Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Elucidation of Unsymmetrical Effect on the Piezoelectric and Semiconducting Properties of Cd doped 1D-ZnO Nanorods

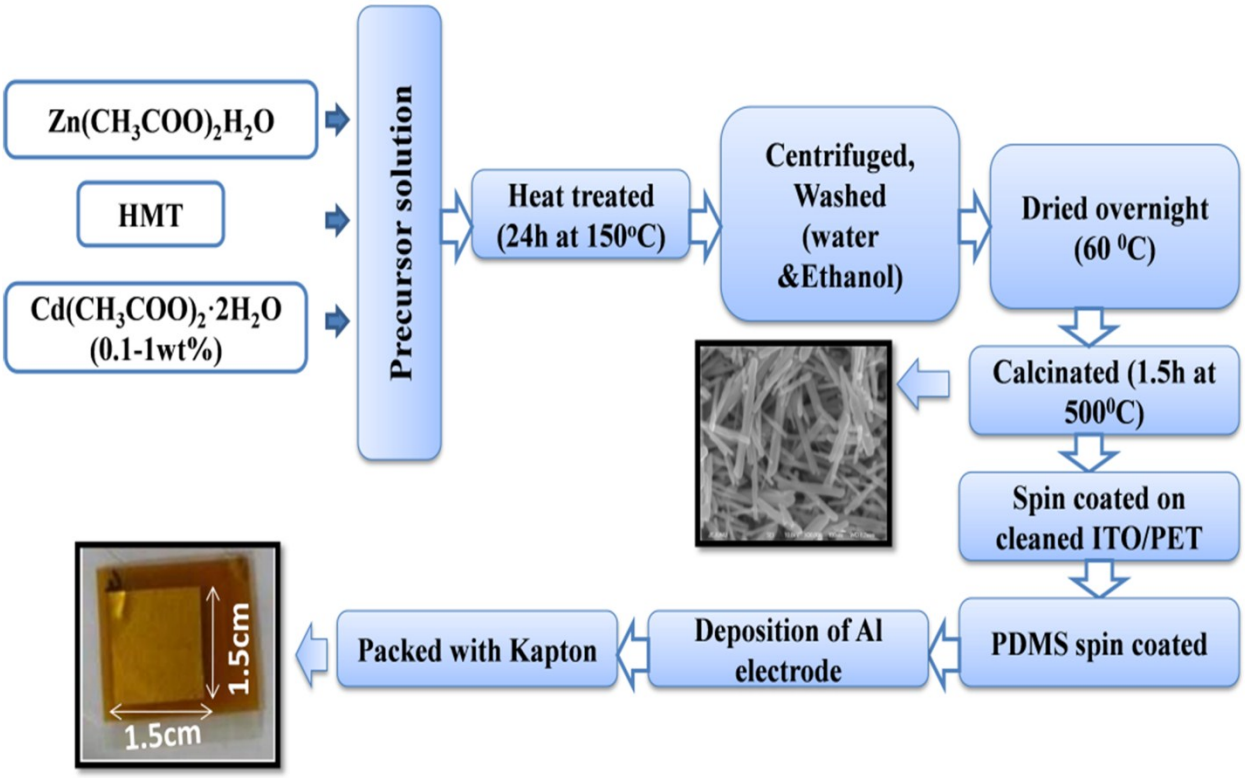

Fig. S1 Schematic representation of fabrication process of P-NG devices

The wt% value of Cd is determined by the weight ratio between Cd and Zn precursors used for synthesis of ZnO NRs i.e., $Cd(CH_3COO)_2{\cdot}2H_2O$]:[$Zn(CH_3COO)_2.2H_2O$]. In a typical procedure, the molar concentration of [$Zn(CH_3COO)_2.H_2O$] is taken to be 0.2 M (0.878g) and the amount of

cadmium acetate dihydrate is varied as Cd/Zn = 0, 0.1, 0.5, 1, 1.5 and 2 wt%. Ex: For 1 wt% Cd doping, 0.00878 g of $Cd(CH_3COO)_2{\cdot}2H_2O$] is weighed i.e.,

$$\frac{Cd}{0.878g} = 1\ wt\%$$

Similarly, 0.00087g and 0.00439g of $Cd(CH_3COO)_2{\cdot}2H_2O$] is weighed for 0.1 wt% and 0.5 wt% of Cd doping.

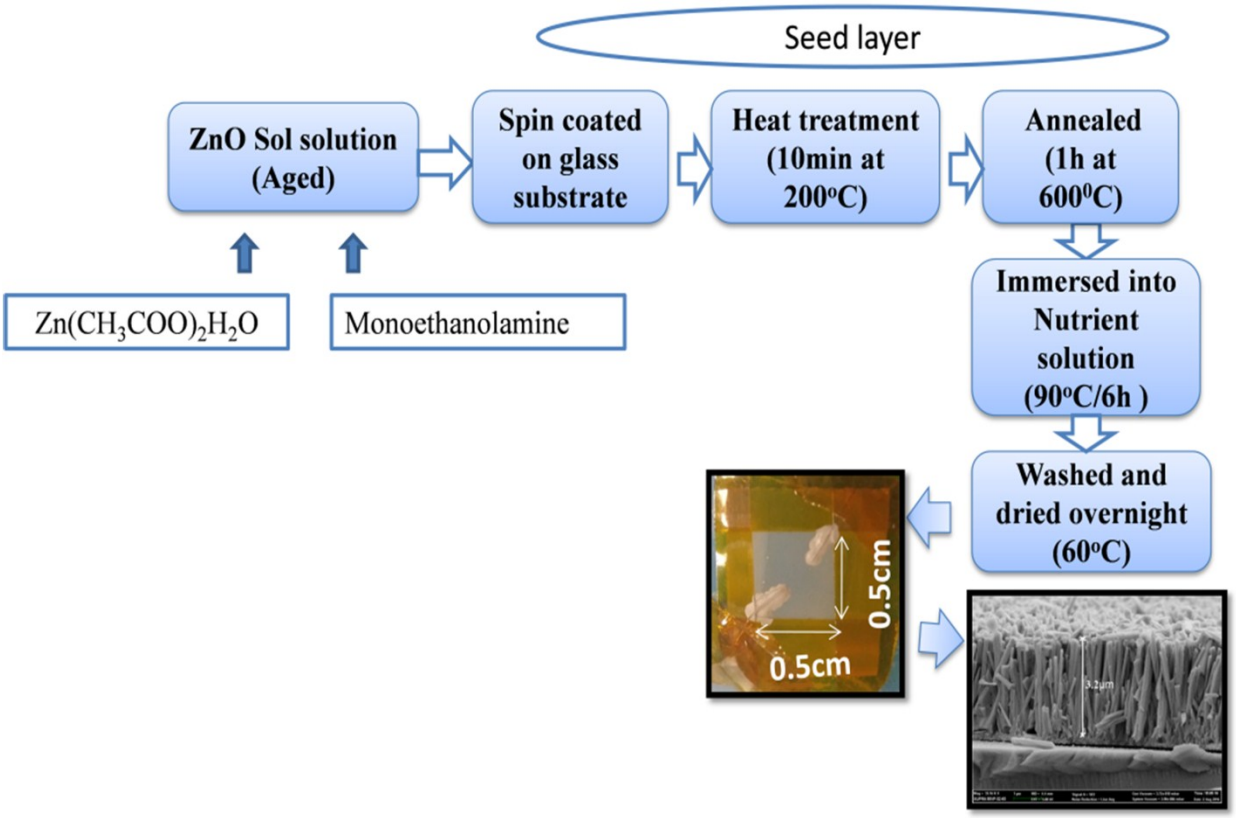

Fig. S2 Experimental flow of UV-Sensor fabrication process

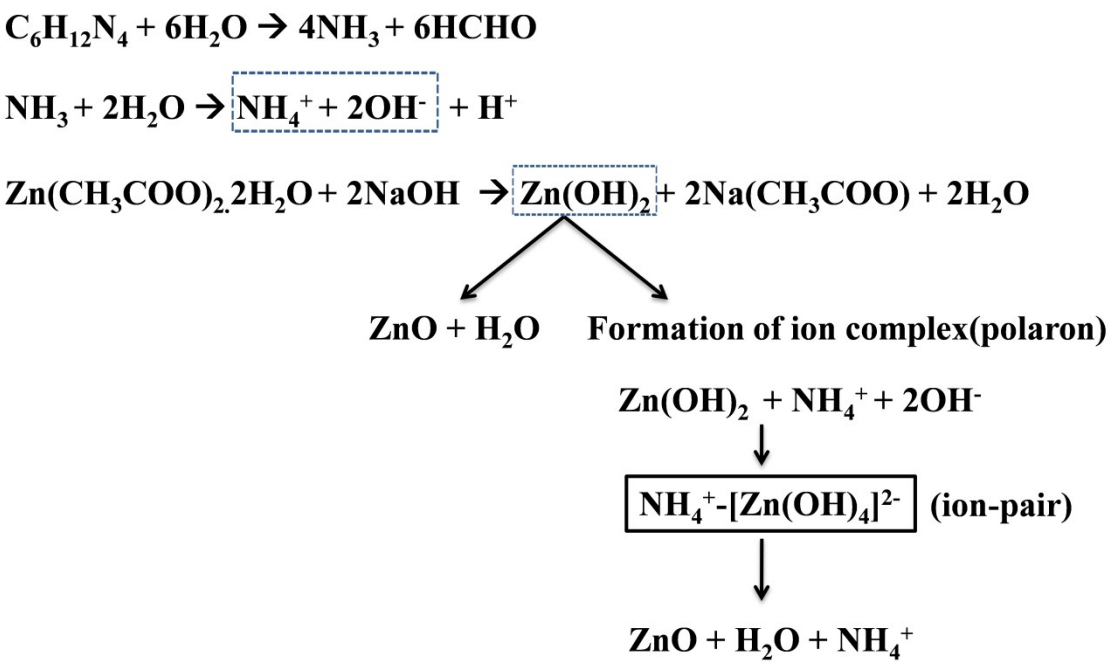

Fig. S3 Growth mechanism of 1D-ZnO NRs

Fig: S3 illustrates the growth mechanism of ZnO NRs formation. The precursor dissolved in aqeous medium forms $Zn(OH)_2$ which undergoes two types of reaction i) it reduces to a smaller extend forming ZnO that acts as a nucleation site ii) it form an ion-complex [Zn(OH)2-] which reacts with HMT to form ion-pair complex or polaron (NH_4^+-$[Zn(OH)_4]^{2-}$) due to electrostatic interaction. The presence of NH_4^+ leads to rod shape morphology by orienting the polaron on c-axis of ZnO crystal. Thus HMT acts as a surfactant by regulating the growth direction of ZnO. Sodium acetate is formed as a by-product during the reaction between Zinc acetate dihydrate and NaOH[1]. Sodium acetate formed is water soluble and therefore it gets removed during the centrifugation and heat treatment (Please refer experimental section). Thus the final end product formed (ZnO NRs) are pure with no impurities or by-products residing in it.

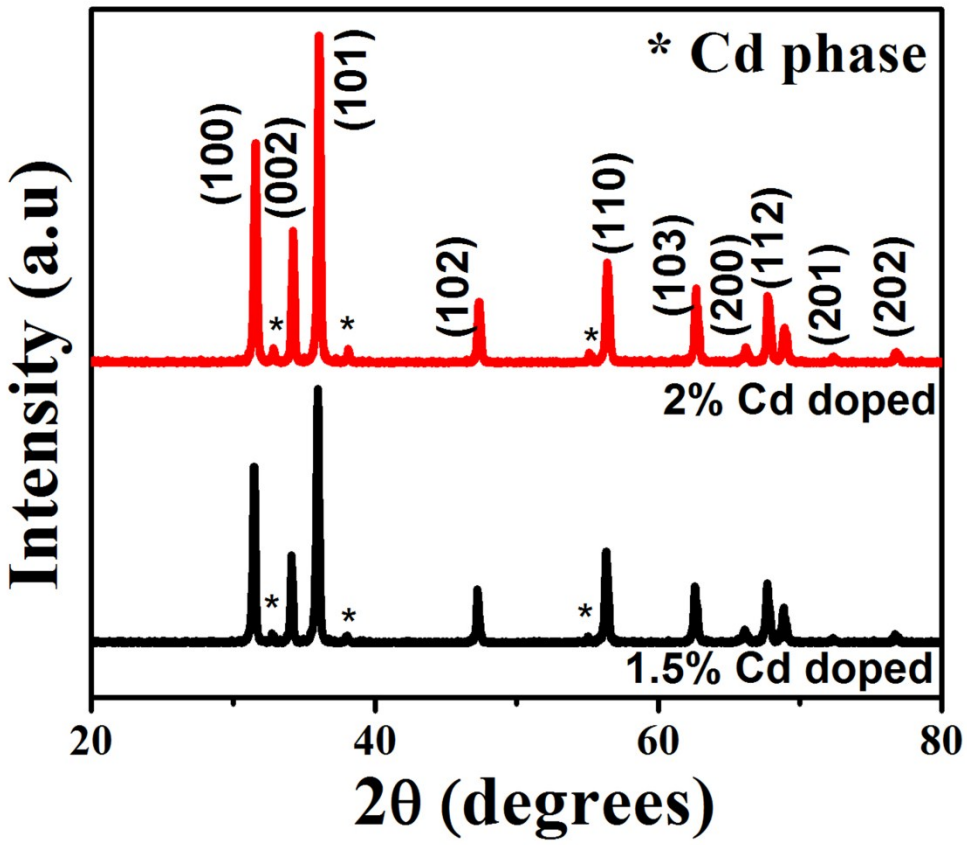

Fig. S4 XRD patterns of 1.5 wt % and 2 wt % Cd doped ZnO NRs

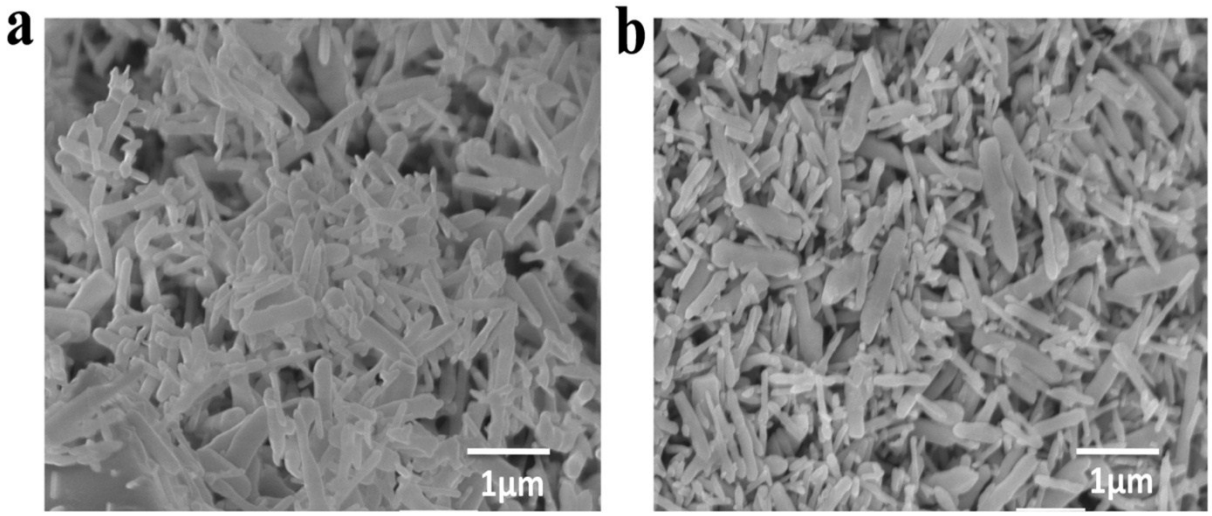

Fig. S5 FESEM images showing the deterioration in ZnO NRs when doped with higher Cd concentration **(a)** 1.5 wt % and **(b)** 2 wt %

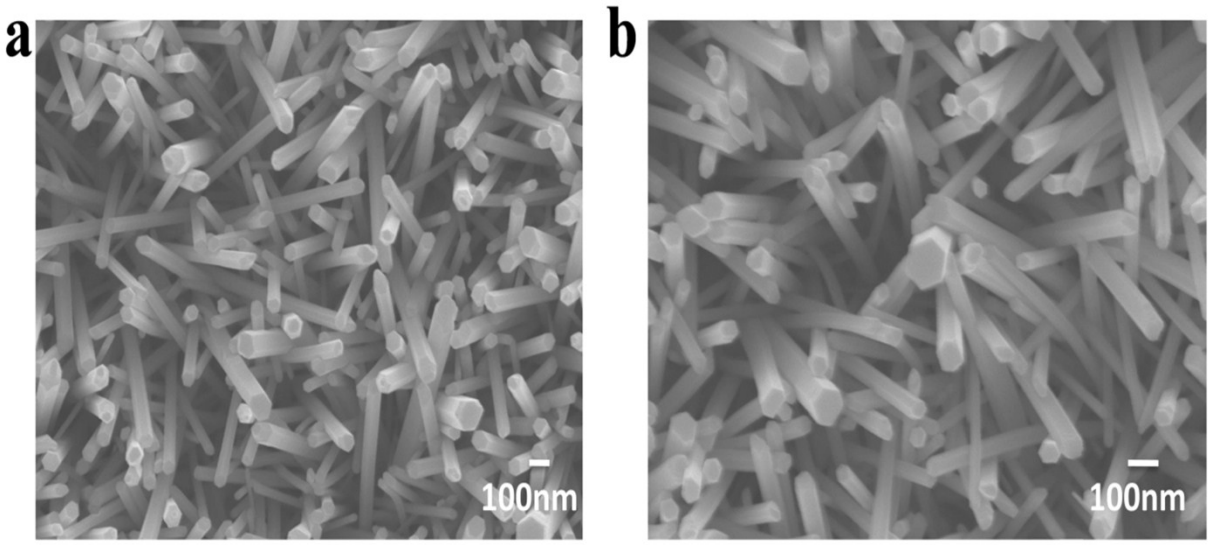

Fig. S6 Top view of FESEM images of vertically grown **(a)** ZnO NRs and **(b)** 1 wt % Cd-ZnO NRs on glass substrate

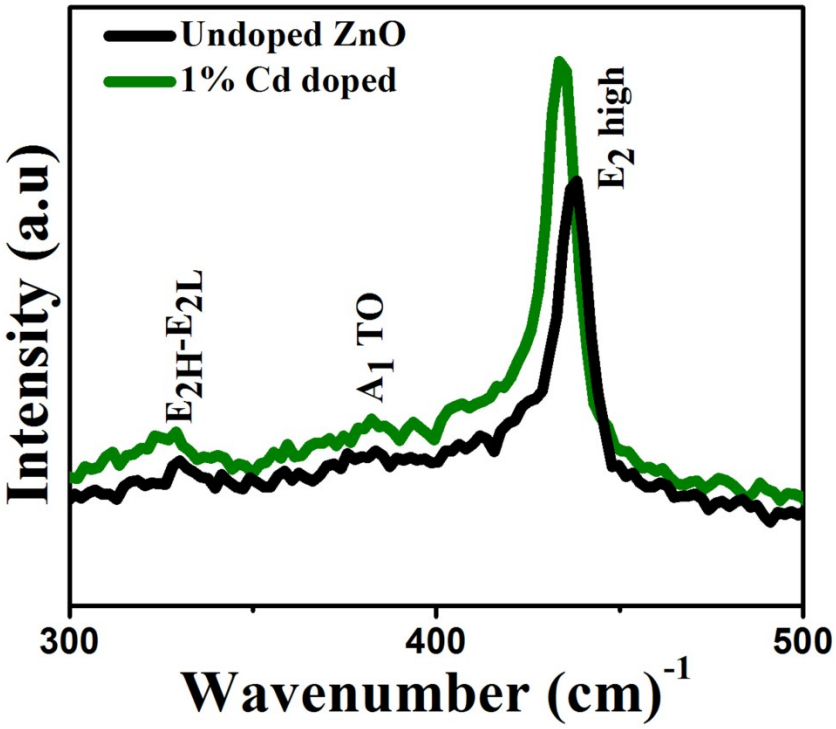

Fig: S7. Raman spectra of undoped and 1 wt% Cd-doped ZnO NRs grown vertically on glass substrate

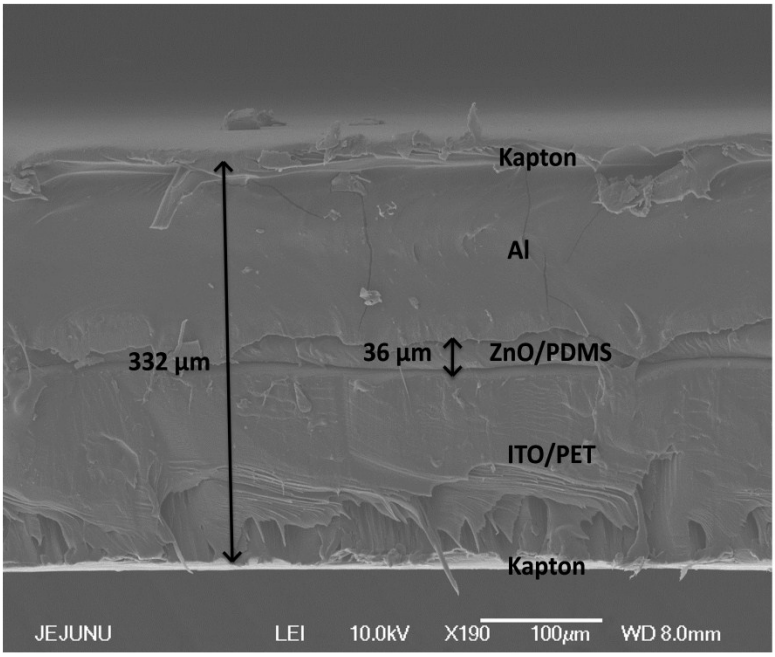

Fig. S8 Cross-sectional FESEM analysis of fabricated PNG device

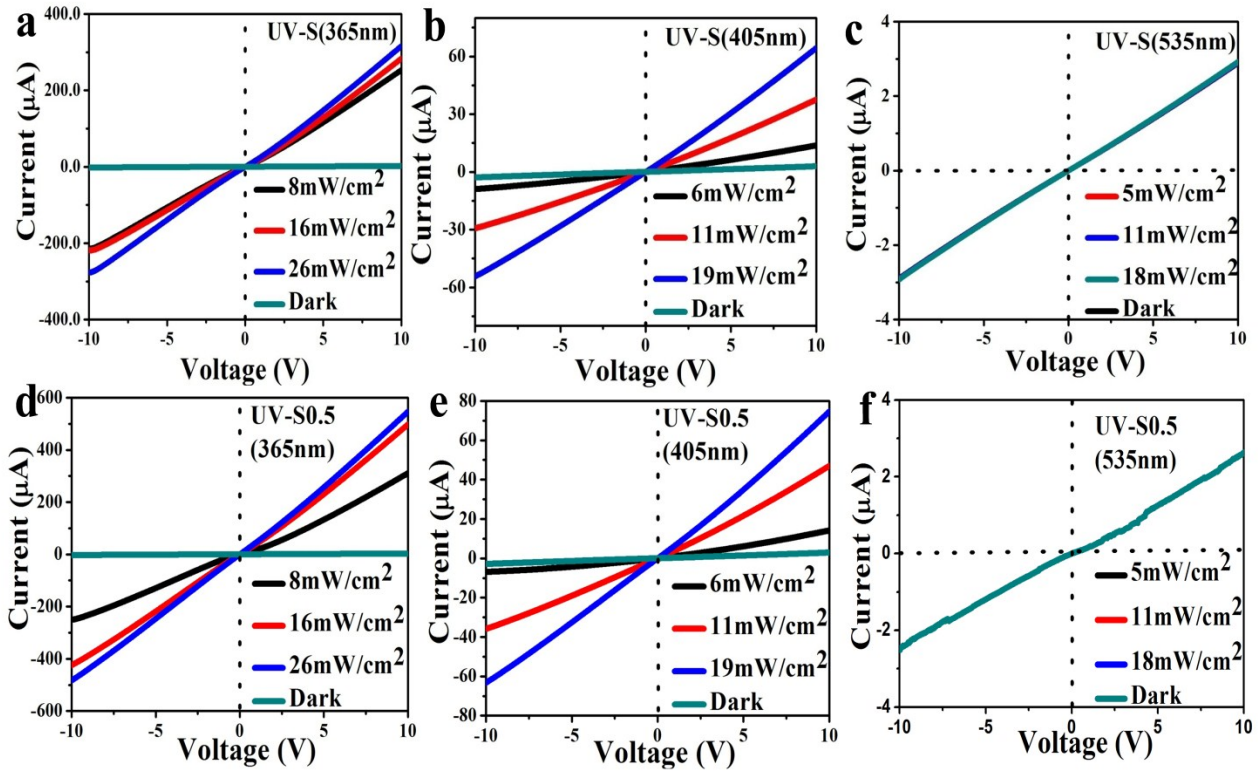

Fig. S9 I-V measurements at various wavelengths and illumination intensities. Undoped ZnO NRs (a) 365 nm, (b) 405 nm (c) 535 nm and 0.5 wt% Cd-doped ZnO NRs (d) 365 nm, (e) 405 nm and (f) 535 nm.

Table: S1 Comparison of the Proposed UV-Sensor Device Performance with Other reports

Material	**V**[a] **(V)**	**I_{ph}**[b] **(A)**	τ_{Rc} **(s)**	τ_{Dd} **(s)**	**R_λ**[e] **(A/W)**	**Ref**
ZnO:Mn	5	0.2 m	2.75	16.8	0.065	[2]
ZnO:Ti	5	102 µ	-	135	0.05	[3]
ZnO:Fe	8	1.13 m	-	-	3.66	[4]
ZnO:Sb	3	28.3 µ	7.3	20.3	-	[5]
ZnO:Mg	5	44.6 µ	-	-	22.33m	[6]
ZnO:Co	5	14 µ	-	-	0.0033	[7]
ZnO:Ag	5	40 m	80m	3.27	-	[8]
ZnO:C	14	-	2.97n	2.97n	$1.7x10^6$	[9]
ZnO:GO	10	1 µ	69	56	-	[10]
ZnO:Cd	10	330 µ	8	10	164m	This work

[a]*Bias Voltage* , [b] *Photocurrent* , [c]*Response time,* [d] *Recovery time,* [e]*Photoresponsivity.*

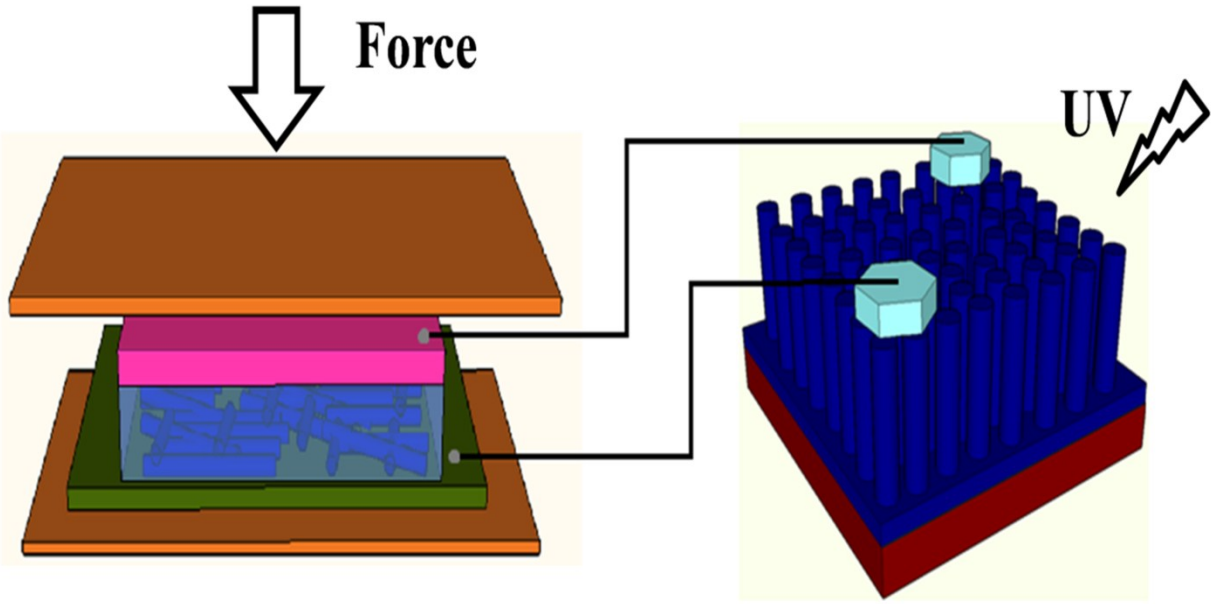

Fig. S10 Schematic of SPUV-S by parallel connections between P-NG and UV-S

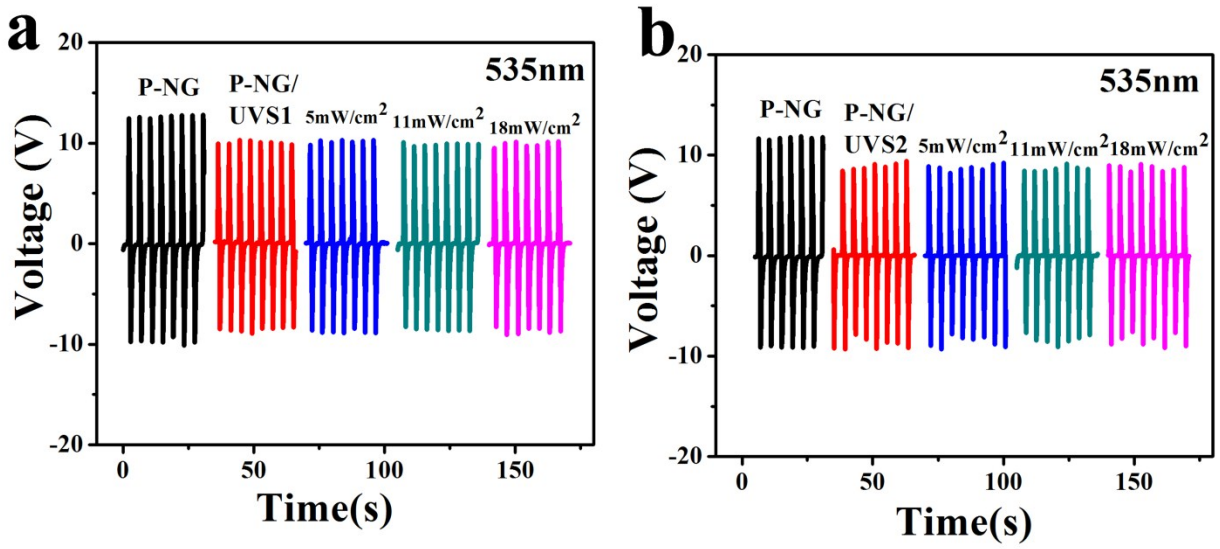

Fig. S11 Performance of self-powered UV-photo sensor (UV-S and UV-S1) at a wavelength of 535 nm

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