Comparative study of heat-light soaking on KF- and CsF-treated CIGS solar cells

Ishwor Khatri¹, Kosuke Shudo², Junpei Matsuura², Mutsumi Sugiyama¹,², Tokio Nakada¹

¹) Research Institute for Science and Technology/²) Faculty of Science and Technology
Tokyo University of Science, 2641 Yamazaki, Noda 278-8510, Japan

E-mail: i_khatri@rs.tus.ac.jp

Introduction: Alkali metal (like sodium, potassium, rubidium, caesium) deposition after CIGS growth, which is generally called as post-deposition treatment (PDT), is a novel way of improving the efficiency of CIGS solar cells. Until now, a little is known on the effect of alkali-PDT. There are still a lot of properties to be revealed. With this motivation, we have investigated the effects of heat-light soaking (HLS) on KF- and CsF-treated CIGS solar cells.

Experimental: Around 3.0µm-thick CIGS thin films were deposited using a water-cooled molecular beam epitaxy system at a maximum substrate temperature of 530°C. KF- and CsF- PDT were performed on air-exposed CIGS thin films at a substrate temperature of 350°C. Before CdS deposition, alkali-metal-treated CIGS thin films were rinsed in DI water. CIGS solar cells were fabricated with MgF₂/Ni/Al/ZnO:Al(300nm)/ZnO (100nm)/CBD-CdS (60nm)/CIGS(2.9~3.0μm)/Mo/SLG structure. HLS of the solar cells was performed at 130°C under AM 1.5, for 30 minutes in air.

Results and discussion: As shown in Table 1, improvement in both Vₜₜ and FF were observed in KF- and CsF-treated CIGS solar cells after HLS. The CsF-treated CIGS cell kept the initial Jₜₜ value and the Vₜₜ and FF increased, thereby the efficiency improved after HLS at 130 °C for 30 min. In contrast, the Jₜₜ deteriorated slightly for the KF-treated CIGS cells, resulting in a smaller gain in efficiency as compared to CsF-treated cells.

This result suggests that the effect of HLS is much more effective on CsF-treated CIGS solar cells than that of KF-treated solar cells. Limited improvement in efficiency of KF-treated CIGS solar cell after HLS is due to the reduction of Jₜₜ. HLS of KF-treated CIGS solar cells reduced EQE at long wavelength region as compared to CsF-treated CIGS solar cells. Furthermore, the EQE of CsF-treated cell was slightly large at short wavelengths as compared to the CIGS cell before HLS. Details such as SEM, J-V, C-V, and J-V-T measurements will be presented during the conference.

Table 1. Basic cell parameters of KF- and CsF-treated CIGS solar cells before and after HLS.