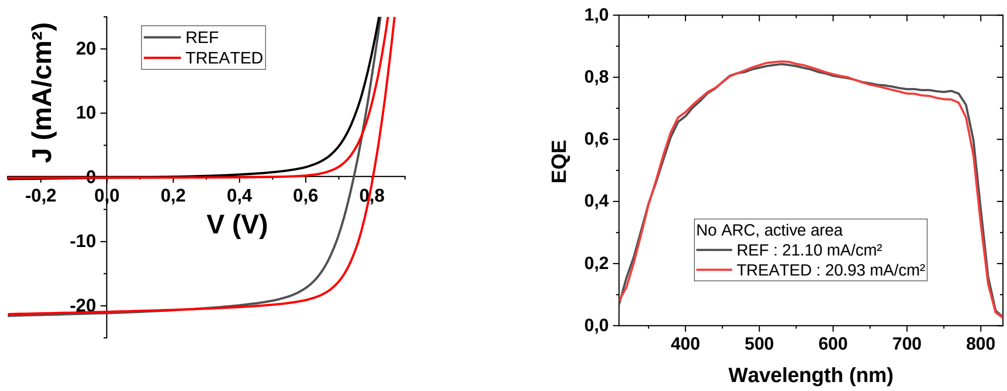
High efficiency solar cells based on wide band gap $Cu(In,Ga)S_2$ absorbers grown on transparent back contact : effect of surface passivation.

N. Barreau, L. Choubrac, F. Pineau

Nantes Université, IMN, CNRS, Institut des Matériaux de Nantes Jean Rouxel, Nantes, France

Thanks to band gap tunable between 1.0 eV and 2.5 eV, $Cu(In,Ga)(Se,S)_2$ semiconductors appear valuable absorber materials for tandem application. Cells based on low band gap $CuIn_{1-x}Ga_xSe_2$ (x<0.3), typically narrower than 1.2 eV, have achieved efficiencies above 20 %. For wider band gap, the situation is much more challenging. In fact, increasing x (*i.e.* gallium content relative to indium) in selenides yields severe V_{oc} deficit inherent to degraded electronic transport. As far as pure-sulfides $Cu(In,Ga)S_2$ are concerned, x value as low as 0.1 and 0.2 is enough to reach band gap values between 1.6 and 1.7 eV, which correspond to such needed for top cell application. Nevertheless, the drawback of the pure sulfides is their poor tolerance to Cu-off stoichiometry compared to selenides. As a matter in fact, it has been shown that even a slight copper deficiency yields the formation of detrimental secondary phases, such as the thiospinels $CuIn(Ga)_5S_8$.

The present contribution aims at presenting our recent progress regarding the performance of cells based on pure-sulfides deposited on transparent back contacts. Through the fine-tuning of absorber composition and front interface passivation, it is possible to reach efficiency close to 15 % with front side illumination. The front interface passivation consists in evaporating a very thin ZnS layer onto the absorber before the deposition of the buffer layer. This leads to improved V_{oc} and FF. We are currently trying to understand the actual effect of this layer on both material properties and electronic transport, and hope we can propose a model during the JNPV.



Typical JV curves (left) and EQEs (right) achieved with and without surface treatment.