Electrical properties of non-degenerate ZnSnN₂ thin films grown by non-equilibrium deposition

Yong Wang¹, Takeo Ohsawa², Naoki Ohashi²

¹International Center for Young Scientists, National Institute for Materials Science, Tsukuba, Japan.

² Research Center for Functional Materials, National Institute for Materials Science, Tsukuba, Japan.

E-mail: wang.yong@nims.go.jp

 $ZnSnN_2$ (ZTN) is an element-abundant n-type semiconductor analogous to the traditional III-nitrides $In_xGa_{1-x}N$ with great potential as a photovoltaic absorber, due to its direct bandgap, steep absorption onset, tunable properties by various approaches (like doping and cation disorder) and environmentally friendly [1-3]. Despite the intriguing possibilities of ZTN for a thin film absorber, its degenerate n-type carrier density and low mobility seriously frustrate the application of ZTN.

In this work, ZTN thin films with various cation compositions have been successfully synthesized on glass substrates by reactive magnetron co-sputtering. It is found that both the cation composition and the heat treatment have significant influence on the electrical properties of ZTN thin films. Non-degenerate ZTN thin films with rich Zn contents have been achieved by non-equilibrium deposition without intentional heating on the substrates, as shown in Fig. 1. Room temperature carrier concentration and mobility are 9 x 10^{17} cm⁻³ and 19 cm²/Vs, respectively. The electrical transport mechanism of ZTN thin films will be discussed via the electrical properties as a function of temperature. Finally, the performances of photovoltaic cells using non-degenerate ZTN thin films as absorbers are presented.



Fig. 1 Electrical properties of ZTN thin films as a function of temperature

REFERENCES:

- [1] L. Lahourcade, N.C. Coronel, K.T. Delaney, et al. Adv. Mater. 25, 2562 (2013).
- [2] A.N. Fioretti, A. Zakutayev, H. Moutinho, et al. J. Mater. Chem. C 3, 11017 (2015).
- [3] F. Alnjiman, S. Diliberto, J. Ghanbaja, et al. Sol. Energy Mater. Sol. Cells 182, 30 (2018).