Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

for

Doping Controlled Pyro-phototronic Effect in Self-powered Zinc Oxide Photodetector for Enhancement of Photoresponse

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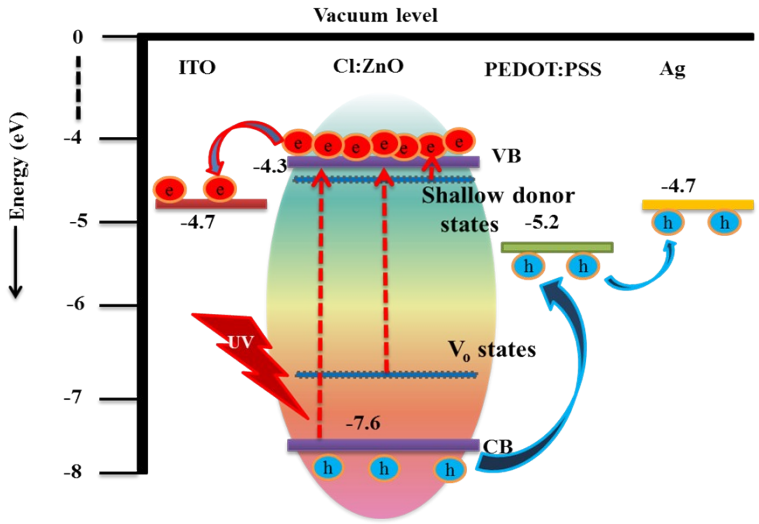

Fig. S1 Energy band diagram of the self-powered Cl:ZnO NRs PD under UV light radiation.

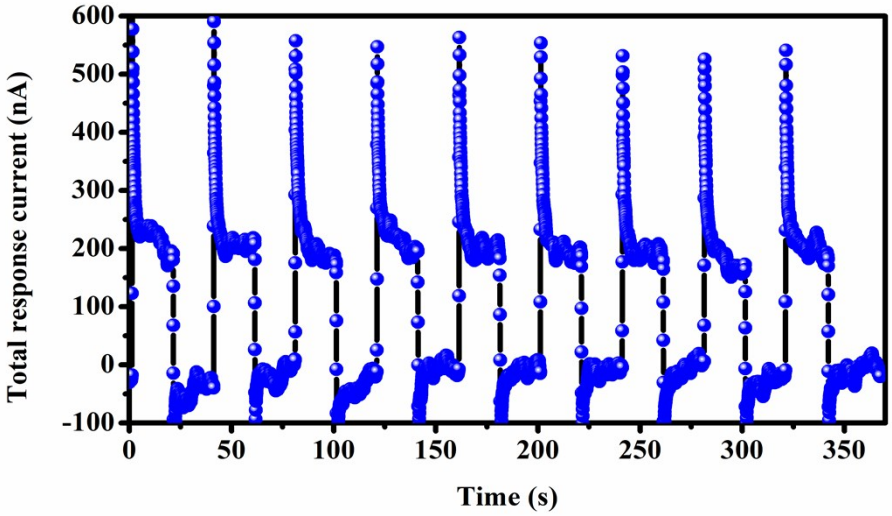

Fig. S2 Cyclic response current analysis of the Cl:ZnO NRs PD in absence of external bias voltage under UV illumination intensity of 3 mW/cm^2.

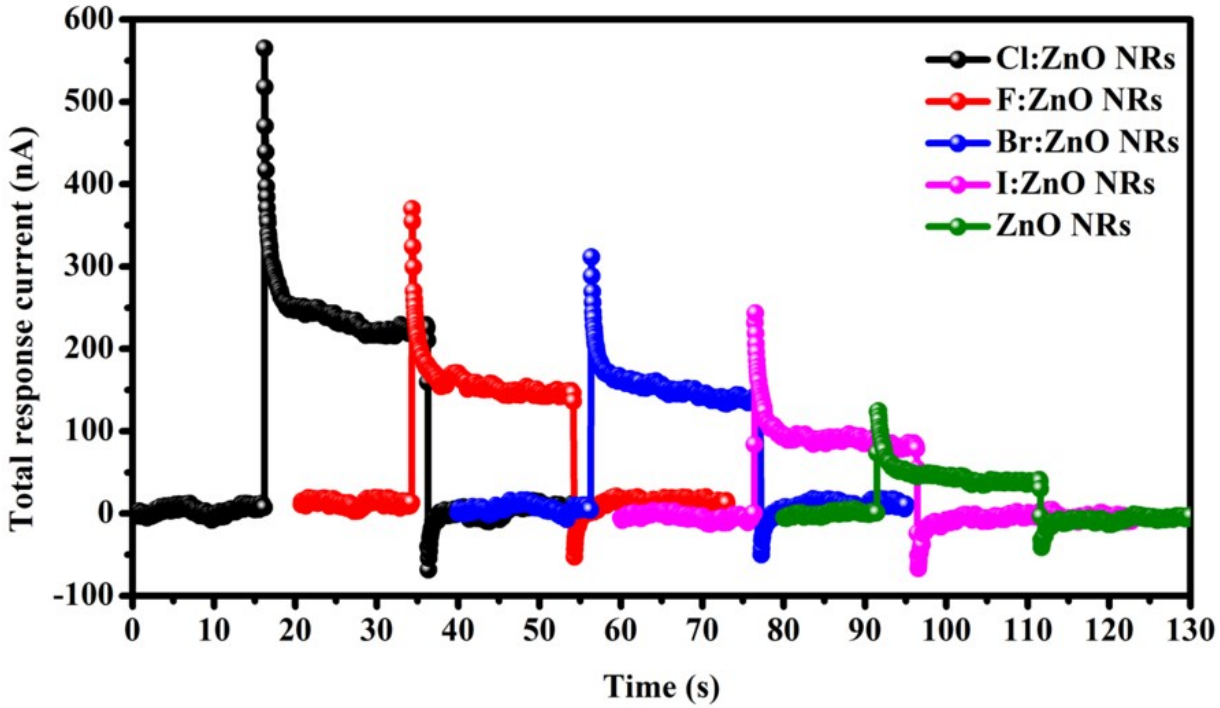

Fig. S3 Saturation photoresponse analysis of pristine ZnO NRs, F:ZnO NRs, Cl:ZnO NRs, Br:ZnO NRs and I:ZnO NRs based self-powered PDs in absence of external bias voltage under the UV light intensity of 3 mW/cm^2.

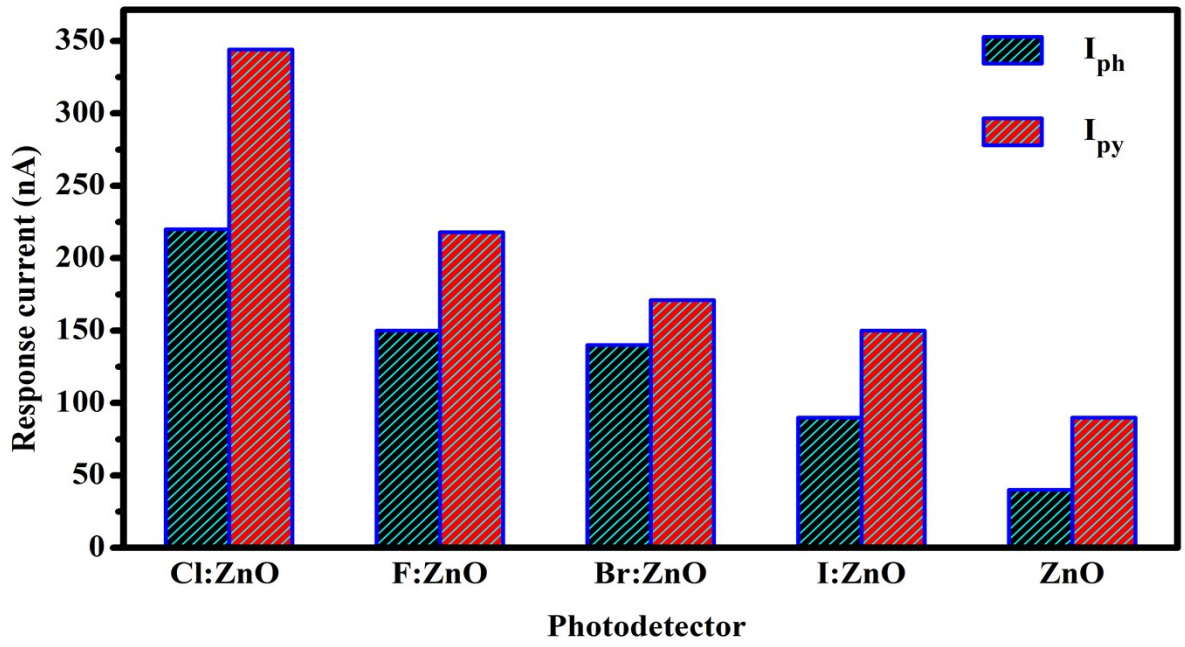

Fig. S4 Comparison response currents (photocurrent and pyrocurrent) plots of ZnO NRs, F:ZnO NRs, Cl:ZnO NRs, Br:ZnO NRs and I:ZnO NRs self-powered PDs under UV radiation intensity of 3 mW/cm^2.

Table S1: Photocurrent, pyrocurrent and response current of PDs at different sheet charge density in a fixed UV illumination intensity of 3 mW/cm^2.

PD	**Sheet charge density (cm^{-2})**	**Photocurrent (I_{ph}, nA)**	**Pyrocurrent (I_{py}, nA)**	**Response current (ΔI, nA)**
ZnO NRs	0.323 x 10^{10}	40	90	130
F:Zno NRs	4.62 x 10^{10}	150	218	368
Cl:ZnO NRs	7 x 10^{10}	220	344	564
Br:ZnO NRs	3.8 x 10^{10}	140	171	311
I:ZnO NRs	0.92 x 10^{10}	90	150	240

Table S2: Photoresponse parameters of the Cl:ZnO NRs self-powered PD.

Parameters	Photoinduced response	Pyro-phototronic effect induced response	Net response
Responsivity (mA/W)	0.531	1.805	2.3354
EQE (%)	0.180	0.614	0.794
Specific detectivity (Jones)	3.503×10^9	11.911×10^9	15.414×10^9
LDR (dB)	27.764	31.646	35.941

Table S3. Comparison of photoresponse parameters of the as-fabricated self-powered PD with previously reported high performance self-powered UV PDs.

PDs	λ (nm)	P (mW/cm^2)	t_r (s)	t_d (s)	I (nA)
ZnO Micro/NW/PEDOT:PSS[S1]	325	-	<1	<1	1.2
p-NiO/ZnO-NRs[S2]	355	3.2	0.23	0.21	300
rGO-ZnO nanostructure[S3]	334	-	<0.2	<0.2	20
TiO_2 NRs[S4]	365	1.55	0.2	0.3	75×10^3
Ag-ZnO NWs[S5]	365	0.06	0.14	0.52	71×10^3
TiO_2 NRs[S6]	365	1.25	0.15	0.05	5×10^3
Cl:ZnO NRs (present work)	365	3	0.028	0.023	0.565×10^3

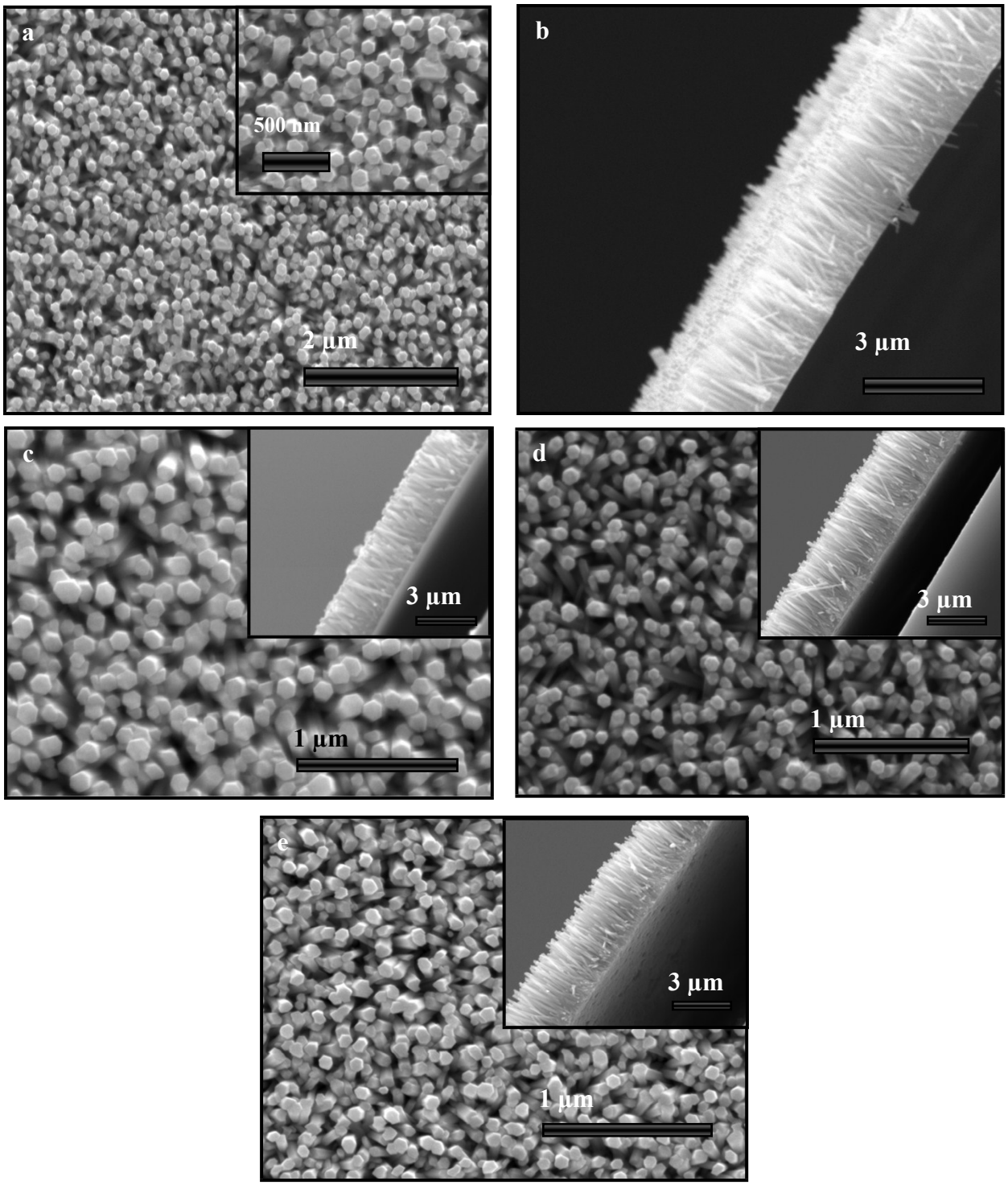

Fig. S5 (a) SEM images of ZnO NRs at low and high magnifications. (b) Cross-sectional image of ZnO NRs. SEM images of (c) F:ZnO NRs, (d) Br:ZnO NRs and (e) I:ZnO NRs, respectively. Inset depicts the cross-sectional views of the respective samples.

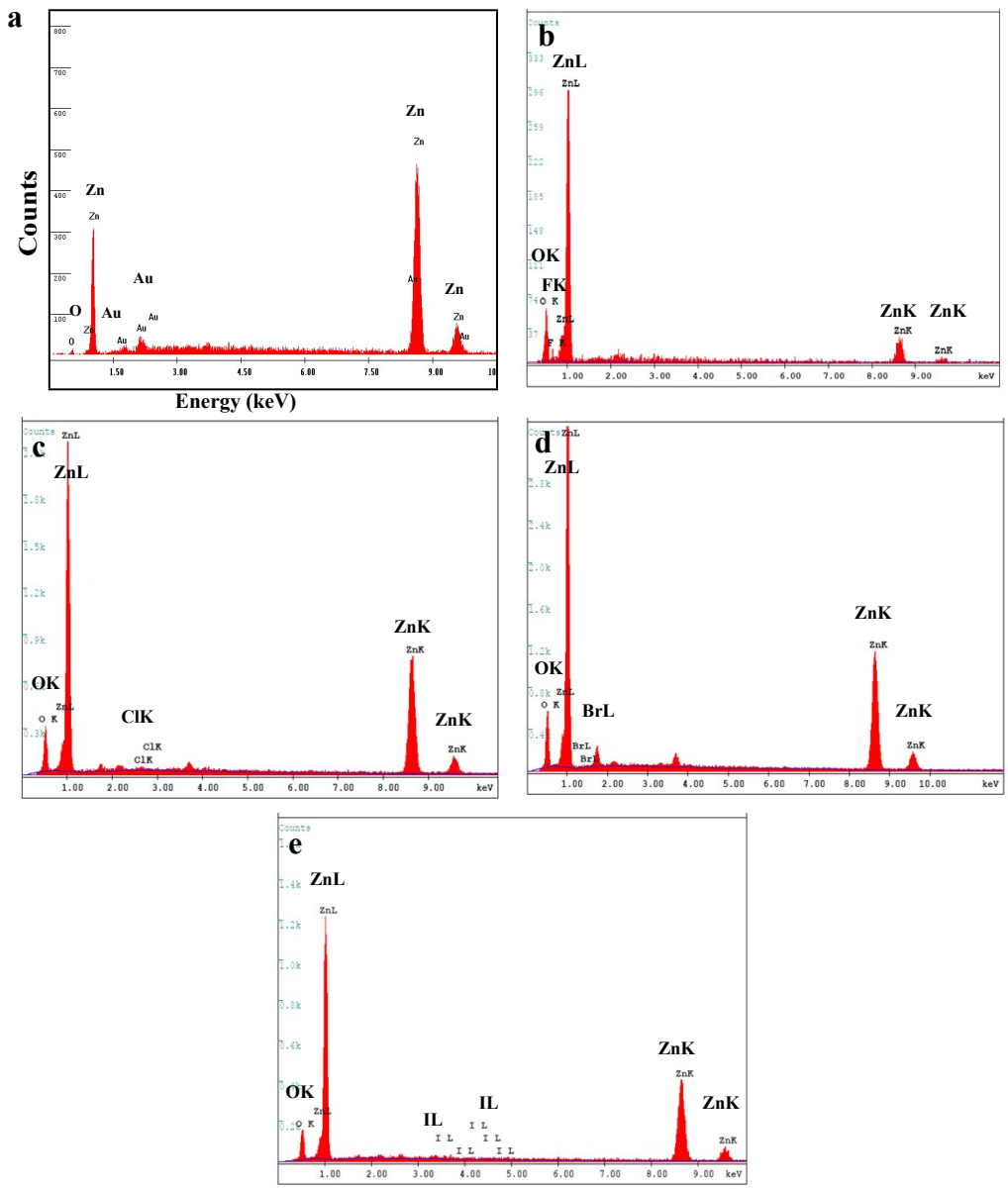

Fig. S6 EDS spectra of (a) pristine ZnO NRs, (b) F:ZnO NRs, (c) Cl:ZnO NRs, (d) Br:ZnO NRs and (e) I:ZnO NRs.

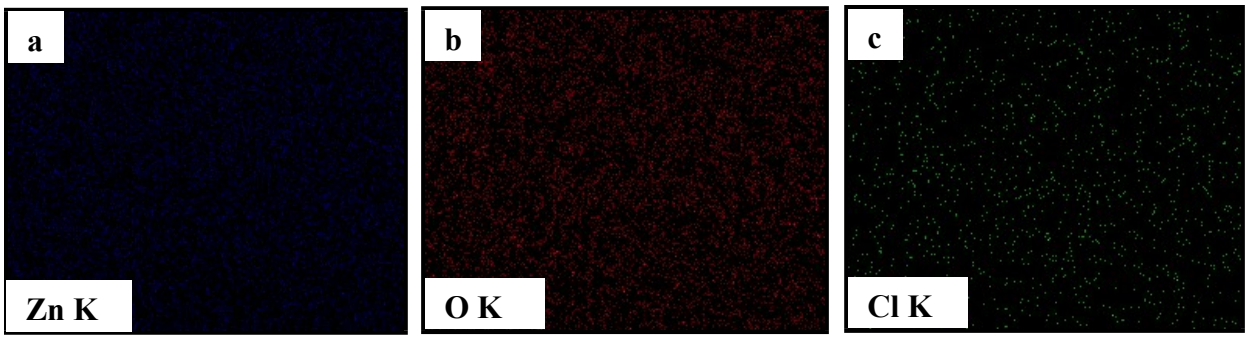

Fig. S7 Elemental mapping: (a) Zn K mapping, (b) O K mapping and (c) Cl K mapping of Cl:ZnO NRs.

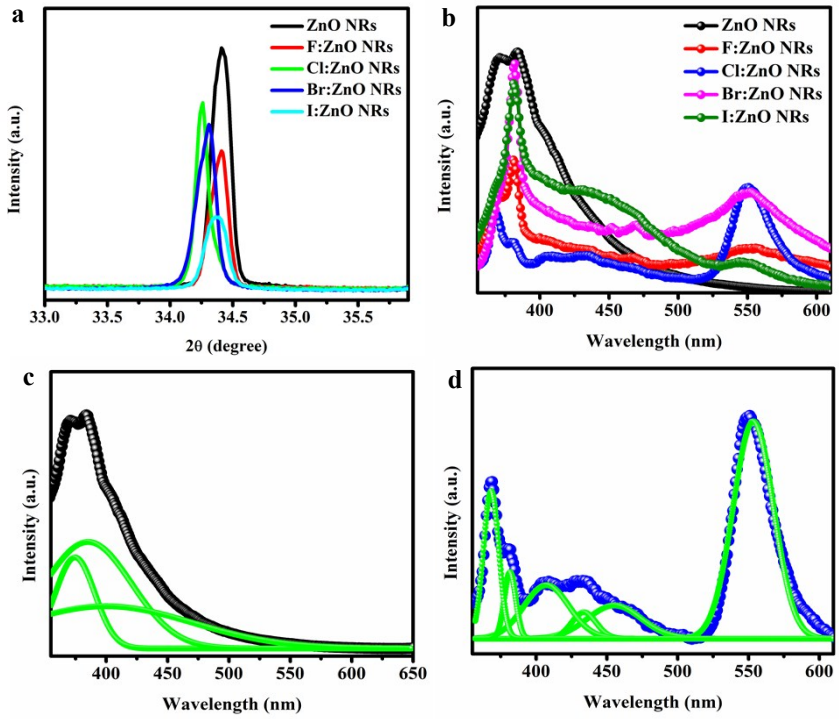

Fig. S8 (a) XRD patterns of pristine ZnO, F:ZnO, Cl:ZnO, Br:ZnO and I:ZnO NRs with the diffraction plane of (002). (b) Room temperature PL spectra of pristine ZnO, F:ZnO, Cl:ZnO, Br:ZnO and I:ZnO NRs. (c) and (d) are the fitted PL spectra of ZnO NRs and Cl:ZnO NRs samples.

References

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