimizing the adhesion, morphology and composition of the final CIGS layer. The best results were achieved by electrodepositing CISe (SEM top view image on figure 1) onto a Cu precursor layer, opening a new route for the fabrication of tandem Si/CIGS solar cells.

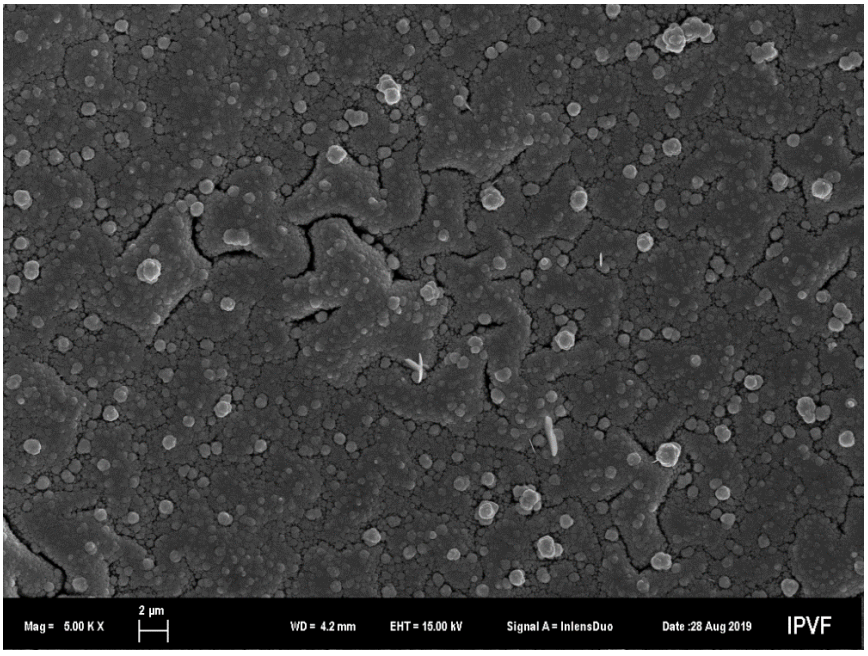

Figure 1 : CISe layer deposited on a silicon substrate coated with 20nm Cu.

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Reference

[1] Hiroi et al, Over 16% efficiency on Se-free $Cu(In,Ga)S_2$ thin film solar cell, E-MRS conference 2017.