

## Supporting Information

### **Effect of a graphene oxide intermediate layer in $\text{Cu}_2\text{ZnSn}(\text{S,Se})_4$ solar cells**

Jihun Kim,<sup>a</sup> Junsung Jang,<sup>b</sup> Mahesh P. Suryawanshi,<sup>c</sup> Mingrui He,<sup>c</sup> Jaeyeong Heo,<sup>b</sup> Dong Seon Lee,<sup>d</sup> Hyo Rim Jung,<sup>b</sup> Eunae Jo,<sup>b</sup> Myeng Gil Gang,<sup>b</sup> Jin Hyeok Kim,<sup>b,\*</sup> Hyeong-Jin Kim,<sup>a,\*</sup>

<sup>a</sup>*School of Integrated Technology, Gwangju Institute of Science and Technology, 123  
Cheomdangwagi-ro, Buk-gu, Gwangju 61005, Republic of Korea*

<sup>b</sup>*Optoelectronic Convergence Research Center and Department of Materials Science and  
Engineering, Chonnam National University, 77 Yongong-ro, Buk-gu, Gwangju 61186,  
Republic of Korea*

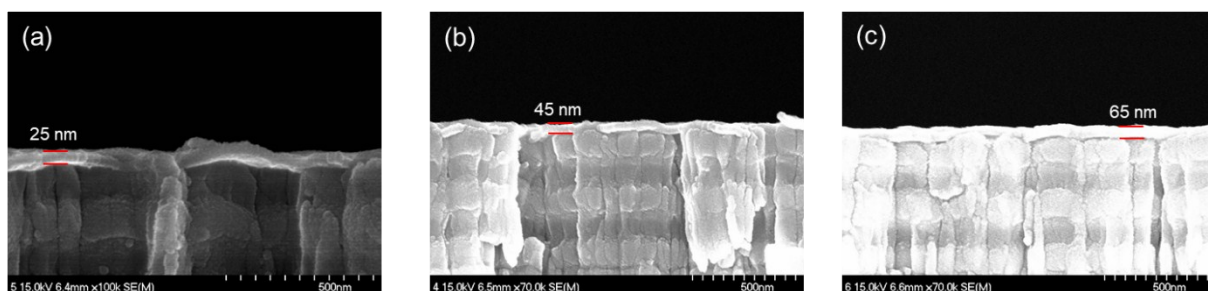
<sup>c</sup>*School of Photovoltaic and Renewable Energy Engineering, University of New South Wales,  
Sydney, New South Wales 2052, Australia*

<sup>d</sup>*School of Electrical Engineering and Computer Science, Gwangju Institute of Science and  
Technology, 123 Cheomdangwagi-ro, Buk-gu, Gwangju 61005, Republic of Korea*

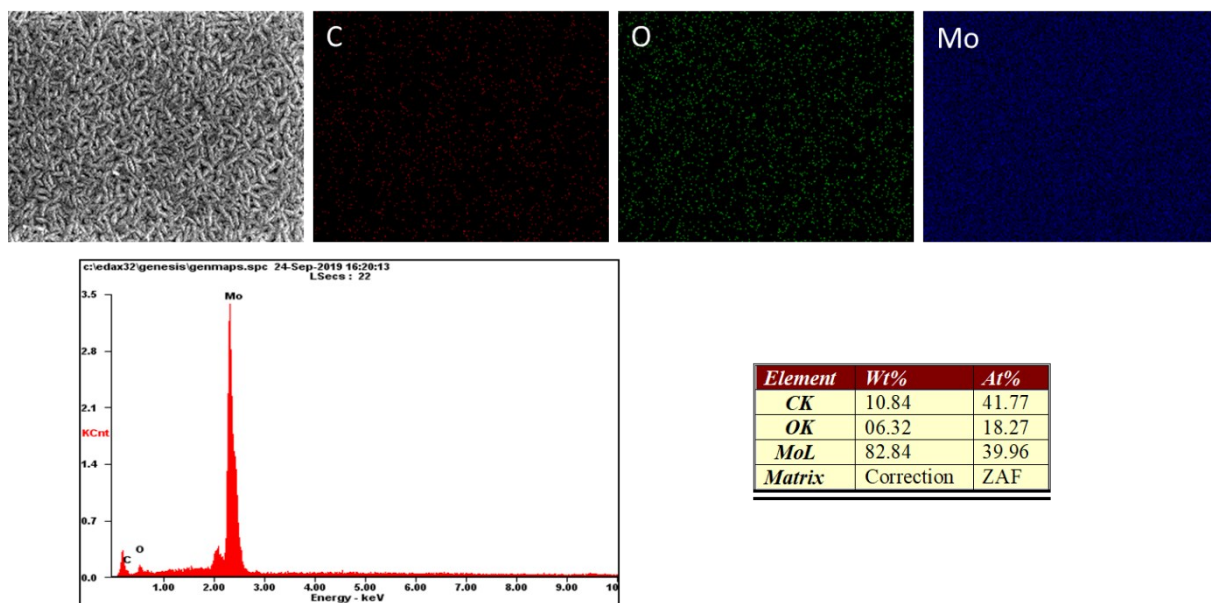
*\*Corresponding Author:*

*E-mail: hjkimc@gist.ac.kr (Prof. H.-J. Kim)*

*E-mail: jinhyeok@chonnam.ac.kr (Prof. J. H. Kim)*

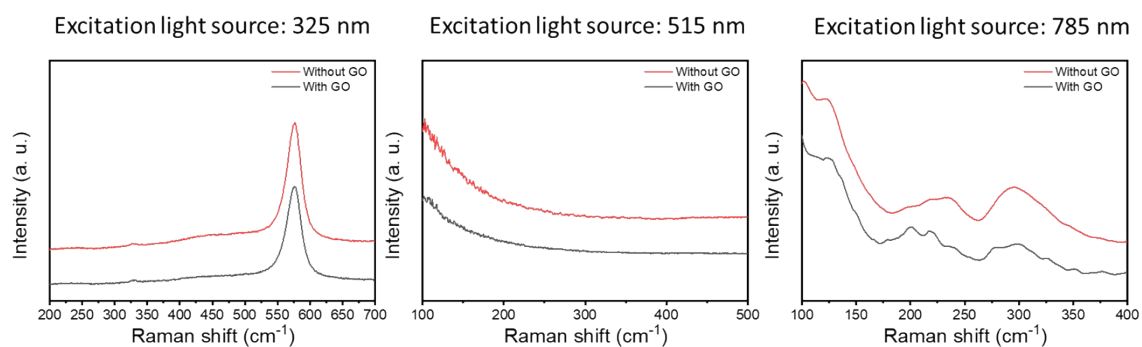


**Fig. S1** Cross-sectional FE-SEM images of a GO layer deposited using different deposition cycles: (a) 3, (b) 7 and (c) 11 times on a Mo/glass substrate

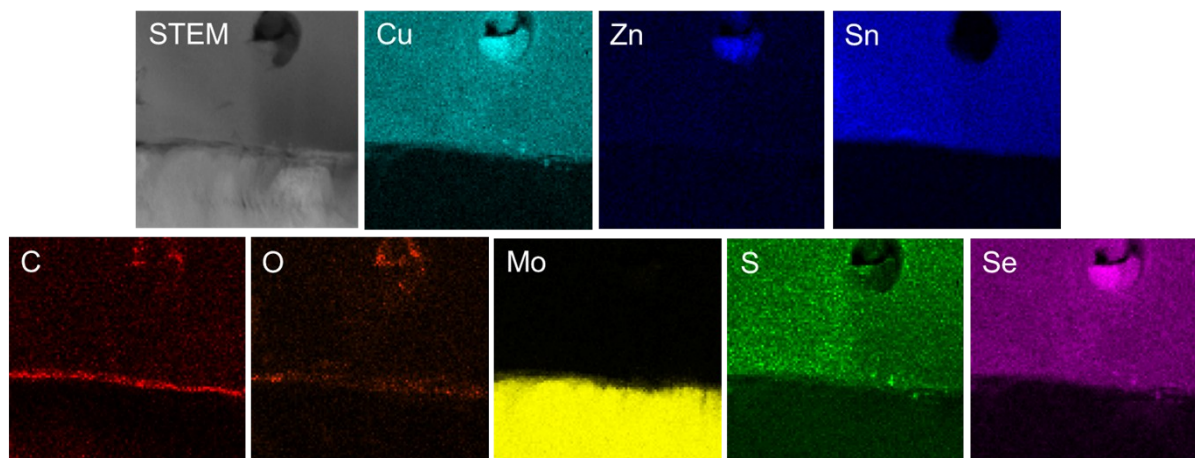


**Fig. S2** EDS mapping results on a GO/Mo surface; numerous carbon and oxygen peaks are observed for the GO/Mo surface

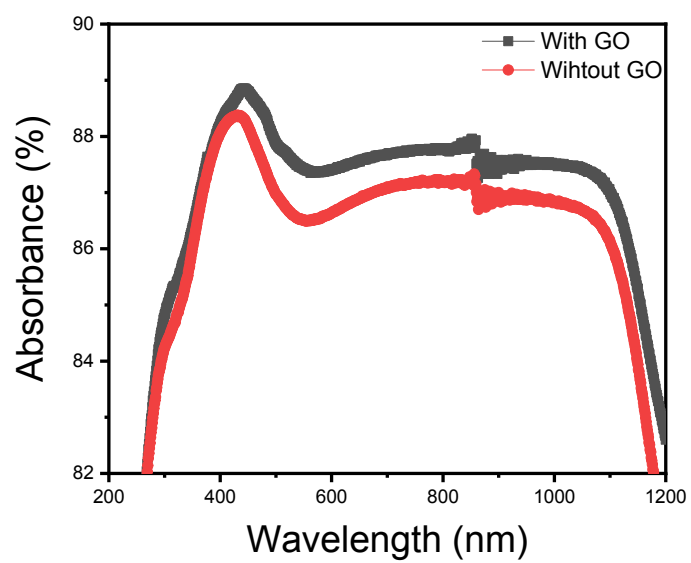
## Raman results (T1)



**Fig. S3** Raman spectra for samples with and without a GO layer at T1



**Fig. S4** Elemental mapping result for CZTSSe solar cell with a GO layer. A growth of MoSe<sub>2</sub> layer is not observed at the interface.



**Fig. S5** UV-Vis absorption spectra for CZTSSe film with and without a GO layer