Influence of growing conditions on optical and electrical properties of $ZnSnN_2$ thin films for PV applications

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N-type semiconductor $ZnSnN_2$ (ZTN) thin layers have recently attracted much attention in the PV community due to their tunable direct bandgap, non-toxicity and abundancy [1-3]. These layers could be used as absorbing layer in a tandem top cell or as a possible selective contact in a silicon absorber cell [4-5].Various deposition techniques can be used to grow such layers, but low cost and large area compatible process such as sputtering (or PVD) could be more cost-effective for PV devices. However, very few experimental results obtained on such layers are available in the literature and it is currently difficult to evaluate its potential for PV applications.

In this work, we report optical and electrical properties of ZTN thin films grown by the PVD technique. ZTN samples were elaborated on c-Si, SiO_2/c-Si and glass substrates at room temperature with variable Zn/(Zn+Sn) and N_2 flux. The atomic composition was determined using EDS-SEM. We find it possible to tune optical bandgap from 0.9 to 1.8 eV determined by spectroscopic ellipsometry, while room temperature Hall effect measurements indicate that electron concentration, mobility and conductivity are ranging from ~ 10^{18} to 10^{20} cm^{-3} , 0.1 to 3 $cm^2.V^{-1}.s^{-1}$ and 0.025 to 10 $S.cm^{-1}$, respectively. These values are in good agreement with properties found in literature for state-of-the-art ZTN layers. Investigation of ZTN films structural properties are on-going using X-ray diffraction and Raman spectroscopy, while further electrical characterization such as conductivity activation energy will be presented in the final paper in order to allow better understanding of this semiconductor material.

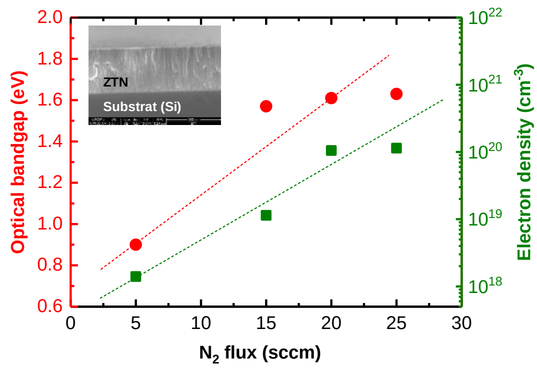

Figure 1: Optical bandgap and electron concentration versus N_2 flux for ZTN/c-Si films. The inset is a SEM image of a typical sample showing columnar growth.

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