Sodium Control in Ultrathin $Cu(In,Ga)Se_2$ Solar Cells on Transparent Back Contact for Efficiencies beyond 12%

Yong Li[a], Guanchao Yin[b], Yao Gao[a], Tristan Köhler[a], Jan Lucaßen[a], Martina Schmid[a]*

[a]*Department of Physics, University of Duisburg-Essen & CENIDE, Lotharstraße 1, 47057 Duisburg, Germany*
[b]*School of Materials Science and Engineering, Wuhan University of Technology, Luoshi Road 122, 430070 Wuhan, China*

*Corresponding author. School of Materials Science and Engineering, Wuhan University of Technology, Luoshi Road 122, 430070 Wuhan, China.

E-mail address: guanchao.yin@whut.edu.cn (G. Yin)

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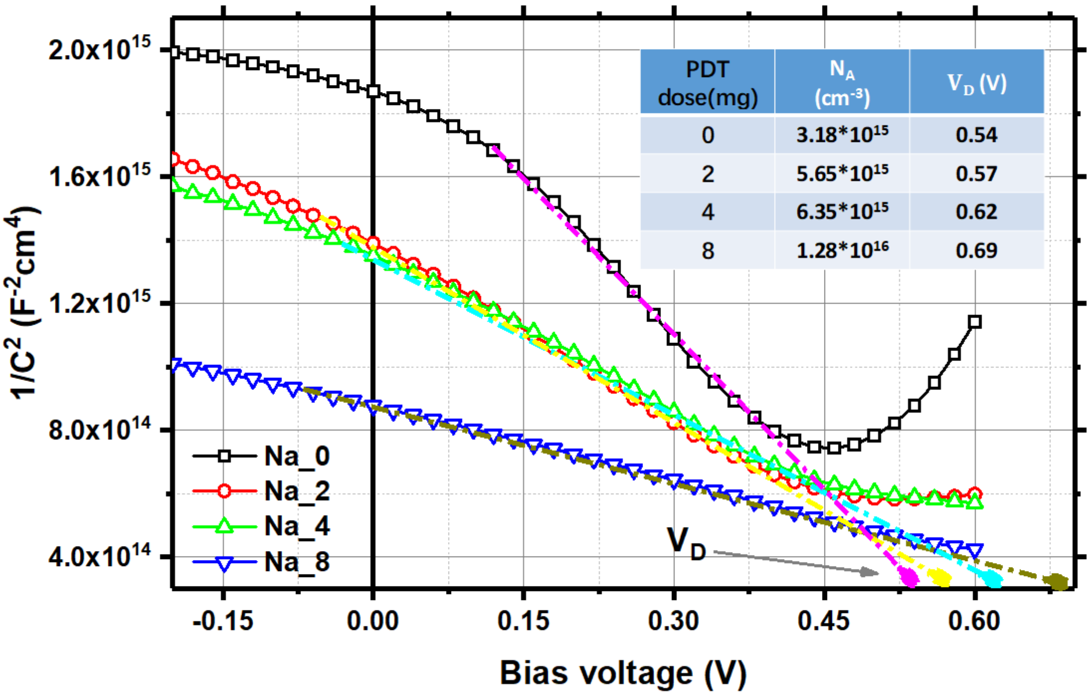

Figure S1: Mott-Schottky plot. N_A can be extracted via the slope of the linear fit, and the contact potential difference V_D as the intercept with the x-axis [1].

S2: SCAPS simulation model

The model is made of three layers, which are ZnO/CdS/CIGSe from top to bottom. The corresponding thicknesses are 300, 50 and 500 nm, respectively. To create a back Ga grading towards the back contact, the CIGSe layer was artificially divided into two sub-layers. The front one (close to CdS) has a thickness of 50 nm and a bandgap of 1.2 eV. The back one (close to the back contact) has a thickness of 450 nm and a bandgap grading from 1.2 to 1.5 eV. The absorber has a doping concentration of $4*10^{15}$ cm^{-3}. A back barrier potential of 0.4 eV is fixed for setting a Schottky contact. The back recombination velocity varies from $1*10^3$ to $1*10^7$ cm/s. To make the model simple, only the recombination at the back interface is considered. The definition file can be obtained from the authors.

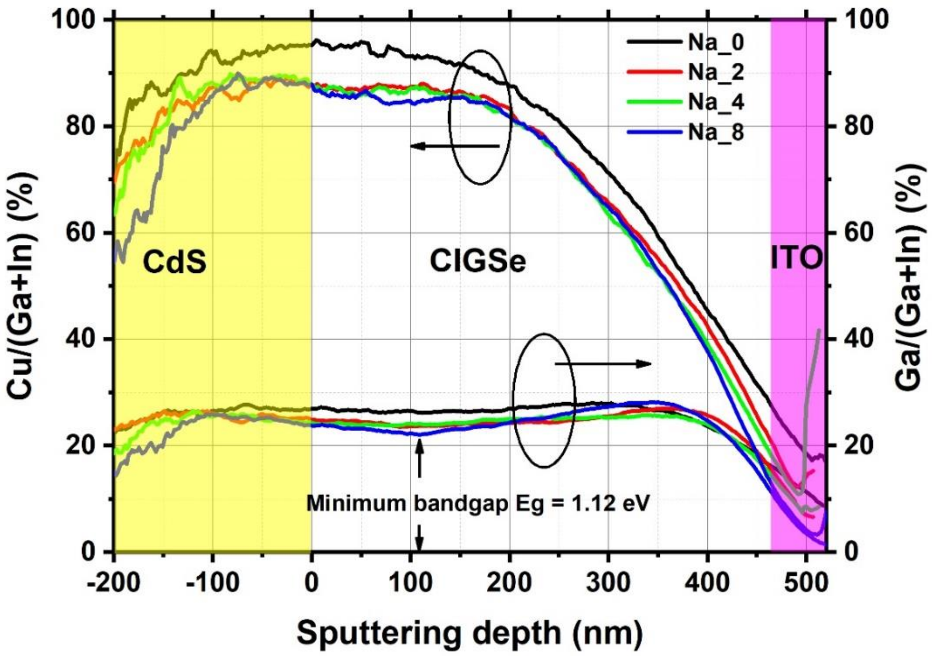

Figure S3: Cu/(Ga+In) ratio and Ga/(Ga+In) ratio depth distribution of $CuIn_xGa_{1-x}Se_2$, obtained by GD-OES. For the calculation of minimum band gap $E_g = 1 + 0.564\ x + 0.116\ x^2$ was used [2].

References

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