The role of window layers in the operation of CIGS solar cells

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Thin-film solar cells are rapidly obtaining a strong foothold in the photovoltaic market, now demonstrating conversion efficiencies (21 – 22%) approaching those of crystalline Si (25%) and exceeding those of multicrystalline Si. A typical copper indium gallium diselenide (CuInGaSe₂, or CIGS) thin-film solar cell (see left) consists of a p-type CIGS absorber layer on a Mo back contact, partnered with a ZnO:Al/i-ZnO/CdS front window stack. Here, the ZnO:Al is the conductive transparent front electrode, the n-type CdS is required to form the necessary p-n junction with the CIGS absorber, but the role of the i-ZnO layer is not well understood.

Project goals and description: In this project, the effect of the i-ZnO material properties on the functioning of the underlying layers, and ultimately, on the device performance will be investigated. This is particularly relevant since in the field, significant efforts are being made to replace the CdS layer with non-toxic Cd-free materials, and such studies must be complimented with an understanding as to how different window layers interact. A combination of experimental and simulation work will be carried out, testing various i-ZnO layers on two device platforms – a) CdS/CIGS/Mo/glass and b) Zn(O,S)/CIGS/Mo/glass. Work will include;

i) Development of the i-ZnO atomic layer deposition (ALD) process to attain control and selectivity of the intrinsic doping level.

ii) Fabrication and electrical characterisation of complete CIGS devices (CdS/CIGS/Mo layers provided by TNO) having varying i-ZnO layers.

iii) Simulation of electrical properties of CIGS devices using 1D solar cell simulation software SCAPS to support experimental trends.

Literature


2. S. Merdes, F. Ziem, T. Lavrenko, T. Walter, I. Lauermann, M. Klingsporn, S. Schmidt, F.


If you are interested or have questions about the project, please contact: Ben Williams (b.l.williams@tue.nl) or Adriana Creatore (m.creatore@tue.nl)