

Supplementary Materials

Improving the crystallization and properties of CZTSSe film by adding NaTFSI in the precursor solution

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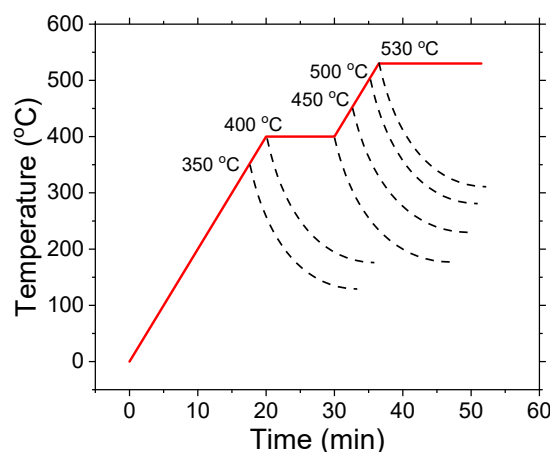


Figure S1. Temperature profile used for the selenization process

Table S1. EDS results for the WO-Na and NaTFSI films

Sample	Cu (%at)	Zn (%at)	Sn (%at)	Se (%at)	S (%at)	S/(S+Se) (%at)
WO-Na	25.9	16.0	13.3	37.9	6.9	15.4
NaTFSI-2	28.4	18.0	14.2	36.8	2.6	6.6
NaCl-2	24.5	17.7	13.9	37.2	6.7	10.8

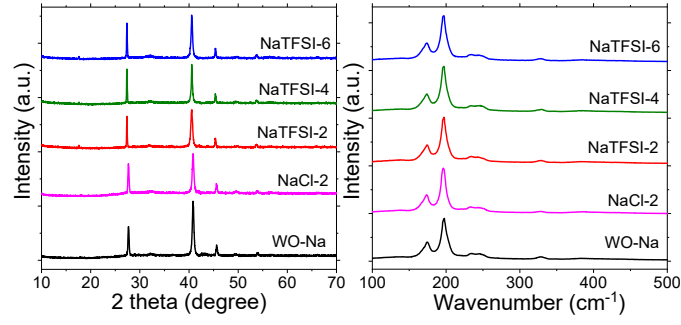


Figure S2. XRD patterns and Raman spectra for CZTSSe films without Na and with different Na salts

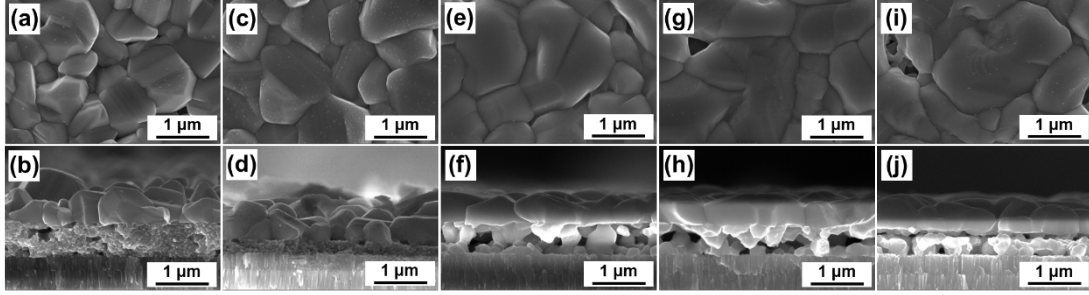


Figure S3. SEM images for the CZTSSe films without Na (a,b), with NaCl (c,d) and with different concentration of NaTFSI (e,f NaTFSI-2; g,h NaTFSI-4; i,j NaTFSI-6).

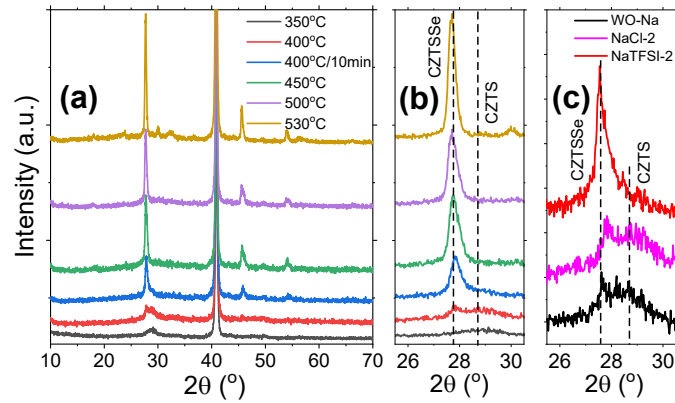


Figure S4. XRD patterns of the half-selenized NaCl-2 films (a,b); comparison of the XRD patterns for the half-selenized films at 400 °C (c).

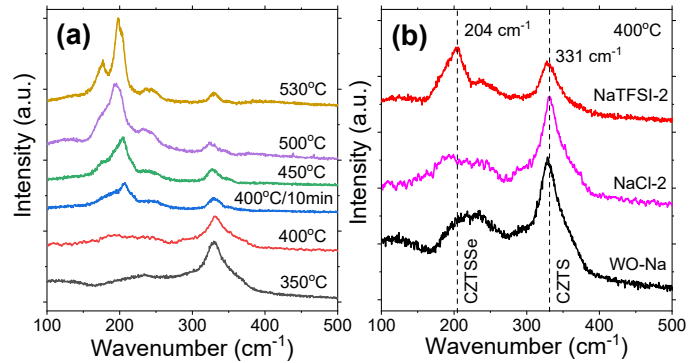


Figure S5. Raman spectra of the half-selenized NaCl-2 films (a); comparison of the Raman spectra for the half-selenized films at 400 °C (b).

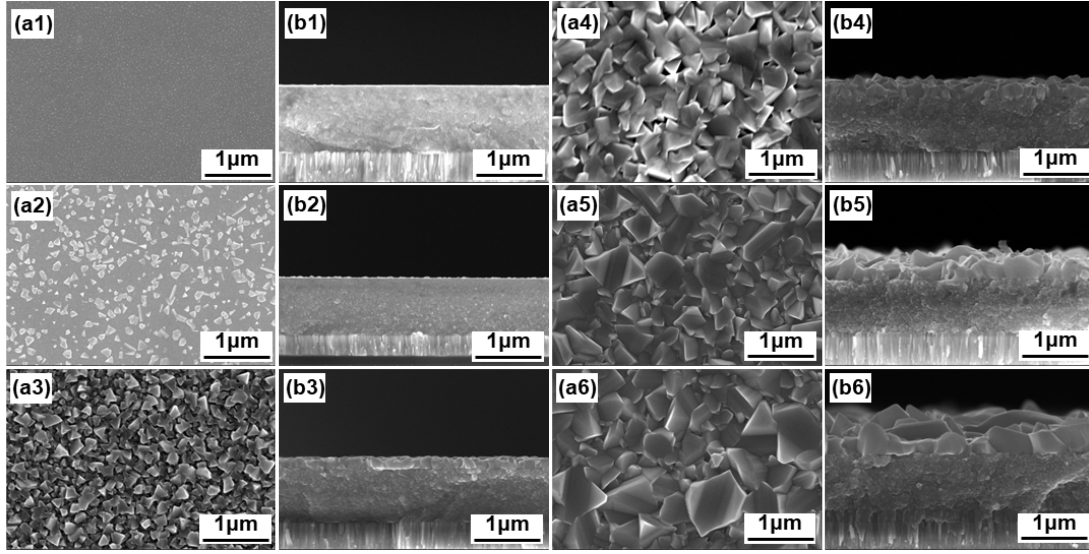


Figure S6. SEM images for the half-selenized NaCl-2 films (a1,b1, 350°C; a2,b2, 400°C; a3,b3, 400 °C/10min; a4,b4, 450°C; a5,b5, 500°C; a6,b6, 530°C).

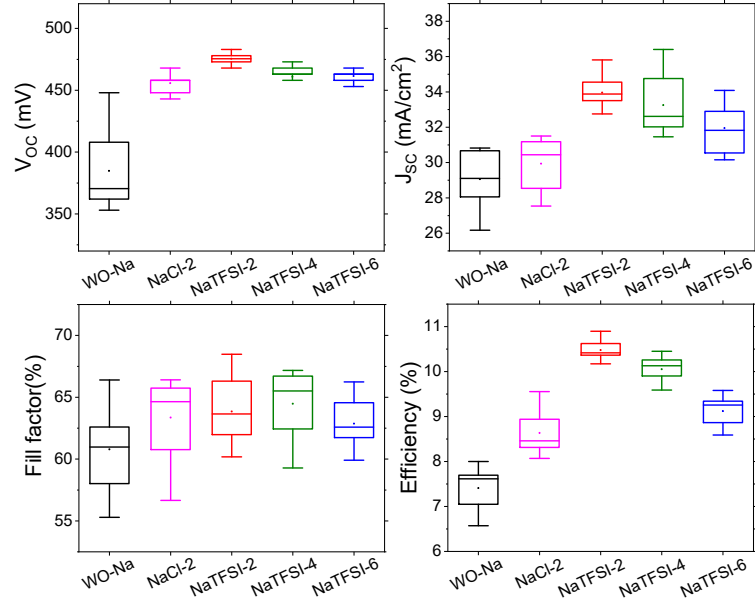


Figure S7. Statistics of the parameters for solar cells based on different CZTSSe films.