Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary Information

Large Area Transparent ZnO Photodetectors with Au Wire Network Electrodes

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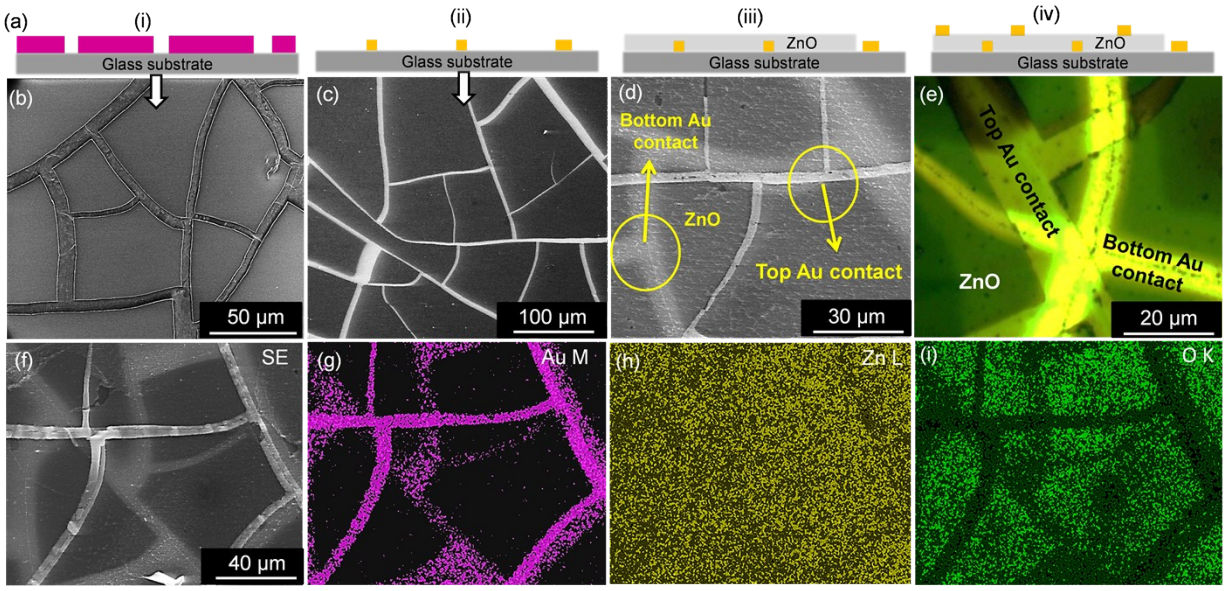

Fig. S1 (a) Schematic depiction of fabrication of Au /ZnO/Au photodetector. (b) and (c) SEM images of crackle network and Au network fabricated on the glass substrate, respectively. (d) SEM and (e) optical microscopic image of a complete device clearly showing the presence of ZnO layer sandwiched between top and bottom Au networks. (f) - (i) represents the elemental mapping of a device where the presence of Au in network structure and ZnO as a thin film is evident.

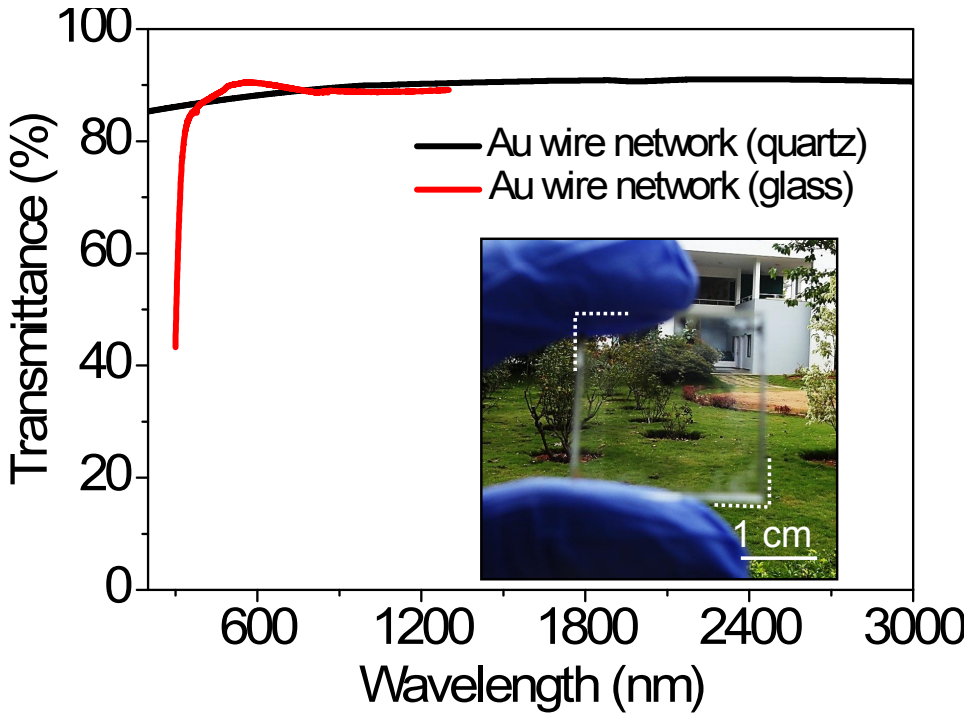

Fig. S2 Transmittance spectrum of Au wire network on a glass substrate (300-1300 nm) and a quartz substrate (200 to 3000 nm). The inset is the photograph of Au wire network on a quartz substrate.

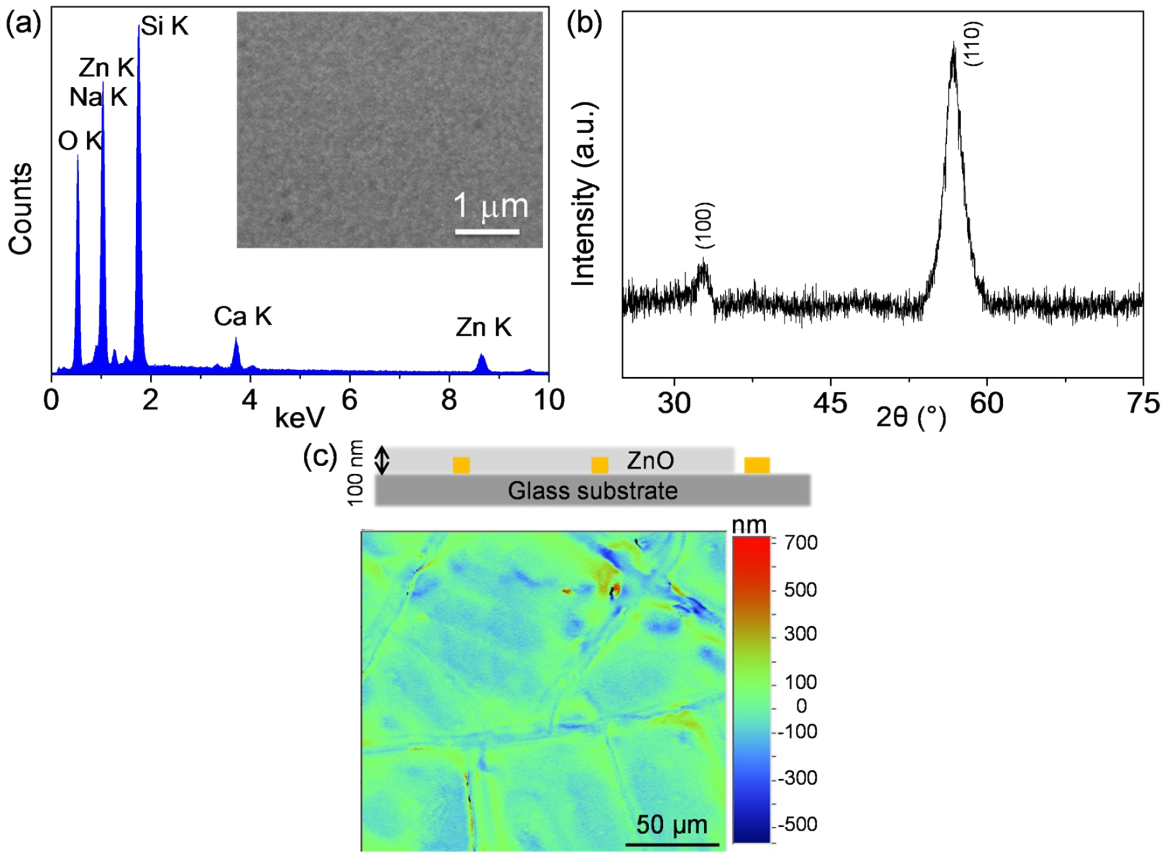

Fig. S3 (a**)** EDAX spectrum of ZnO layer; Inset shows the SEM image of ZnO film of 100 nm thickness without the Au network. (b) XRD patterns of ZnO film deposited on glass substrate exhibits diffraction peaks characteristic to (100) and (110) of ZnO. (c) Optical profiler image of ZnO thin film deposited over Au wire mesh. Above is the schematic illustration denoted with a thickness of ZnO.

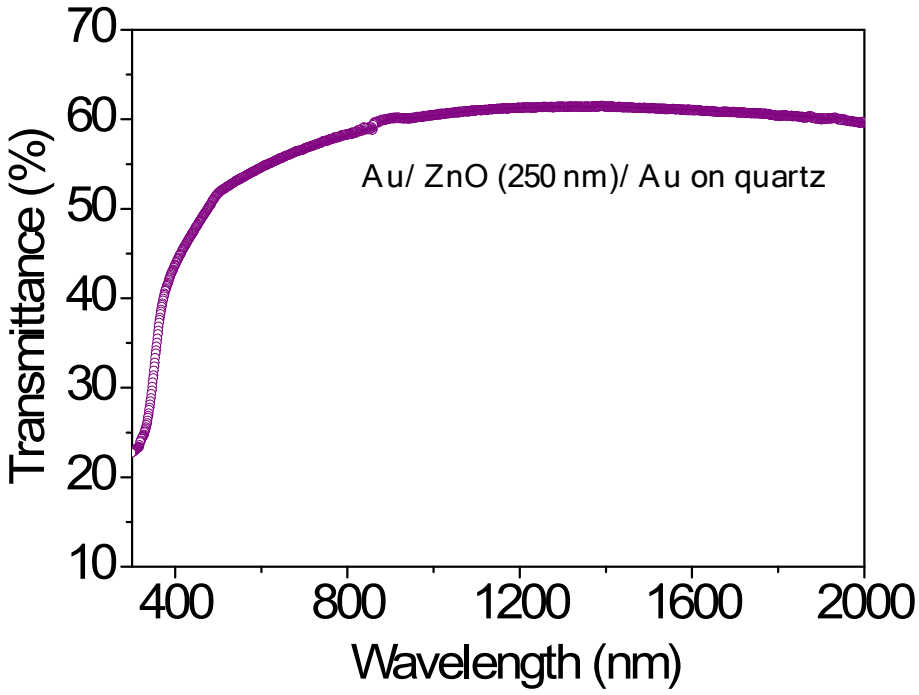

Fig. S4 Transmittance spectrum of the device fabricated on the quartz substrate. The transmittance spectrum of the device on the quartz substrate clearly indicates that absorption below 400 nm is mainly due to ZnO layer as metal mesh and quartz is transparent at this wavelength (see Fig. S2).

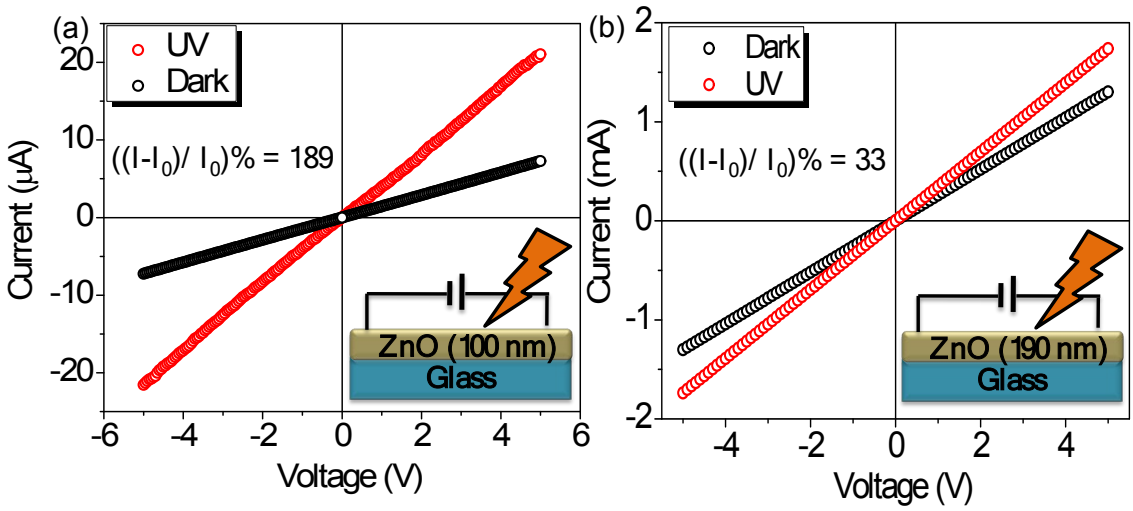

Fig. S5 I-V characteristics of (a) 100 and (b) 190 nm ZnO films on a glass substrate with Ag paint contact. The inset shows the schematic of measurements.

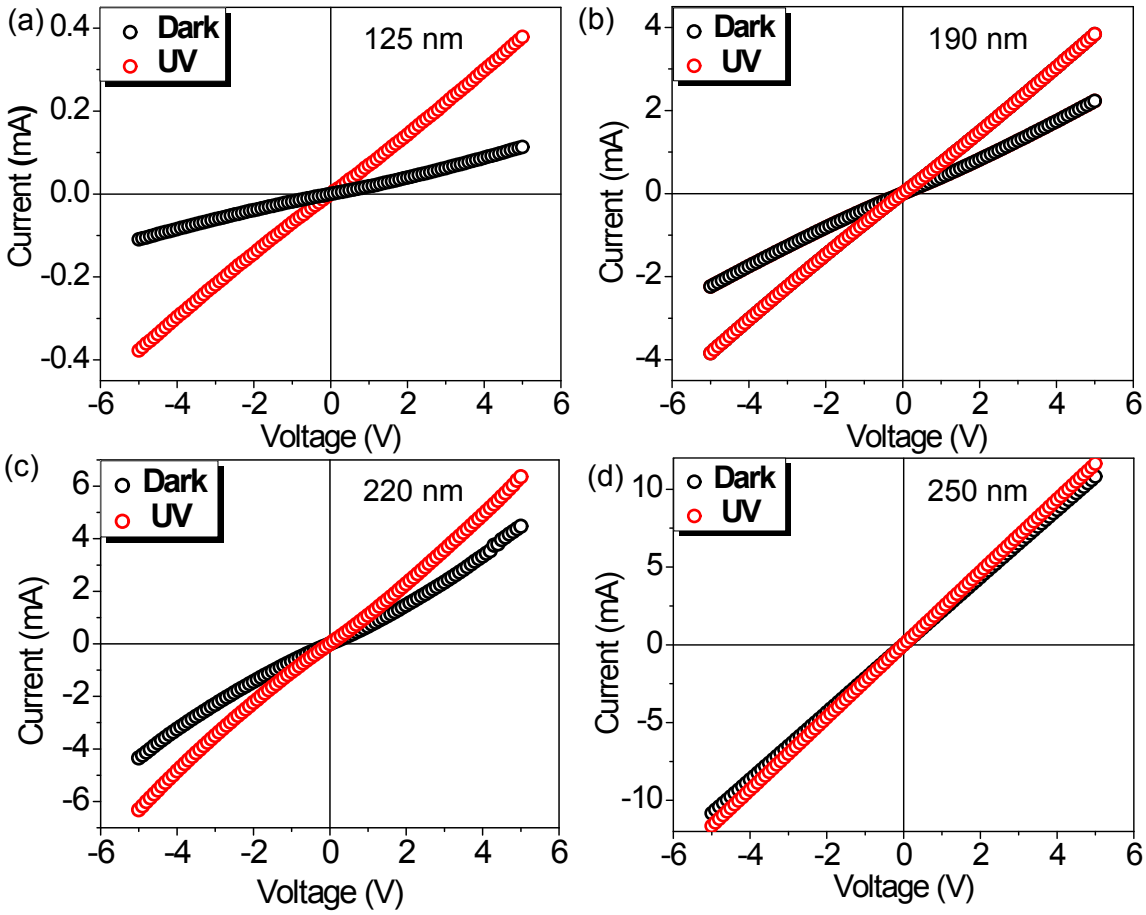

Fig. S6 (a-d) I-V characteristics of Au mesh/ZnO/Au mesh with different ZnO layer thickness.

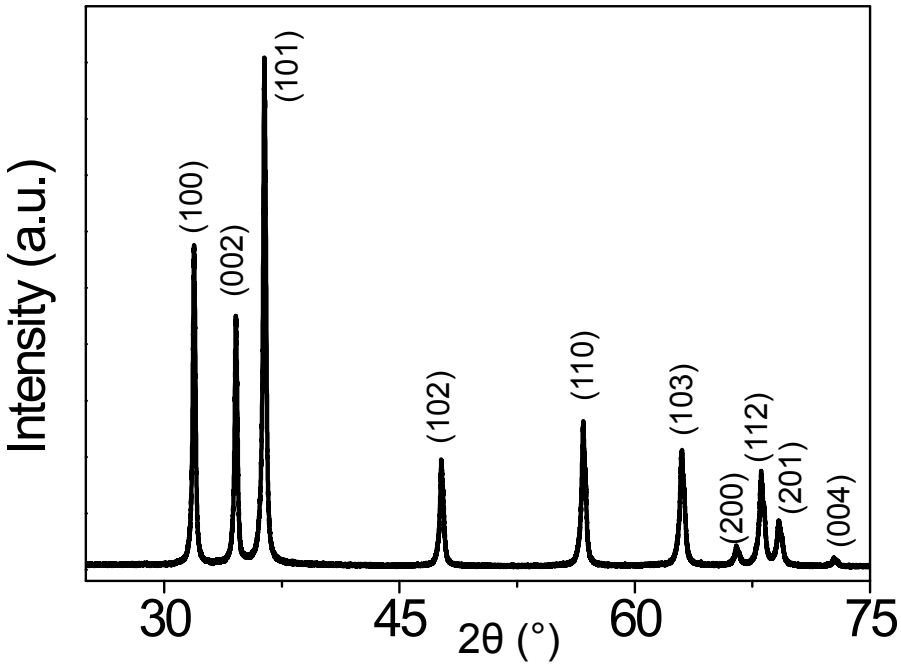

Fig. S7 XRD pattern of ZnO pellet used as the target for pulsed laser deposition.

Note S1

The barrier height for Au mesh/ZnO (100 nm)/Au mesh was calculated using following equation.

Barrier height formula and calculation

$$\Phi_{Bo} = \frac{kT}{q}\ln\left(\frac{AA^{*}T^{2}}{I_o}\right)$$

where,

k → Boltzmann constant = 1.3806 x 10^{-23} J K^{-1}

T → Temperature in Kelvin = 298 K

Q → The elementary charge = 1.602x10^{-19} C

A → Area of the contact = 0.6 cm^2

A* → Richardson constant for ZnO= 32 A cm^{-2} K^{-2}

I_s → Saturation current = Intercept ($\ln I_s$) → I_s = 129 nA

Thus, Φ_b = 0.776 eV

The obtained barrier height is comparable to the barrier height of interdigitated configuration of Au/ZnO/Au (0.8 eV)[1] and higher (0.735 eV) than the planar asymmetric electrode configuration (Au/Cr/ZnO/Al).[2]

References

1. H. Y. Chen, K- W. Liu, X. Chen, Z- Z. Zhang, M- M. Fan, M- M. Jiang, X- H. Xie, H- F. Zhao and D-Z. Shen*, J. Mater. Chem. C*, 2014, **2**, 9689-9694.

2. G. M. Ali and P. Chakrabarti, *IEEE Photonics J.* 2010, **2**, 784-793.