# Supporting Information

# Photoelectrochemical Characterization of $CuInSe_2$ and $Cu(In_{1-x}Ga_x)Se_2$ Thin Films for Solar Cells

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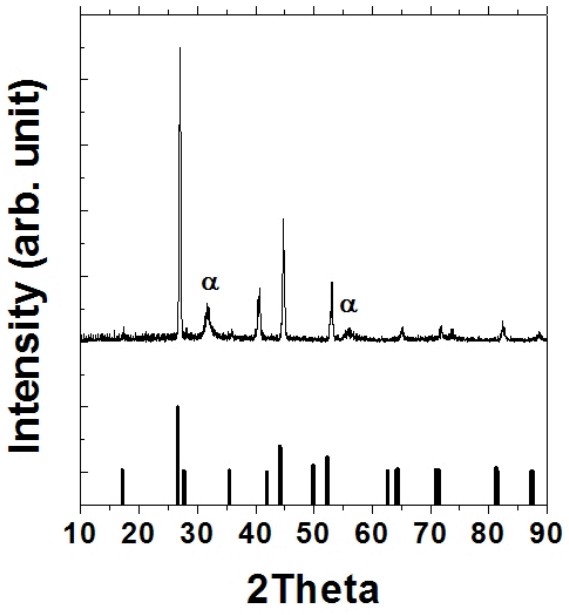


**Figure S1.** X-ray diffraction pattern of electrodeposited CIGS film (a) and $CuInSe_2$ reference pattern (b, JCPDS #40-11487). $MoSe_2$ XRD patterns are also indicated (α, Abou-Ras D.; Kostorz G.; Bremaud D.; Kalin M.; Kurdesau F.V.; Tiwari A.N.; Dobeli M. *Thin Solid Films* **2005,** 480-481, 433-438.)

| Element | Cu | In | Ga | Se |
|---|---|---|---|---|
| Composition (%) | 27 | 19 | 7 | 47 |

**Table 1.** Element compositions of electrodeposited CIGS film obtained from energy dispersive X-ray spectroscopy (EDS) measurements.

**Instrumentation.** X-ray diffraction (XRD) pattern was obtained using a Bruker-Nonius D8 Advance powder diffractometer with Cu Kα radiation (λ=1.54 Å) operated at 40 kV and 40 mA. The diffractogram was obtained with scan rate of 12 ° /min in 0.02 ° increments. Energy dispersive X-ray spectroscopy (EDS) equipped on LEO1530 Scanning electron microscopy (SEM) was used for elemental analysis of electrodeposited CIGS film.

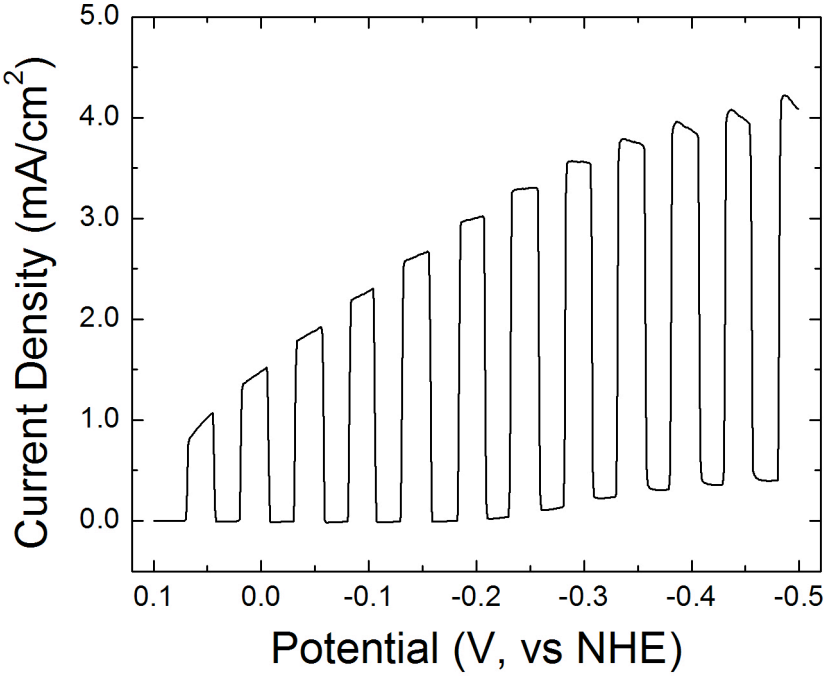


**Figure S2**. Linear sweep voltammograms (LSVs) of NP-CIGS film on Au with light chopping in 0.1 M $EV(ClO_4)_2$ and 0.1 M $TBAPF_6$ in acetonitrile (MeCN). Scan rate: 10 mV/s, light source: Xe lamp (ca. 100 mW/cm$^2$).

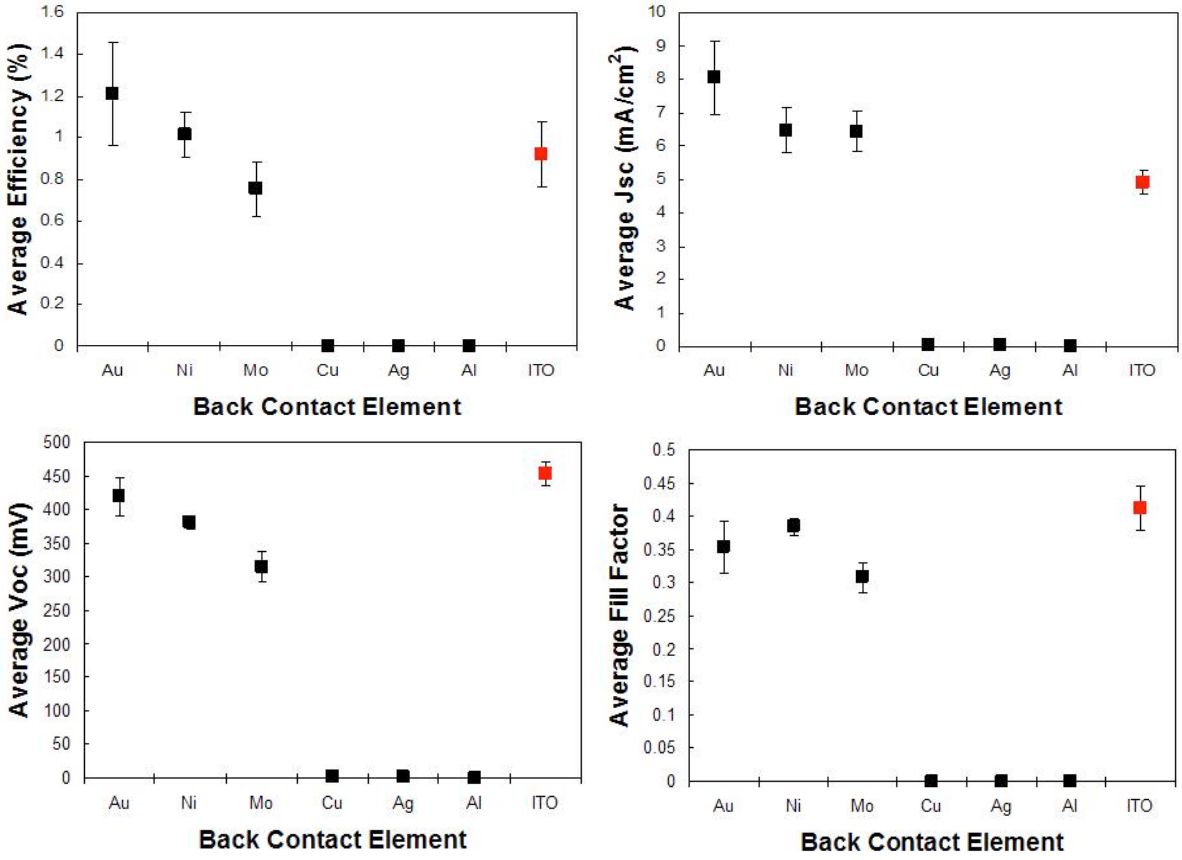


**Figure S3**. Plots of average efficiency, short circuit current ($J_{sc}$), open circuit voltage ($V_{oc}$), and fill factor (FF) of solid state device prepared on various substrates (Au, Ni, Mo, and ITO).

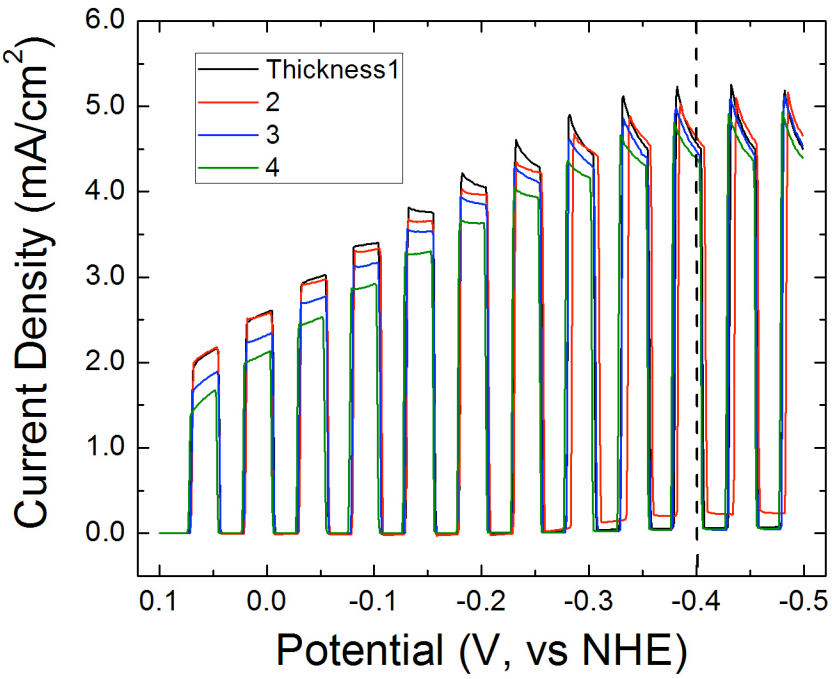


**Figure S4.** LSVs of NP-CIS/CdS films on Au of various thickness with light chopping in 0.1 M $EV(ClO_4)_2$ and 0.1 M $TBAPF_6$ in MeCN. The thickness of sample 1 was about 150 nm and samples 2, 3, and 4 were prepared by spraying CIS nanoparticle solution 2, 3, and 4 times longer. Scan rate: 10 mV/s, light source: Xe lamp (ca. 100 $mW/cm^2$).

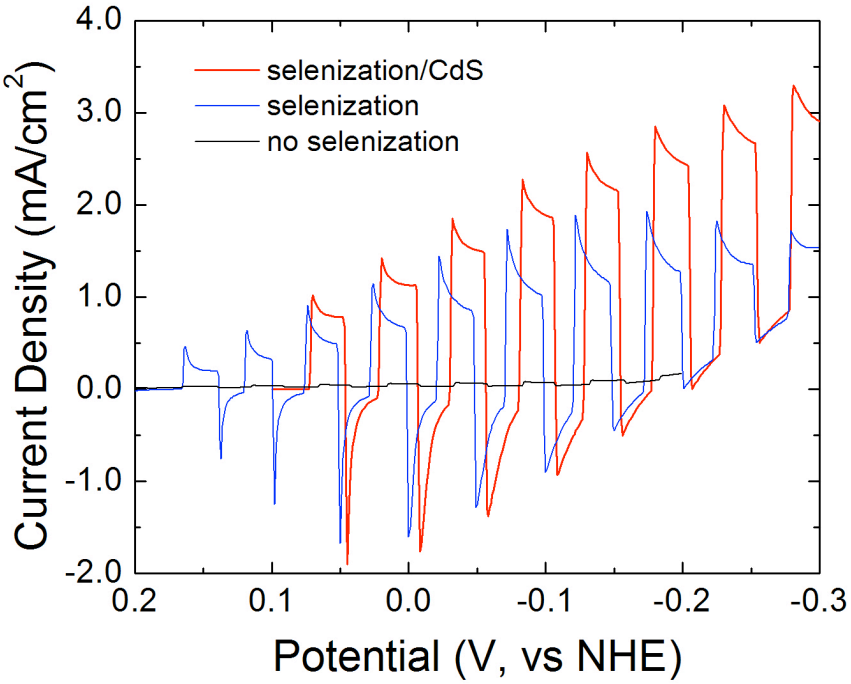


**Figure S5.** LSVs of selenized NP-CIS/CdS (red), selenized NP-CIS (blue), and as prepared NP-CIS (black) films on Mo with light chopping in 0.1 M $EV(ClO_4)_2$ and 0.1 M $TBAPF_6$ in MeCN. Scan rate: 10 mV/s, light source: Xe lamp (ca. 100 mW/cm$^2$).

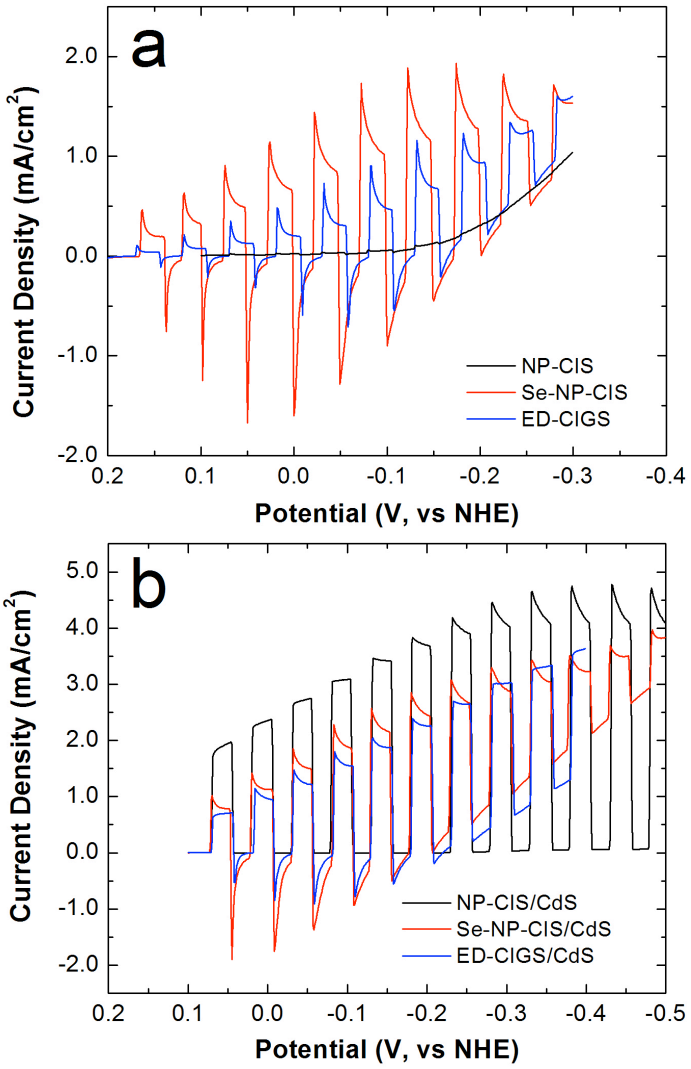


**Figure S6.** Comparison of LSVs of NP-CIS (black), selenized NP-CIS (red), and ED-CIGS (blue) films before (a) and after (b) CdS layer deposition.