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On the bias effect in ZnSnN2 thin films grown by reactive magnetron co-sputtering.

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Recent studies on II-IV-V_2 nitrides evidenced that this class of materials are potential candidates for photovoltaic applications due to their tunable band gap (1.4-3.2 eV). Furthermore, they are composed of earth-abundant and non-toxic elements for a low-cost industrialization. They may replace InxGa1-xN alloys materials commonly used for optoelectronics devices because they present the same properties [1]. Few years ago, studies from Atwater's group showed that a large composition of alloys can be grown without phase separation. Moreover, they exhibit a lower formation enthalpy than InGaN alloys [2]. Recently, few works investigate the disorder caused by unintentional oxygen incorporation, and the grains boundaries oxygen contamination in $ZnSnN_2$ thin films [3]. To reduce oxygen contamination and improve physico-chemical properties, a new approach is investigated by the use of bias during film growth. This work shows the results of $ZnSnN_2$ thin films grown by reactive co-sputtering using zinc, and tin metallic targets in a reactive nitrogen atmosphere in high vacuum chamber. The application of different bias power during the growth (from 0 to 30 W) modified the morphology, the texture and the properties of the thin films. The atomic content of oxygen can be significantly reduced by applying a bias power (from 6.3 to 2.4 at.%). The optical band gap has been deduced from UV-visible spectroscopy and electrical properties was investigated by four point probe method and hall effect measurements. The bias power decreases the experimental band gap energy until 1.42 eV by reducing the high electron carrier concentration responsible of the Burstein-Moss effect. Furthermore, applying a 30 W bias slightly enhances the activation energy and photoconductivity.

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