

# Investigation of the Potassium Fluoride Post-deposition Treatment with and without Se Vapor on CIGS Solar Cell Performance

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The introduction of potassium fluoride post-deposition treatment (KF-PDT), where KF is evaporated onto a heated CIGS layer has opened the potential for higher efficiencies [1-3]. However, the comparable investigations of KF-PDT with and without Se supply during KF-PDT haven't been reported so far. Therefore, we characterized the CIGS solar cells with and without Se supply during KF-PDT. Typically 2.3~2.5 $\mu\text{m}$ -thick CIGS absorber layers were deposited onto Mo-coated soda-lime glass (SLG) substrates by three-stage process using molecular beam epitaxy (MBE) system at a maximum substrate temperature of 510°C. The KF-PDT was performed at 350°C on air exposed CIGS absorber layers with and without Se vapor under identical conditions. CIGS solar cells were fabricated with  $\text{MgF}_2/\text{Ni}/\text{Al}/\text{ZnO}:\text{Al}(300\text{nm})/\text{ZnO}(100\text{nm})/\text{CBD-CdS}(70\text{nm})/\text{CIGS}(2.3\sim 2.5\mu\text{m})/\text{Mo}/\text{SLG}$  structure. Figure 1 shows J-V characteristics of the CIGS solar cells with and without Se supply during KF-PDT along with the CIGS solar cell without any treatment. The best efficiencies of these solar cells were 18.5%, 18% and 13.6%, respectively. SIMS measurement showed higher atomic concentration of K in CIGS samples with KF-PDT (not shown here). The C-V measurement revealed that the net doping concentration of solar cells with KF-PDT was higher compared to the solar cells with KF-Se PDT and without KF-PDT, as shown in Fig 1(b). The carrier concentration after KF-PDT is found higher not only at the surface region but also throughout the CIGS thickness, implying the bulk passivation due to the potassium incorporation. The details of CIGS solar cell performance and thin film properties with respect to the KF-PDT will be discussed.

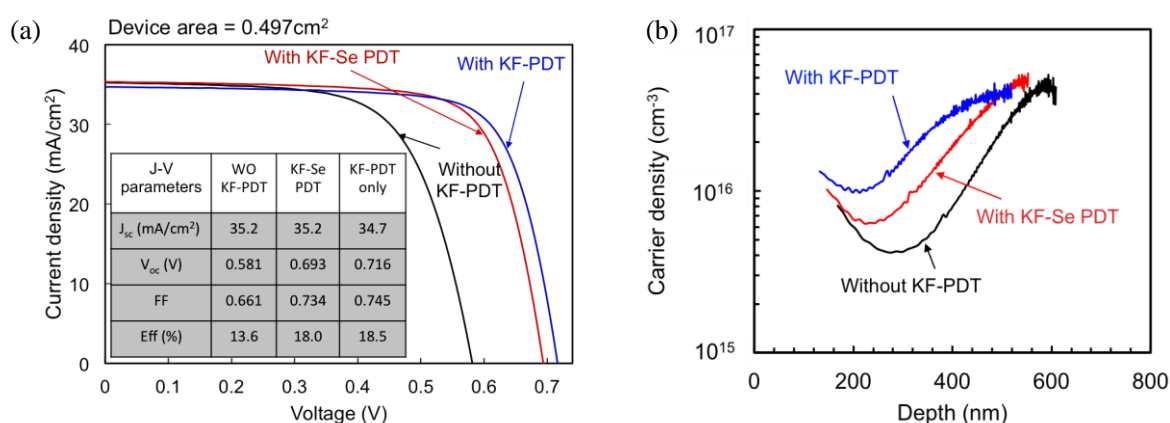


Fig. 1 (a) J-V characteristics and (b) depth profiles of carrier concentration for CIGS solar cells fabricated without KF-PDT (black line), KF-Se PDT (red line) and with KF-PDT (blue line).

## References:

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- [2] P. Jackson et al., Phys. Status Solid RRL 9 (2015) 28-31.
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