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CONTACT (NAME ONLY): Lisanne Van Puyvelde

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Abstract

TITLE: Combining optical and electrical studies to unravel the effect of Sb doping on CIGS solar cell

AUTHORS (FIRST NAME, LAST NAME): Lisanne Van Puyvelde[1], Johan Lauwaert[1], Philippe F. Smet[1], Dirk Poelman[1], Christoph Detavernier[1], Fabian Pianezzi[2], Shiro Nishiwaki[2], Ayodhya N. Tiwari[2], Samira Khelifi[3], Marc Burgelman[3], Henk Vrielinck[1]

INSTITUTIONS (ALL): 1. Department of Solid State Sciences, Ghent University, Gent, Belgium.
2. Laboratory for Thin Films and Photovoltaics, Empa, Swiss Federal Laboratories for Materials, Science and Technology, Duebendorf, Switzerland.
3. Department of Electronic and Information Systems (ELIS), Ghent University, Gent, Belgium.

ABSTRACT BODY: A way to lower the manufacturing cost of Cu(In,Ga)Se2 (CIGS) thin film solar cells is to use flexible polymer substrates instead of glass substrates. Because such substrates require a low temperature during absorber deposition, the efficiency of the cells remains slightly lower (18.7% [1]) compared to CIGS on glass substrates (20.3% [2]). Partial compensation of this efficiency loss might be accomplished by Sb doping [3] of the absorber, which is reported to have a positive effect on the morphology of this layer. In this work the defect structure of Sb doped CIGS solar cells is investigated using optical and electrical spectroscopic techniques. Experiments were performed on cells deposited on soda lime glass substrate, adding a thin Sb layer (8, 12 nm) onto the Mo back contact prior to the CIGS absorber deposition. The results are compared with those for cells without Sb doping using the same process.
Fourier-Transform near infrared photocurrent measurements in the 10–300K range demonstrate that the band gap of Sb-doped samples is larger than for undoped samples. Photoluminescence spectra in the 5–100K region provide information on shallow-level defects. Deep-Level Transient Spectroscopy spectra of Sb-doped cells exhibit two features not encountered for non-doped cells: 1) a peak at lower temperature than the N1 signal and 2) incomplete charge carrier freeze-out down to 8 K. While the first result appears to be the fingerprint of an extra non-Ohmic contact in the solar cell structure [4], the second suggests the introduction of a very shallow acceptor by Sb doping. As a salient feature one can accurately monitor the partial hole freeze-out in the 40-60 K range and determine the signature of the intrinsic defects that provide the p-type conductivity of the CIGS absorber using Admittance Spectroscopy.
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