Supporting Information for

# Multi-dimensional templated synthesis of hierarchical $Fe_2O_3$/NiO composites and their superior ethanol sensing property promoted by nanoscale p-n heterojunctions

***AUTHORS***

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Fabrication of pure $Fe_2O_3$ nanofibers

0.8g PAN was first added to 10 ml DMF to make an 8 wt.% solution, 0.4g $FeCl_3 \cdot 6H_2O$ was then added to the solution as the electrospinning precursor solution. The electrospinning parameters were as followings: the flow rate of solution was 0.5ml·$h^{-1}$; the voltage was 12 kV and the distance was 15 cm. The as-collected PAN-$FeCl_3$ nanofibers were annealed at 600 ℃ in air with a heating rate of 1 ℃·$min^{-1}$ and kept for 4h. The as-obtained sample was named as p-$Fe_2O_3$.

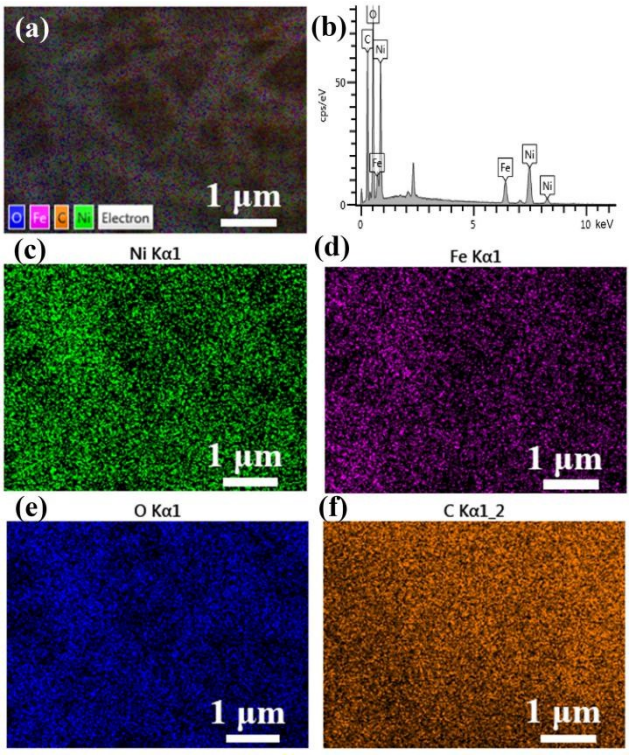


**Figure S1.** (a-b) EDS spectra of the $Fe_2O_3$/NiO-1 composites and EDS elemental mapping images of (c) Ni, (d) Fe, (e) O and (f) C.

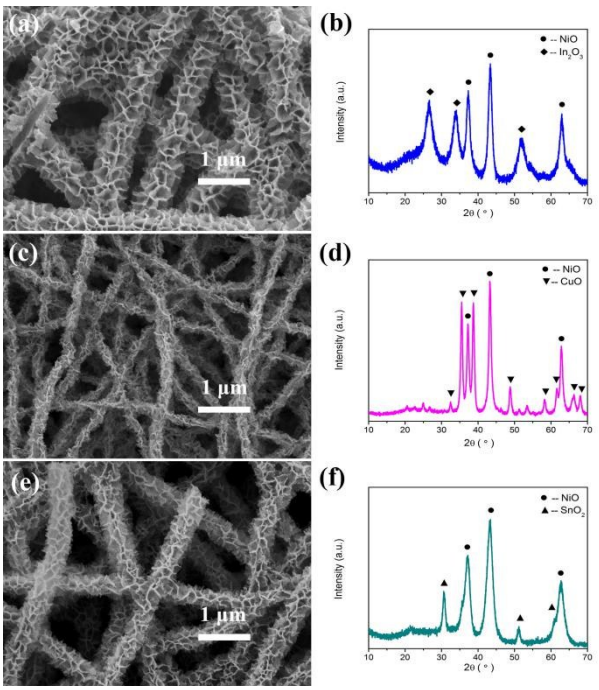


**Figure S2.** SEM images and XRD patterns of the as-prepared (a-b) $In_2O_3$/NiO, (c-d) CuO /NiO and (e-f) $SnO_2$/NiO composites.

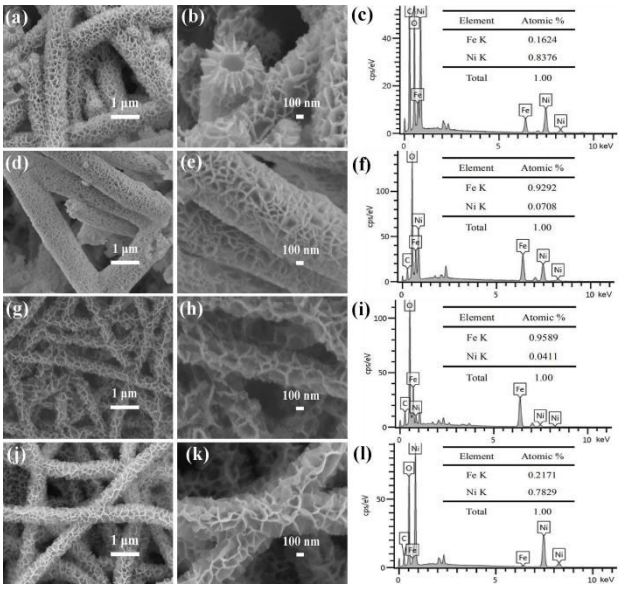


**Figure S3.** SEM images and the corresponding EDS spectra of the hierarchical $\frac{x}{2}Fe_2O_3$/(1-$x$)NiO composites: (a-c) $Fe_2O_3$/NiO-2, (d-f) $Fe_2O_3$/NiO-3, (g-i) $Fe_2O_3$/NiO-5 and (j-l) $Fe_2O_3$/NiO-1(OS) with the relative content from ICP method (inset).

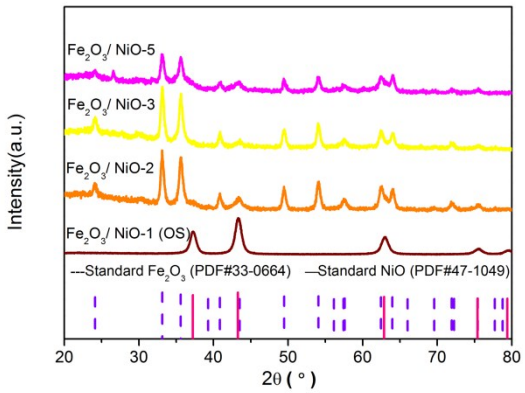


**Figure S4.** XRD patterns of $Fe_2O_3$/NiO-1(OS), $Fe_2O_3$/NiO-2, $Fe_2O_3$/NiO-3 and $Fe_2O_3$/NiO-5.

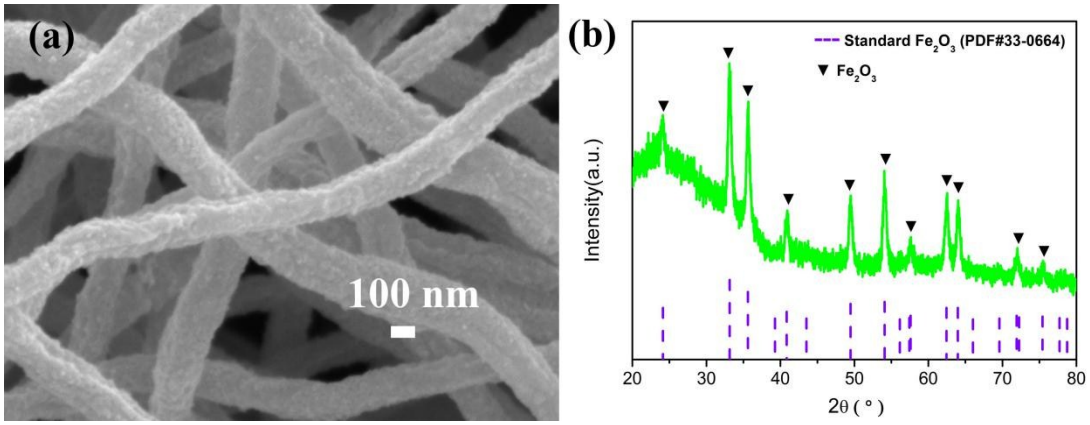


**Figure S5.** SEM image and XRD pattern of p-$Fe_2O_3$.

**Table S1.** Linear fitting data of different samples

| Sample | $R^2$ | Slope Value | Standard Error | Intercept Value | Standard Error |
|---|---|---|---|---|---|
| **p-NiO** | 0.88717 | 0.16578 | 0.02074 | -0.9193 | 0.03913 |
| **p-$Fe_2O_3$** | 0.92234 | 0.14748 | 0.01505 | -0.02647 | 0.02844 |
| **$Fe_2O_3$/NiO-1 (MS)** | 0.95982 | 0.33966 | 0.02450 | -0.17817 | 0.04630 |
| **$Fe_2O_3$/NiO-1** | 0.96565 | 0.49459 | 0.03291 | -0.07046 | 0.06218 |
| **$Fe_2O_3$/NiO-4** | 0.94889 | 0.33753 | 0.02760 | 0.00313 | 0.05216 |