

Reactive Mechanism of $\text{Cu}_2\text{ZnSnSe}_4$ Thin Films Prepared by Reactive Annealing of the Cu/Zn Metal Layer in a $\text{SnSe}_x + \text{Se}$ Atmosphere

Liyong Yao ¹, Jianping Ao ^{2,*}, Ming-Jer Jeng ^{3,4,*}, Jinlian Bi ², Shoushuai Gao ², Guozhong Sun ², Qing He ², Zhiqiang Zhou ², Yi Zhang ², Yun Sun ², and Liann-Be Chang ^{3,4}

¹ Tianjin Institute of Power Source, Tianjin 300384, China; yaoliyong@yeah.net

² Institute of Photoelectronic Thin Film Devices and Technology of Nankai University, Key Laboratory of Photoelectronic Thin Film Devices and Technology of Tianjin, Key Laboratory of Optical Information Science and Technology of Ministry of Education, Collaborative Innovation Center of Chemical Science and Engineering, Nankai University, Tianjin 300071, China; bijinlian815@126.com (J.B.); gaoshoushuai@yeah.net (S.G.); taigic@nankai.edu.cn (G.S.); Heqing27@nankai.edu.cn (Q.H.); zhqzhou@126.com (Z.Z.); yizhang@nankai.edu.cn (Y.Z.); suny@nankai.edu.cn (Y.S.)

³ Department of Electronic Engineering, Chang Gung University, KueiShan 333, Taiwan; liann@mail.cgu.edu.tw

⁴ Department of Otolaryngology-Head and Neck Surgery, Chang Gung Memorial Hospital, Linkou 244, Taiwan

* Correspondence: aojp@nankai.edu.cn (J.A.); mjeng@mail.cgu.edu.tw (M.-J.J.); Tel.: +86-22-2350-8572 (ext. 8011) (J.A.); +886-3-211-8800 (ext. 3507) (M.-J.J.); Fax: +86-22-2350-2778 (J.A.); +886-3-211-8507 (M.-J.J.)

Supporting Information

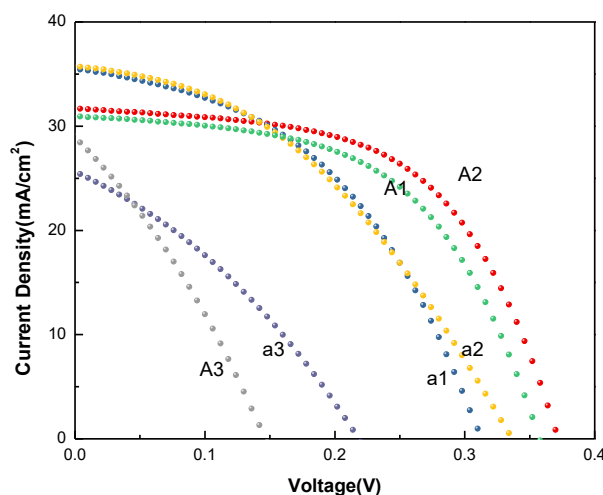


Figure S1. The J-V curves of CZTSe solar cells with sample A1-A3 and a1-a3.

Table S1. Solar performance parameters of CZTSe solar cells with sample A1-A3 and a1-a3.

	Eff(%)	Voc(mV)	Jsc(mA/cm ²)	F.F
A1	6.04	358	30.9	0.55
A2	6.64	373	31.7	0.56
A3	1.3	147	28.9	0.30
a1	5.02	313	35.5	0.45
a2	4.88	337	35.8	0.41
a3	1.84	218	25.6	0.33