Combined treatment of cesium fluoride as precursor and post-treatment on CIGS thin film solar cell fabricated onto sodalime glass substrates

[1)]Research Institute of Science and Technology, [2)] Faculty of Science and Technology,
Tokyo University of Science, 2641, Yamazaki, Noda
Ishwor Khatri [1)*], and Mutsumi Sugiyama[1,2)]
***E-mail:** ishworkhatrinep@gmail.com

Introduction: The most recent breakthrough in efficiency improvement was achieved through post-deposition treatment (PDT) of heavy alkali metals[1,2)]. However, the combined treatments of heavy alkali metals as precursor and post-treatment in CIGS absorber has not been studies. With this motivation, we analyze the electronic properties of the combined treatments of cesium fluoride (CsF) as precursor and post-treatment in CIGS thin film solar cell fabricated onto sodalime glass substrates.

Experimental details: CIGS thin-films of various GGI (Ga/[In+Ga]) ratio were fabricated using molecular beam epitaxy (MBE) as described elsewhere[3)]. CsF was incorporated into the thin-films as precursor, PDT and their combined treatments. The schematic diagram of the investigated solar cells is shown in **Figure 1**. CIGS without CsF-treatment was also investigated for comparison. The green color in Figure 1 represents the region through which Cs was thought to be distributed into the thin film.

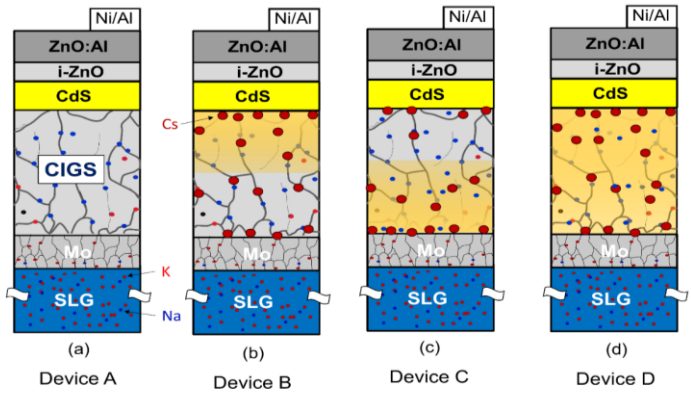

Figure1. Schematic diagram of CIGS solar cells investigated. (a) Device A: without CsF-treatment; (b) device B: with CsF-PDT; (c) device C: with Cs-precursor; (d) device D: combined treatment of precursor and PDT.

Results and Discussion: It was found that CsF as a precursor for performance improvement was not very innovated in CIGS thin film of high gallium (Ga) concentration. New defect level was formed in such devices. On the other hand, in low Ga contained CIGS thin film, CsF as precursor and its combined treatment with PDT improved solar cell performance. It is noticed that the solubility of Cs in CIGS thin-film varied with GGI ratio, which was a key factor for performance limitation and alkali metal distribution. The detail will be discussed in the meeting using data obtained from *J-V-T*, *C-V*, SIMS, and admittance spectroscopy.

Acknowledgement: This work was supported in part by the Research Center for Space Colony under the Tokyo University of Science, and JSPS KAKENHI under Grant No. 19K15029 from MEXT, Japan.

References: [1] M. Nakamura et al. IEEE Journal of Photovoltaics 2019; 9: 1863, [2] P. Jackson et al. Phys. Status Solidi RRL 2016; 10: 583-586 [3] I. Khatri et al. Prog. Photovolt. Res. Appl. 2019; 27:22-29.