

## Supporting Information

### Preparation of band gap grading $\text{Cu}_2\text{ZnSn}(\text{S},\text{Se})_4$ thin film solar cells by the Post-Sulfo-Selenization treatment

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In Supplementary Information, we have provided sample data without bandgap gradient after PSS treatment. It is used to illustrate the degree which the band gap grading effect can improve the performance of thin film solar cell. The sample is named PSS-ng.

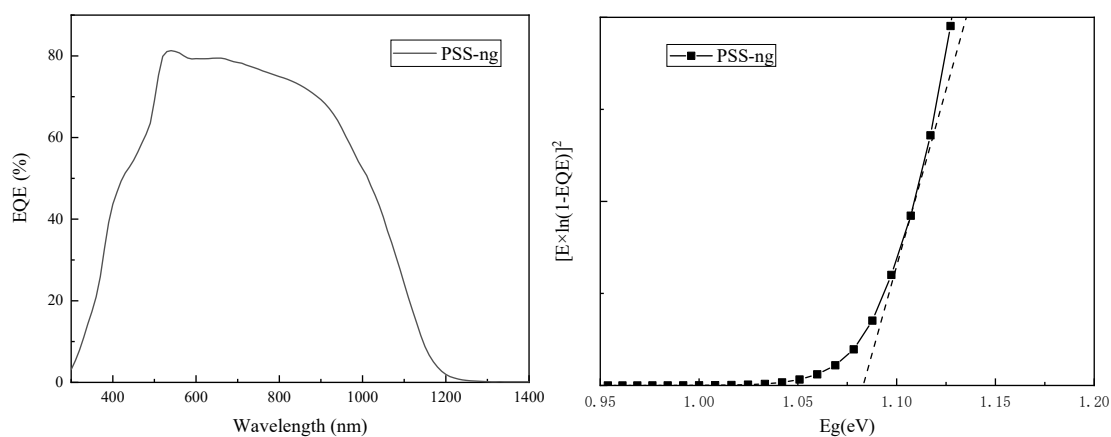


Fig.S1 (a)The EQE spectrum and (b) the band gap diagrams of the sample PSS-ng.

According to the EQE test, the  $E_g^{\text{EQE}}$  of sample PSS-ng is 1.083eV.

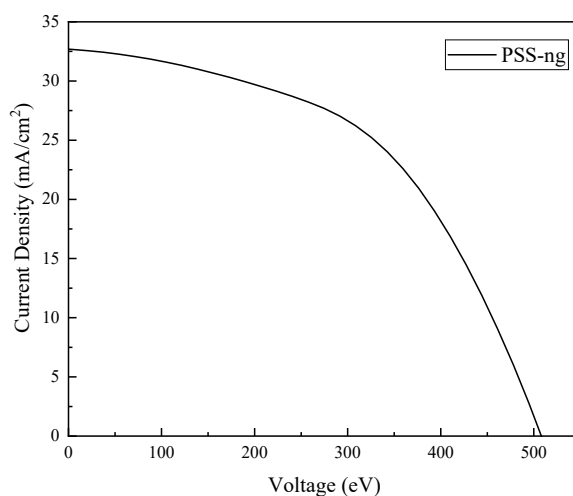


Fig.S2 The J-V characteristic of the sample PSS-ng.

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Table.S1 The parameters of the PSS-ng device.

Sample	$V_{oc}$ (mV)	$J_{sc}$ (mA/cm <sup>2</sup> )	FF (%)	PCE (%)	$R_s$ ( $\Omega \cdot \text{cm}^2$ )	$R_{sh}$ ( $\Omega \cdot \text{cm}^2$ )
PSS-ng	507.75	32.68	49.59	8.23	3.85	103.5

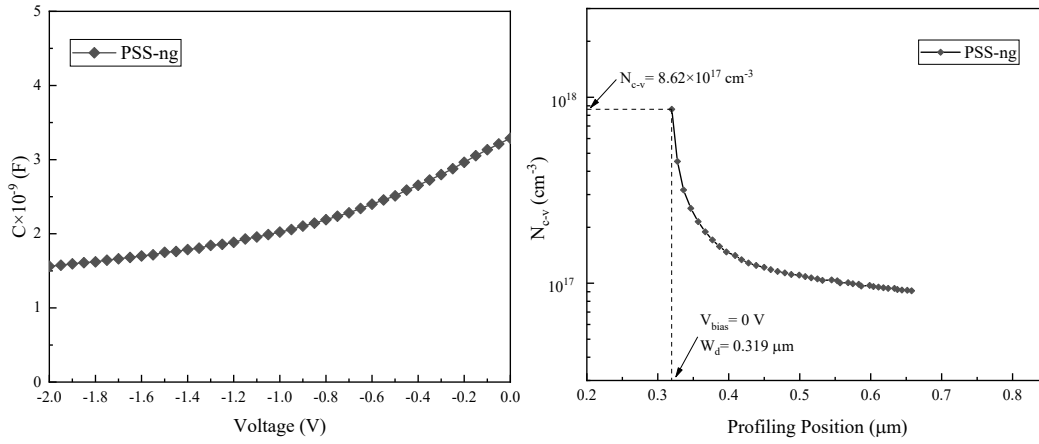


Fig.S3 The C-V and  $N_{c-v}$  curves of the sample PSS-ng. These data were taken under a 0 to -2 V reverse bias at 300 K.