

Supplementary Information

Significance of selenization with NaCl treatment on the physical properties and solar cell performance of crack-free Cu(In,Ga)Se₂ microcrystals absorber

Latha Marasamy,^{*a} Aruna-Devi Rasu Chettiar,^a Ravichandran Manisekaran,^b Evangeline Linda,^a Md. Ferdous Rahman,^c M. Khalid Hossain,^d Claudia Elena Pérez García,^a José Santos-Cruz,^a Velumani Subramaniam^e and Francisco de Moure Flores^a

^aFacultad de Química, Materiales-Energía, Universidad Autónoma de Querétaro (UAQ), Santiago de Querétaro, Querétaro, C.P. 76010, México, ^bInterdisciplinary Research Laboratory (LII), Nanostructures and Biomaterials Area, Escuela Nacional de Estudios Superiores Unidad León, Universidad Nacional Autónoma de México (UNAM), Predio el Saucillo y el Potrero, Comunidad de los Tepetates, León, C.P. 37684, México, ^cAdvanced Energy Materials and Solar Cell Research Laboratory, Department of Electrical and Electronic Engineering, Begum Rokeya University, Rangpur 5400, Bangladesh. ^dInstitute of Electronics, Atomic Energy Research Establishment, Bangladesh Atomic Energy Commission, Dhaka 1349, Bangladesh. ^eDepartamento de Ingeniería Eléctrica (SEES), Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional (CINVESTAV-IPN), Av. IPN 2508, San Pedro Zacatenco, Ciudad de México, C.P. 07360, México.

*Corresponding author email-id: latha.marasamy@uaq.mx

Table S1. EDS composition of thin film with respect to CIGSe MCs powder concentration along with annealing temperature.

Coating conditions	CIGSe MCs powder concentration (mg)	Composition (at %)				Cu/(In+Ga)	Ga/(In+Ga)
		Cu	In	Ga	Se		
As-coated	100	22.81	18.18	7.40	51.61	0.89	0.29
	75	22.85	18.22	7.35	51.58	0.89	0.29
	50	22.98	17.79	7.71	51.52	0.90	0.30
An@350°C	100	22.79	18.13	7.28	51.80	0.90	0.29
	75	22.91	18.19	7.65	51.25	0.89	0.30
	50	23.15	17.96	7.80	51.09	0.90	0.30

An@400°C	100	23.09	18.06	7.51	51.34	0.90	0.29
	75	23.01	18.01	7.63	51.35	0.90	0.30
	50	22.95	18.19	7.71	51.15	0.89	0.30

Table S2 The comprehensive solar cell parameters of five CIGSe MCs devices in each condition

An@350°C	V_{oc} (V)	J_{sc} (mA/cm²)	FF (%)	PCE (%)
Solar Cell 1	0.602	10.54	45.70	2.90
Solar Cell 2	0.613	12.51	42.12	3.23
Solar Cell 3	0.604	10.56	48.13	3.07
Solar Cell 4	0.627	10.33	44.00	2.85
Solar Cell 5	0.610	12.96	37.19	2.94
Average	0.611	11.38	43.43	3.00

Se@500°C	V_{oc} (V)	J_{sc} (mA/cm²)	FF (%)	PCE (%)
Solar Cell 1	0.600	13.73	49.65	4.09
Solar Cell 2	0.613	13.21	49.03	3.97
Solar Cell 3	0.632	12.83	46.86	3.80
Solar Cell 4	0.615	12.92	49.33	3.92
Solar Cell 5	0.639	13.23	48.85	4.13
Average	0.620	13.18	48.74	3.98

Se@500°C with NaCl	V_{oc} (V)	J_{sc} (mA/cm²)	FF (%)	PCE (%)
Solar Cell 1	0.645	16.64	46.59	5.00
Solar Cell 2	0.683	17.87	44.08	5.38
Solar Cell 3	0.669	16.49	44.42	4.90
Solar Cell 4	0.674	14.07	51.67	4.90
Solar Cell 5	0.686	16.68	50.16	5.74
Average	0.671	16.35	47.38	5.18

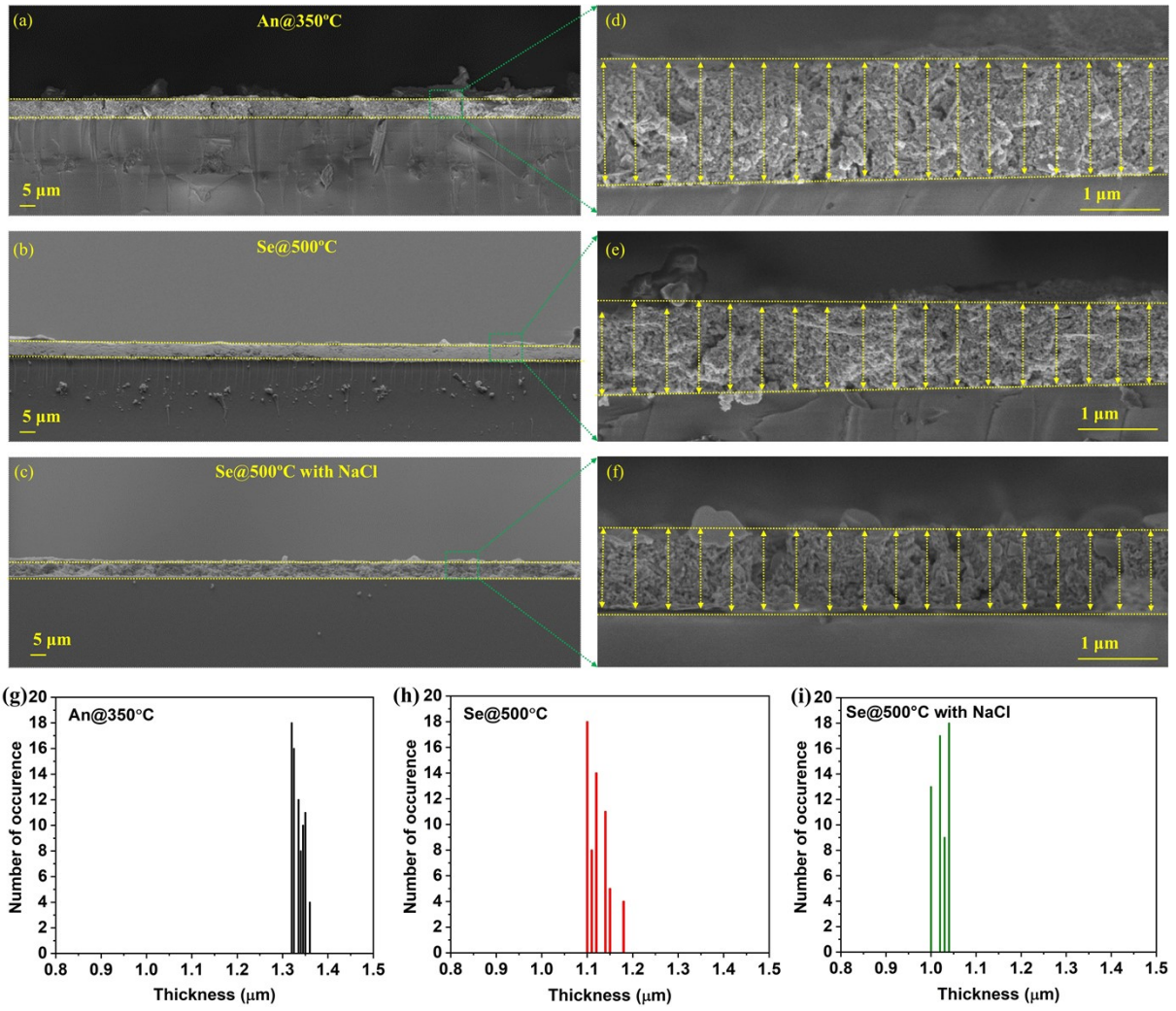


Fig. S1. (a-f) FESEM images of An@350°C, Se@500°C and Se@500°C with NaCl thin films at low and high magnifications and (g-i) corresponding thickness distribution.