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Supplementary Materials for

Enhanced photo-response performance of Cu_2O-based graded heterojunction optoelectronic devices with Ga_2O_3 buffer layer

Meng Xiao[1, 2], Kailian Dong[1, 2], Jiwei Liang[1, 2], Jin He[1]* and Guojia Fang[1, 2]*

[1] Key Lab of Artificial Micro- and Nano-Structures of Ministry of Education of China, School of Physics and Technology, Wuhan University, Wuhan 430072, Hubei, China

[2] Shenzhen Institute, Wuhan University, Shenzhen 518055, Guangdong, China

***Corresponding authors.**

E-mail addresses:

gjfang@whu.edu.cn (G.J. Fang), jin.he@whu.edu.cn

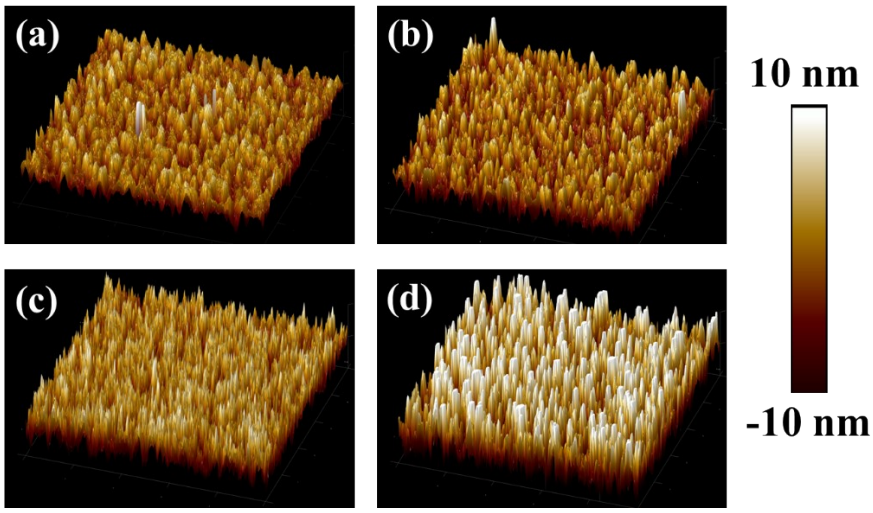

Figure S1. The AFM 3D images of various Ga_2O_3 films deposited on ITO glass with different oxygen pressure. a)10^{-4} Pa, b)1 Pa, c)5 Pa, and d)20 Pa.

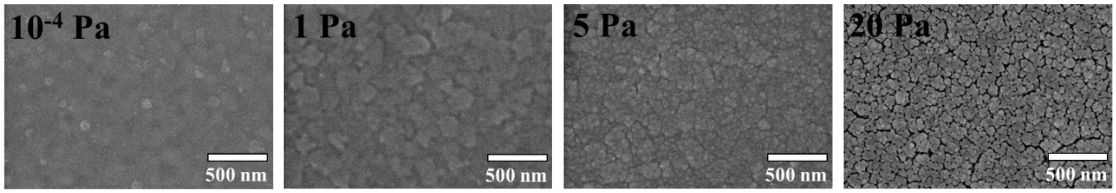

Figure S2. Top-view SEM images of Ga_2O_3 films deposited at various oxygen pressure.

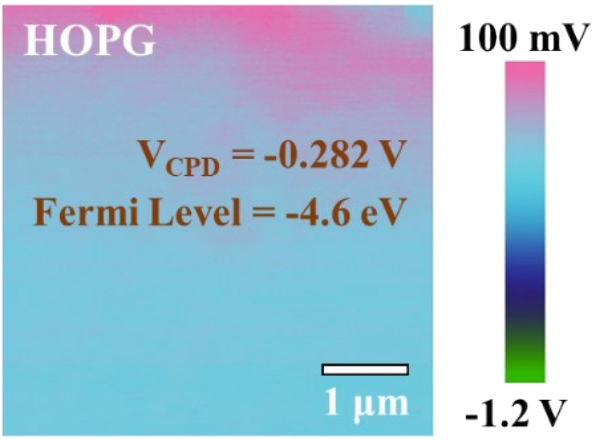

Figure S3. KPFM image of a HOPG flake.

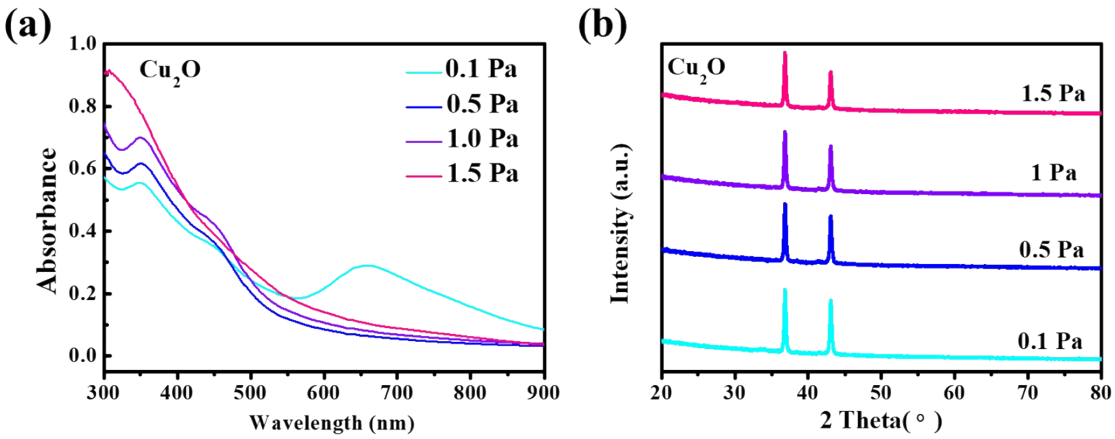

Figure S4. a) Absorption spectra b) X-ray diffraction spectra of Cu_2O films deposited at various oxygen pressure.

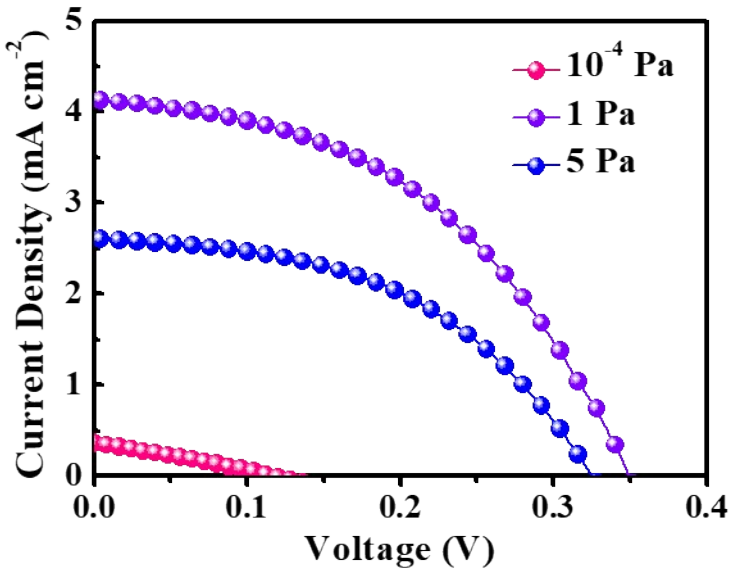

Figure S5. Current density-voltage curves measured under an AM 1.5G solar simulator of the photovoltaic device architectures of ITO/Ga_2O_3/Cu_2O/Au using various oxygen pressure prepared Ga_2O_3.

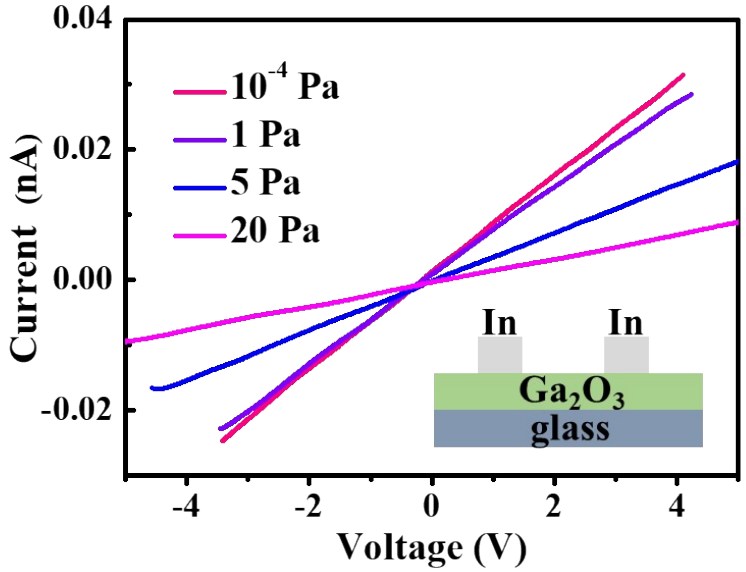

Figure S6. Current-voltage characteristics for electrical conductance comparison of devices with a structure of In/Ga_2O_3/In using various oxygen pressure prepared Ga_2O_3.

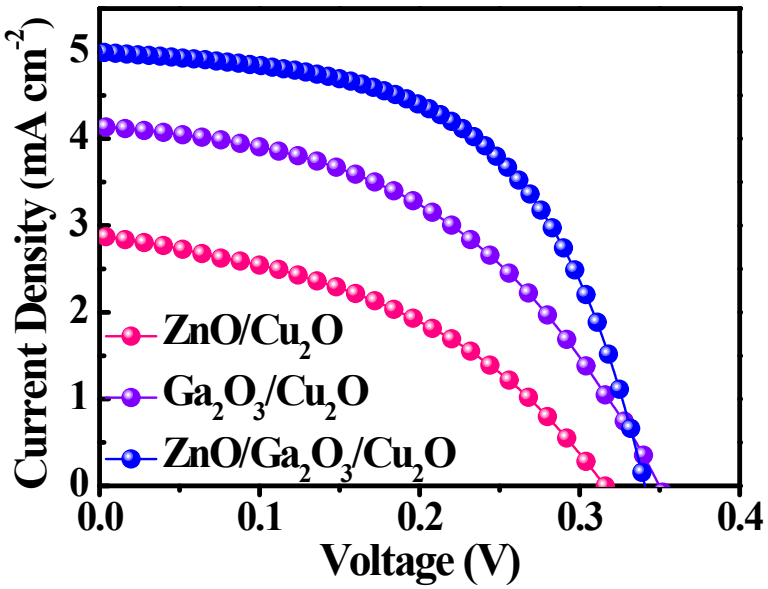

Figure S7. Current density-voltage curves measured under an AM 1.5G solar simulator of the various device architectures. (ITO/ZnO/Cu_2O/Au; ITO/Ga_2O_3/Cu_2O/Au; ITO/ZnO/Ga_2O_3/Cu_2O/Au)

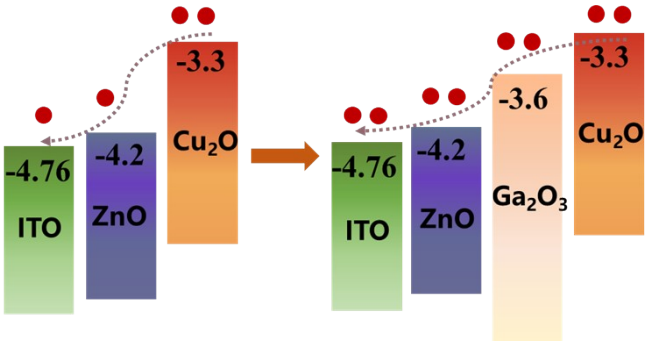

Figure S8. The electronic band alignment of the ITO/ZnO/Cu_2O and ITO/ZnO/Ga_2O_3/Cu_2O heterojunction, showing a stepped arrangement by incorporating PLD Ga_2O_3.

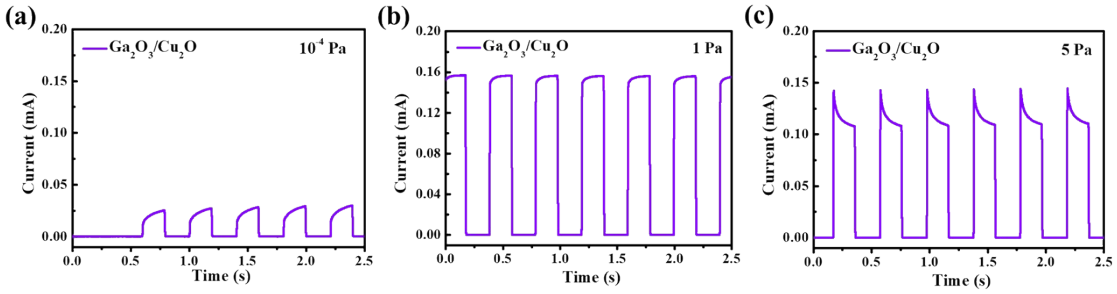

Figure S9. a-c) The temporal photoresponse of devices with structure of ITO/Ga_2O_3/Cu_2O/Au at 0 bias voltage, during multiples dark/light cycles of approximately 2.5 s. Ga_2O_3 films were deposited at different oxygen pressure.

Table S1. Parameters of the solar cells fabricated with different architectures.

	*J*sc (mA cm^{-2})	*V*oc (V)	FF	PCE (%)
ZnO/ Cu_2O	2.88	0.31	0.426	0.38
Ga_2O_3/Cu_2O	4.13	0.35	0.456	0.66
ZnO /Ga_2O_3/ Cu_2O	4.99	0.34	0.554	0.94

Table S2. Electrical properties of Cu_2O prepared on glass at various oxygen pressure.

Pressure (Pa)	Hall Mobility ($cm^2\ V^{-1}\ s^{-1}$)	Carrier Density (cm^{-3})
0.1	$3.84*10^{-1}$	$2.31*10^{18}$
0.5	$4.04*10^{-1}$	$8.84*10^{17}$
1	$1.31*10^{0}$	$2.22*10^{16}$
1.5	$9.57*10^{-1}$	$8.52*10^{15}$