Electronic Supplementary Material (ESI) for Nanoscale.

Supplementary information

Nitrogen doped In_2O_3-ZnO nanocomposite mesoporous thin film based highly sensitive and selective ethanol sensor

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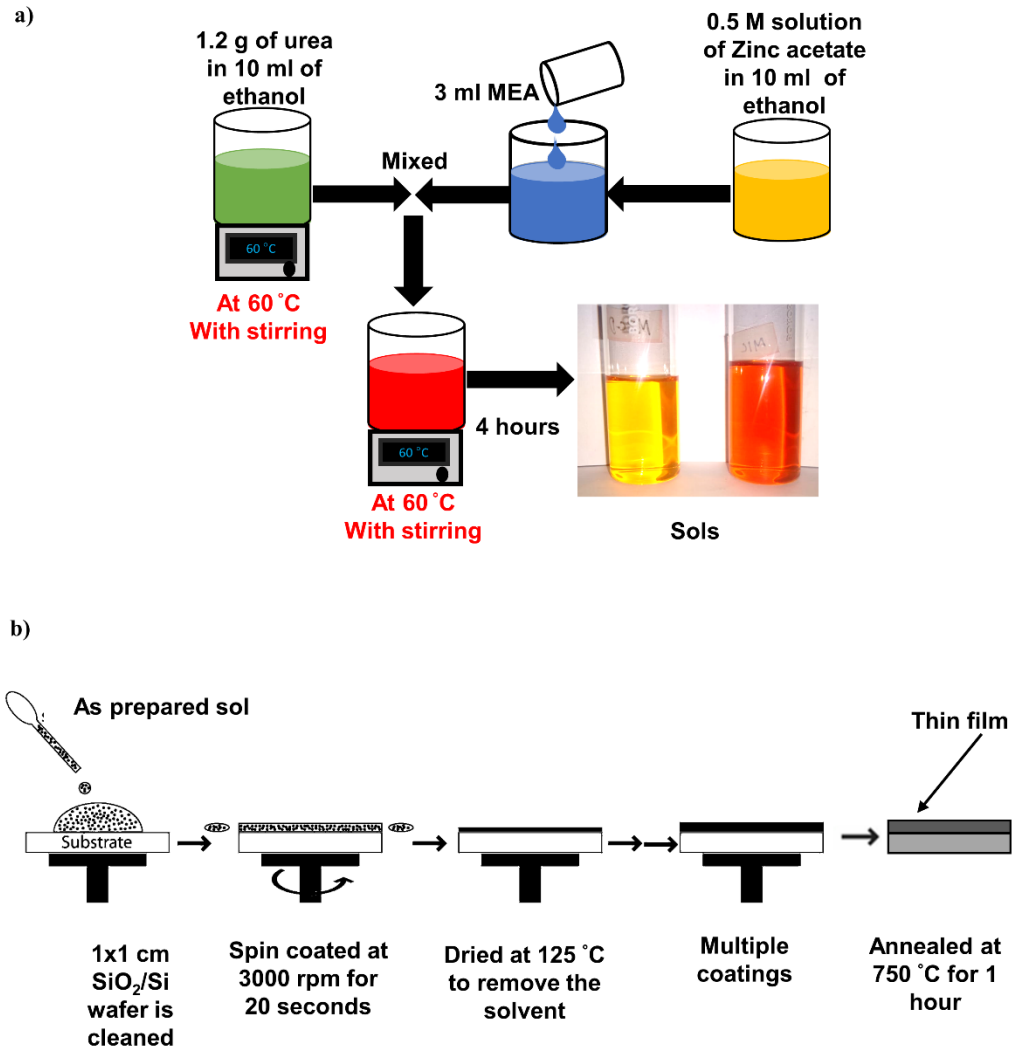

Figure S1. a) synthesis of sol and b) synthesis of the composite thin film by spin coating technique.

Table S1. Details of chemicals used for synthesis of composites

Sl.no	Sample	Zinc acetate (g)	Indium acetate (g)
1	IZON-25	0.822	0.365
2	IZON-50	0.549	0.723
3	IZON-75	0.275	1.094
4	IZO-50	0.822	0.365

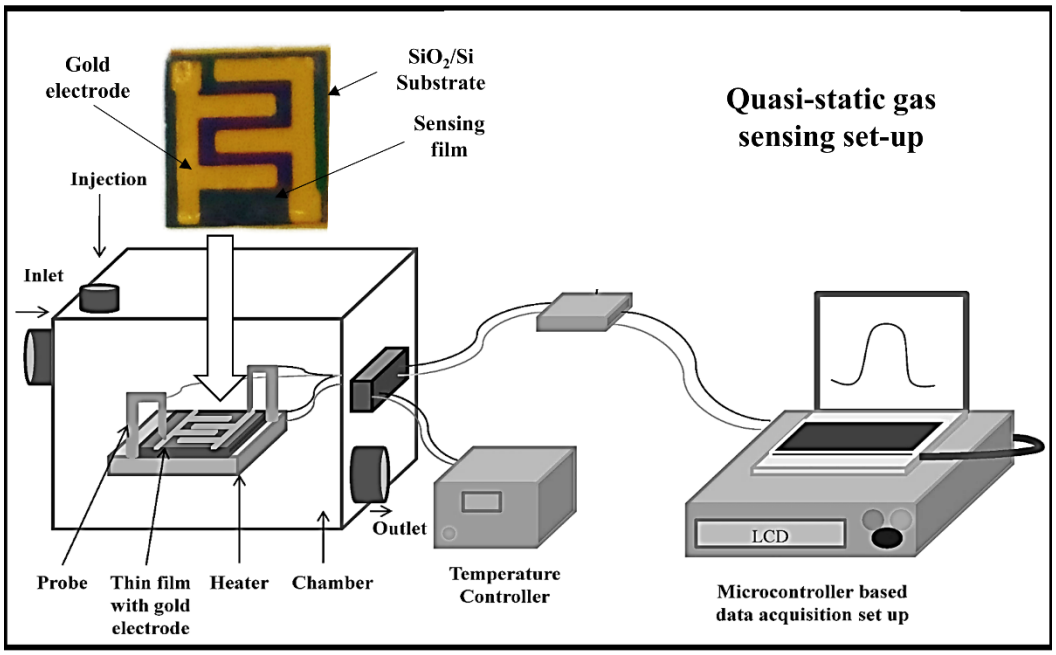

Figure S2. photograph of the fabricated device and the schematic of quasi-static gas sensing set-up.

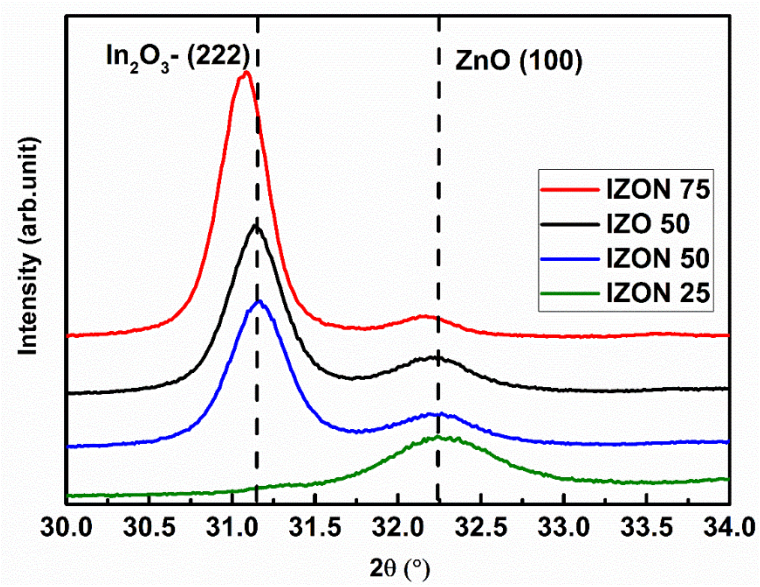

Figure S3. Shift in two major XRD peaks of composites thin films

The crystallite size of the In_2O_3 and ZnO has been calculated for the composite thin films using the Scherrer equation, $D = \frac{K\lambda}{\beta \cos(\theta)}$, Where D is the crystallite size of the thin films, λ is the X-ray wavelength (1.54 Å), β is the FWHM in radians, K is constant with a value of 0.94, and θ is the peak position in radians. Further the micro strain (ε) along the In_2O_3 (222) and ZnO (100) plane of the thin films is calculated using the equation, $\varepsilon = \frac{\beta}{4tan\theta}$.

Table S2. Estimated parameters from XRD analysis

Sample	Crystallite size, D (nm) ±0.5 nm		Cell parameters (Å) ±0.02 Å		Strain (ε) x 10^{-3}	
	In_2O_3	ZnO	In_2O_3, a	ZnO, a & c	In_2O_3 (222)	ZnO (100)
IZON 25	26.18	13.42	10.31	3.24 & 5.22	3.17	13.3
IZON 50	19.04	10.92	10.22	3.24 & 5.20	4.57	9.49
IZO 50	20.95	14.21	10.22	3.24 & 5.20	4.14	7.41
IZON 75	23.94	31.51	10.42	3.23 & 5.21	3.33	3.32

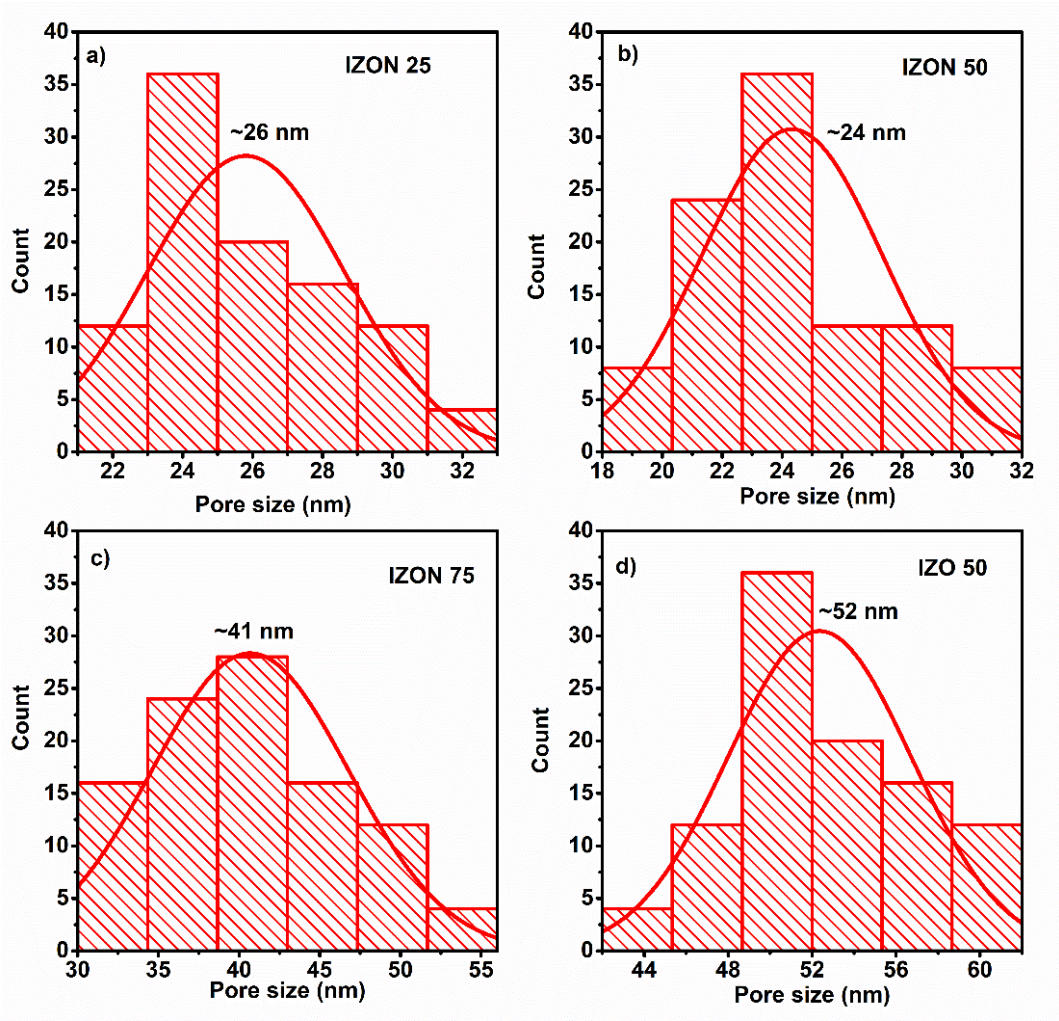

Figure S4. Surface pore size distribution of a) IZON 25, b) IZON 50, IZON 75 and IZO 50 composite thin films.

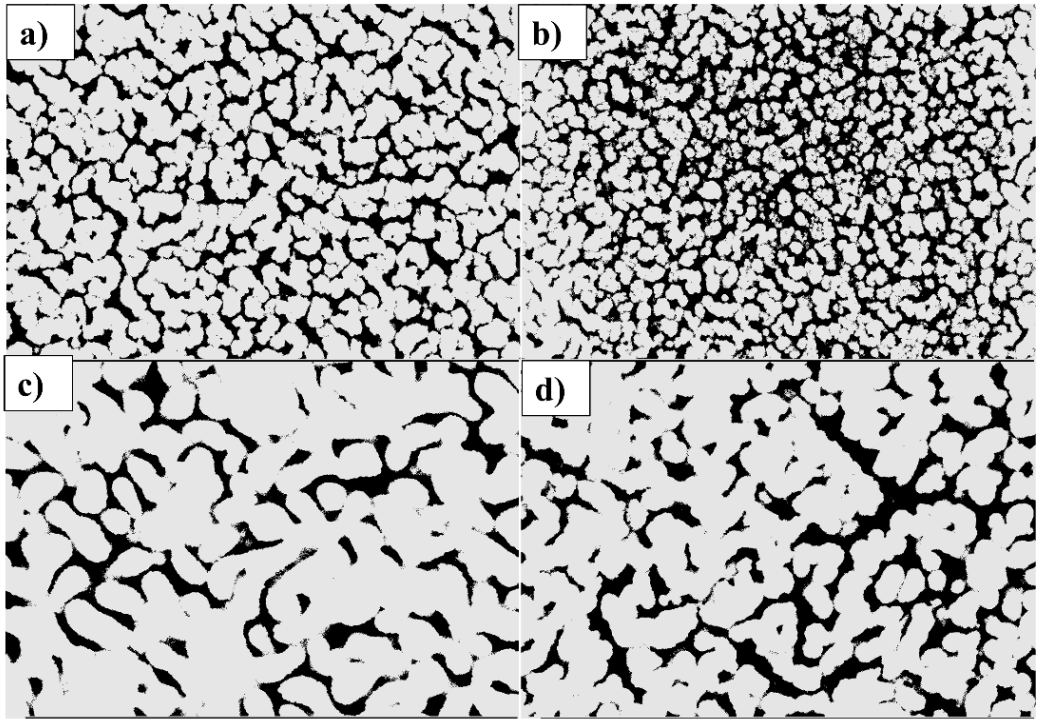

Figure S5 Processed scanning electron microscopy images of a) IZON 25, b) IZON 50, c) IZON 75 and d) IZO 50 composite thin films

Table S3. Composition of composite thin films

Film/Atom (at%)	N	O	In	Zn
IZON-25	0.60	58.11	11.38	29.91
IZON-50	0.60	61.37	19.21	18.82
IZON-75	0.60	57.71	31.46	10.22
IZO-50	0	61.61	19.52	18.87

Table S4. Sensing response, response and recovery times of various composite thin films

Film	Response at 200 °C (%)	Response time (s)	Recovery time (s)
IZON-25	~80	~5	~300
IZON-50	~94	~2	~300
IZON-75	~50	~30	~300
IZO-50	~77	~9	~250

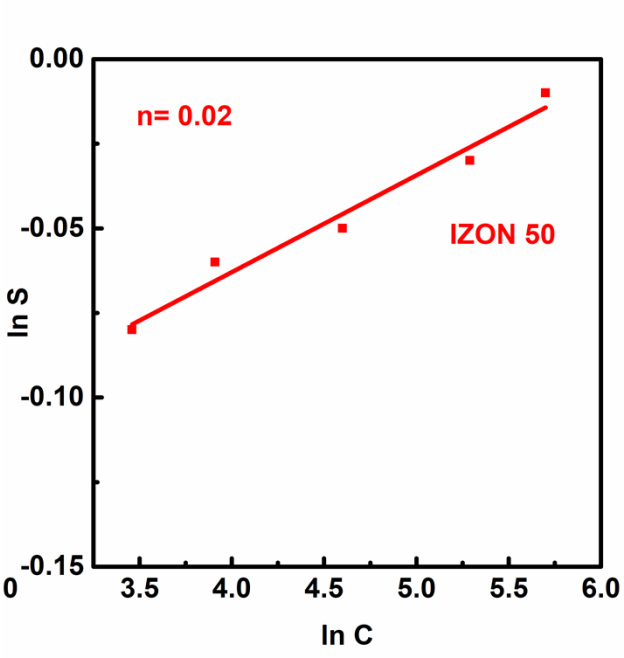

Figure S6. Sensitivity plot of IZON 50 thin film.

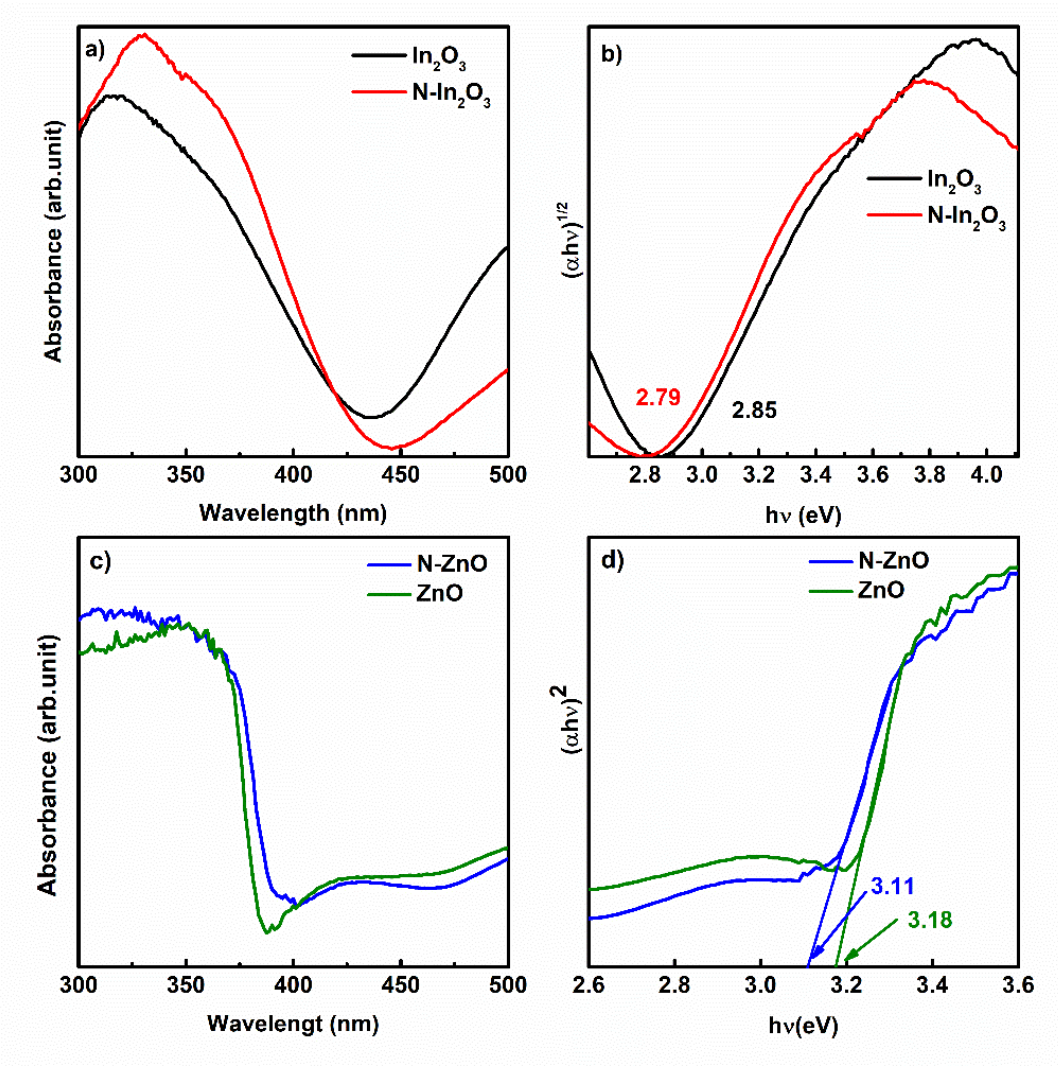

Figure S7 a&c) DRS and b&d) Tauc plot of individual metal oxide thin films.

Table S5. Sensing parameters of various thin films

Film	Temperature (°C)	Response (%)
IZO-50	200	~74
IZON-50	200	~94
N-ZnO	225	~86
N-In_2O_3	250	~82

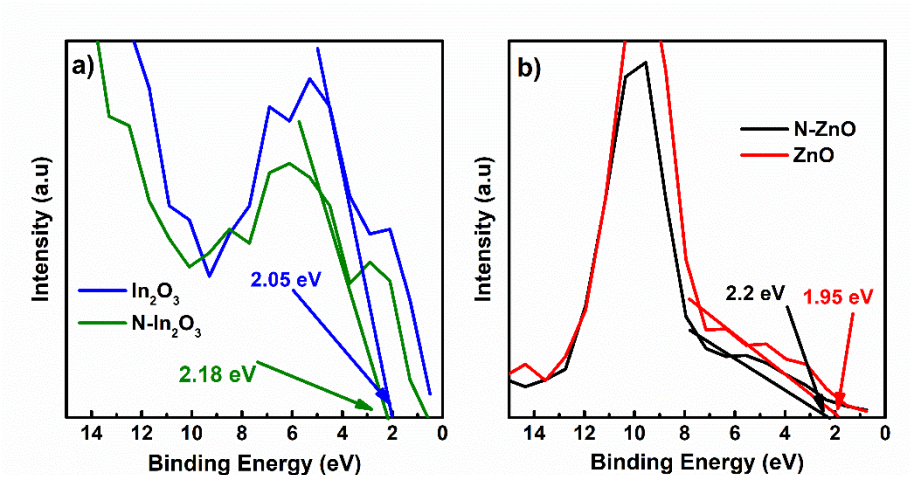

Figure S8. Valance band edge diagrams of a) In_2O_3 & N-In_2O_3 and b) ZnO & N-ZnO