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The beneficial effect of Rubidium in Cu(In,Ga)Se2 solar cells

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Cu(In,Ga)Se₂ solar cells are the most efficient ones among all thin film photovoltaics. The recent push in record efficiencies was mainly realized by applying a RbF post deposition treatment (PDT) to the absorber. However, it is not yet fully clear why the introduced Rb improves the solar cell performance. In order to investigate the beneficial effect of Rb, a Cu(In,Ga)Se₂ absorber was grown on a Mo coated alkali free substrate and subjected to a RbF PDT. This pure RbF PDT leads to a significantly higher conversion efficiency. A thin cross sectional lamella was cut out of the layer stack and investigated via a combination of different electron microscopy techniques and synchrotron based X-ray fluorescence analysis. It is evident that Rb segregates at random grain boundaries and dislocation cores, where it likely passivates defects. In contrast, Rb does not segregate at benign Σ3 twin boundaries. Additionally, Rb agglomerates at the interface between the absorber and the MoSe₂ layer. Our results thus provide clear indications of the origin of the beneficial effect of Rb in Cu(In,Ga)Se₂ solar cells [Schöppe et al., Nano Energy 42 (2017) 307]. Subsequently, we investigated a high efficiency solar cell grown on a glass substrate and subjected to a RbF PDT, thus providing a conversion efficiency of over 20 %. Applying the same combination of analysis techniques, we clearly demonstrate that our conclusions for a pure RbF PDT are also valid for state of the art devices.

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