Supporting Information

Solution Processed CIGS Solar Cells with 15.25% Efficiency by Surface Sulfurization

Shengjie Yuan[+], Xinshou Wang[+], Yunhai Zhao, Qianqian Chang, Zhen Xu, Jun Kong*, Sixin Wu*
Key Lab for Special Functional Materials, Ministry of Education, National & Local Joint Engineering Research Center for High-Efficiency Display and Lighting Technology, School of Materials Science and Engineering, Collaborative Innovation Center of Nano Functional Materials and Applications, Henan University, Kaifeng 475004, China
E-mail: hdkj@henu.edu.cn; wusixin@henu.edu.cn

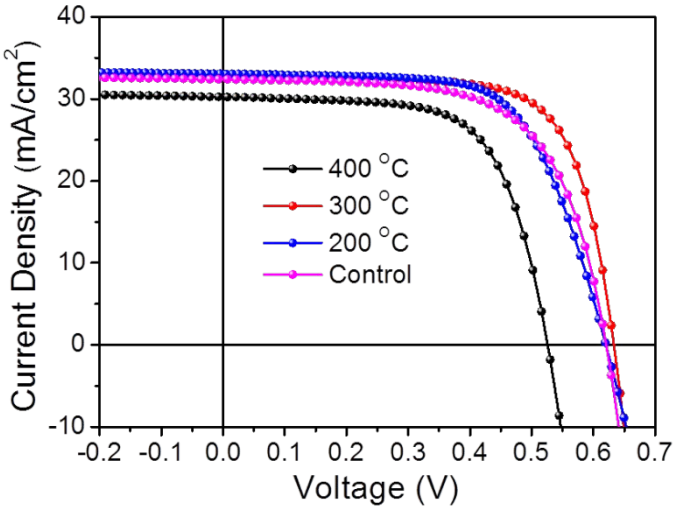

Figure S1. J–V curves of TA treated CIGS devices under different temperature.

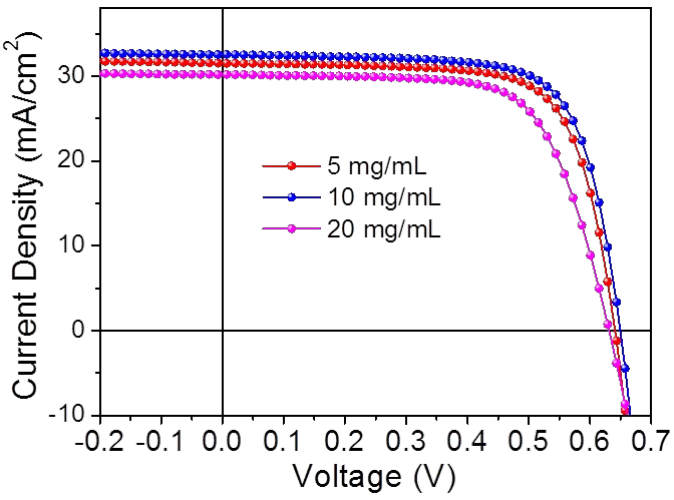

Figure S2. J–V curves of treated CIGS devices with different TA concentration.

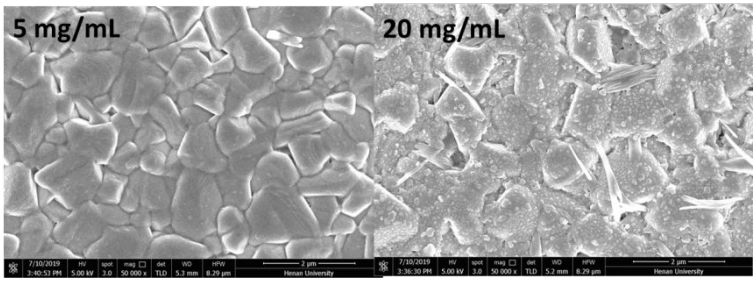

Figure S3. The surface SEM images of the TA treated CIGS thin films with different TA concentration.

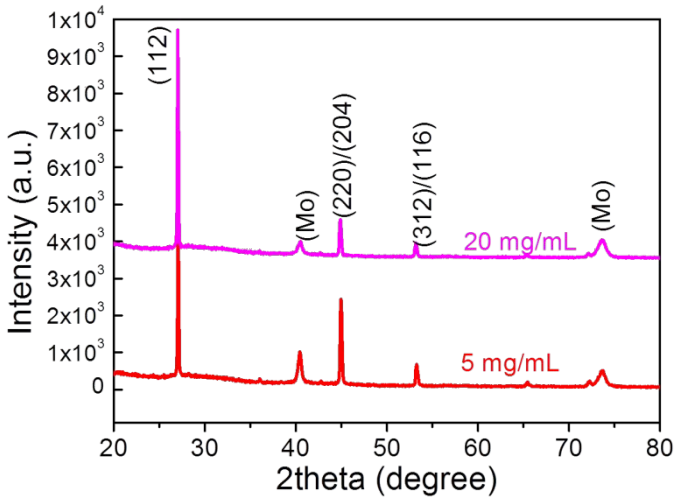

Figure S4. The XRD patterns of the TA treated CIGS samples with different TA concentration.

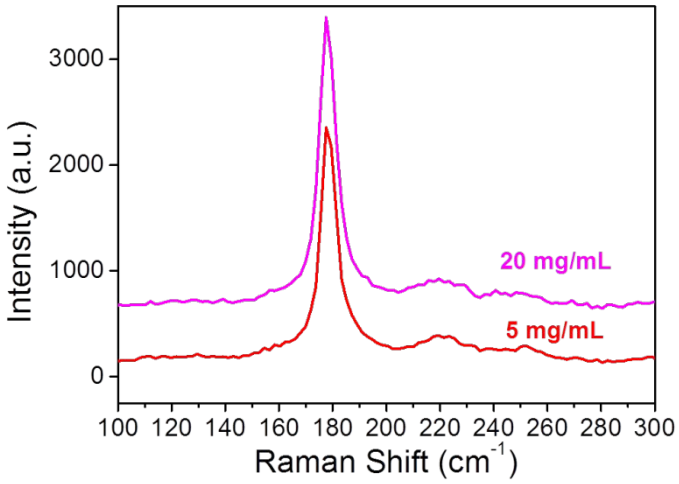

Figure S5. The Raman spectra of the TA treated CIGS samples with different TA concentration.

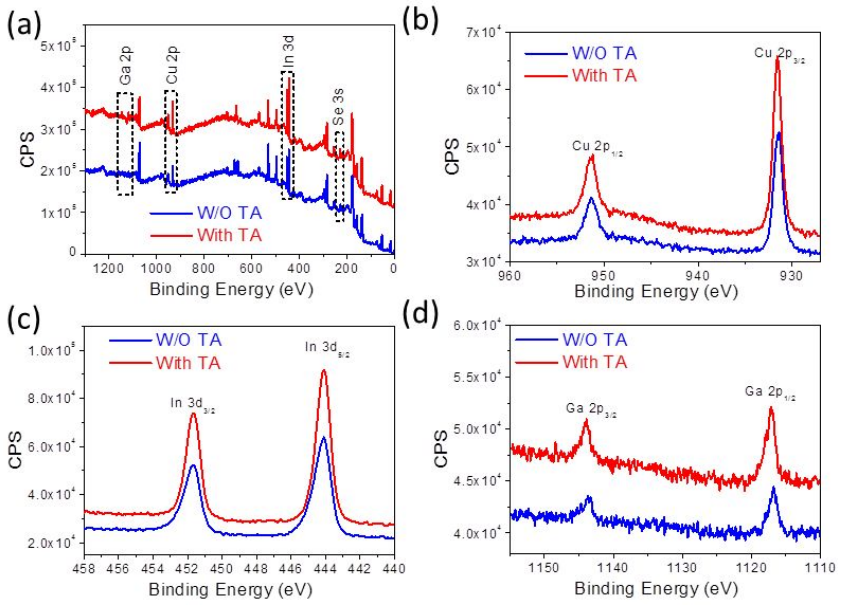

Figure S6. XPS of CIGS films (a) Wide-scan XPS spectra. (b) Cu 2p. (c) In 3d. (d) Ga 2p.

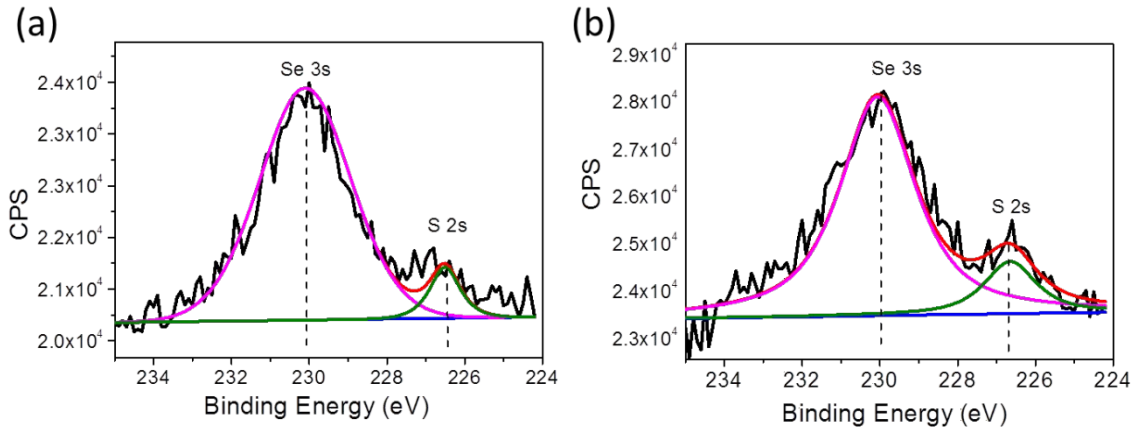

Figure S7. XPS of Se 3s and S 2s of the CIGS films treated with different TA concentration (a) 5mg/mL.(b) 20mg/mL.

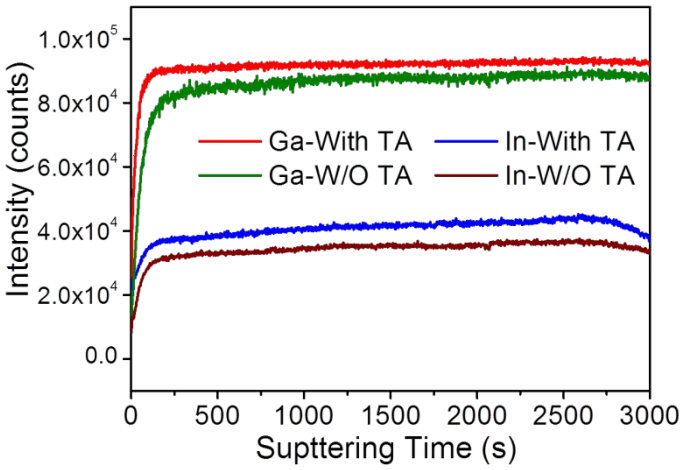

Figure S8. Secondary ion mass spectroscopy (SIMS) depth profiles of In and Ga.

Table S1. Typical device parameters of CIGS devices under different sulfurization temperature.

Temperature (^{O}C)	**PCE (%)**	**V_{OC} (V)**	**J_{SC} (mA/cm^2)**	**FF (%)**
control	13.14	0.602	33.16	65.85
200	13.33	0.617	33.05	65.48
300	14.79	0.633	32.72	71.39
400	10.54	0.525	30.24	66.14

Table S2. Typical device parameters of CIGS devices under different TA concentration.

Concentration (mg/mL)	**PCE (%)**	**V_{OC} (V)**	**J_{SC} (mA/cm^2)**	**FF (%)**
5	14.47	0.638	31.51	72.00
10	15.25	0.650	32.53	72.21
20	13.06	0.631	30.16	68.60