Electronic Supplementary Information (ESI) :

Self-Assembly of single-crystalline α-Fe_2O_3 nanoplates to columnar superstructures: controllable synthesis, growth mechanism, and properties

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Table S1. The α-Fe_2O_3 crystals obtained by a hydrothermal route in the presence of glycerin (1 mL) at 140 °C with different concentration of Fe^{3+} and reaction time.

Sample number	$C(Fe^{3+})$	Reaction time	Morphology	Sizes		
				diameter	thickness	length
α-Fe_2O_3-1	0.01 M	30 h	column-like (Fig. 3a)	~120 nm	~20 nm	~220 nm
α-Fe_2O_3-2	0.02 M	30 h	column-like (Fig. 2a)	~380 nm	~40 nm	~2 μm
α-Fe_2O_3-3	0.03 M	30 h	column-like (Fig. 3b)	~750 nm	~80 nm	~2.2 μm
α-Fe_2O_3-4	0.02 M	5 h	plates (Fig. S6b)	~240 nm	~30 nm	-
α-Fe_2O_3-5	0.04 M	30 h	plates (Fig. 3c)	~1.5 μm	~240 nm	-
α-Fe_2O_3-6	0.1 M	30 h	plates (Fig. 3d)	~2.5 μm	~500 nm	-

Table S2. The yields and morphologies of products obtained with different experimental parameters such as temperature, types of polyol and surfactant, and reaction time.

Sample number	C_{Fe3+}	Additives		Reaction conditions	Yeilds (wt %)	Morphology
		polyols	Surfactant			
α-Fe_2O_3-7	0.02 M	1 mL EG[a]	absence	140 °C for 30 h	~80	sphere (Fig. S5a)
α-Fe_2O_3-8	0.02 M	1 mL DPE[a]	absence	140 °C for 30 h	~85	sphere (Fig. S5b)
α-Fe_2O_3-9	0.02 M	1 mL NPA[a]	absence	140 °C for 30 h	~85	aggregated sphere (Fig. S5c)
α-Fe_2O_3-10	0.02 M	1 mL PEG-200[a]	absence	140 °C for 30 h	~80	aggregated sphere (Fig. S5d)
α-Fe_2O_3-11	0.02 M	without polyols	absence	140 °C for 30 h	~60	polyhedron (Fig. S5e)
α-Fe_2O_3-12	0.02 M	2 mL glycerin	absence	140 °C for 30 h	~90	plates (Fig. S5f)
α-Fe_2O_3-13	0.02 M	5 mL glycerin	absence	140 °C for 30 h	~50	plates (Fig. S5g)
α-Fe_2O_3-14	0.02 M	1 mL glycerin	absence	120 °C for 30 h	~45	plates (Fig. S4a)
α-Fe_2O_3-15	0.02 M	1 mL glycerin	absence	130 °C for 30 h	~75	column-like (Fig. S4b)
α-Fe_2O_3-16	0.02 M	1 mL glycerin	absence	150 °C for 30 h	~98	column-like (Fig. S4c)
α-Fe_2O_3-17	0.02 M	1 mL glycerin	absence	160 °C for 30 h	~98	column-like (Fig. S4d)
α-Fe_2O_3-18	0.02 M	1 mL glycerin	CTAB[a]	140 °C for 30 h	~80	column-like (Fig. 4a)
α-Fe_2O_3-19	0.02 M	1 mL glycerin	CTAC[a]	140 °C for 30 h	~85	column-like (Fig. 4b)
α-Fe_2O_3-20	0.02 M	1 mL glycerin	PVP[a]	140 °C for 30 h	~60	platelet (Fig. 4c)
α-Fe_2O_3-21	0.02 M	1 mL glycerin	PVA[a]	140 °C for 30 h	~60	plates (Fig. 4d)
α-Fe_2O_3-22	0.02 M	1 mL glycerin	SDS[a]	140 °C for 30 h	~55	particle (Fig. 4e)
α-Fe_2O_3-23	0.02 M	1 mL glycerin	SDBS[a]	140 °C for 30 h	~50	particle (Fig. 4f)
α-Fe_2O_3-24	0.02 M	1 mL glycerin	absence	140 °C for 2 h	~35	particle (Fig. S6a)
α-Fe_2O_3-25	0.02 M	1 mL glycerin	absence	140 °C for 10 h	~80	platelet (few) and column-like (Fig. S6c)
α-Fe_2O_3-26	0.02 M	1 mL glycerin	absence	140 °C for 20 h	~ 90	plates (very few) and column-like (Fig. S6d)

[a] EG = ethylene glycol, DPE = diethylene glycol, NPA = n-propyl alcohol, PEG-200= poly(ethylene glycol 200), CTAB=cetyltrimethylammonium chloride bromide, CTAC=cetyltrimethylammonium chloride, PVP= polyvinylpyrrolidone, PVA=poly(vinyl alcohol), SDS= sodium dodecyl sulfonate, SDBS=sodium dodecyl benzene sulfonate.

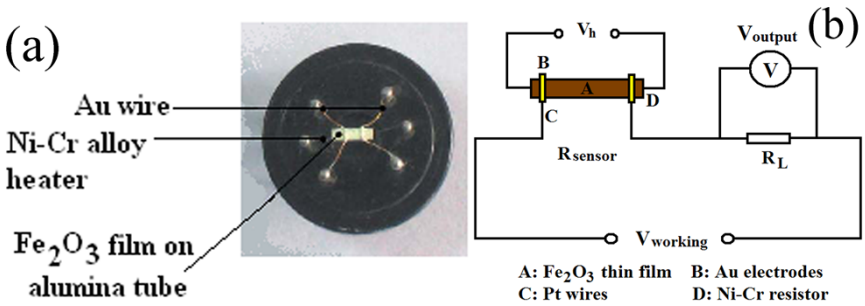

Fig. S1 (a) Photograph of the gas sensor, and (b) working principle of the gas sensing measurement system (V_h: heating voltage; V_{out}: signal voltage and R_L: load resistor).

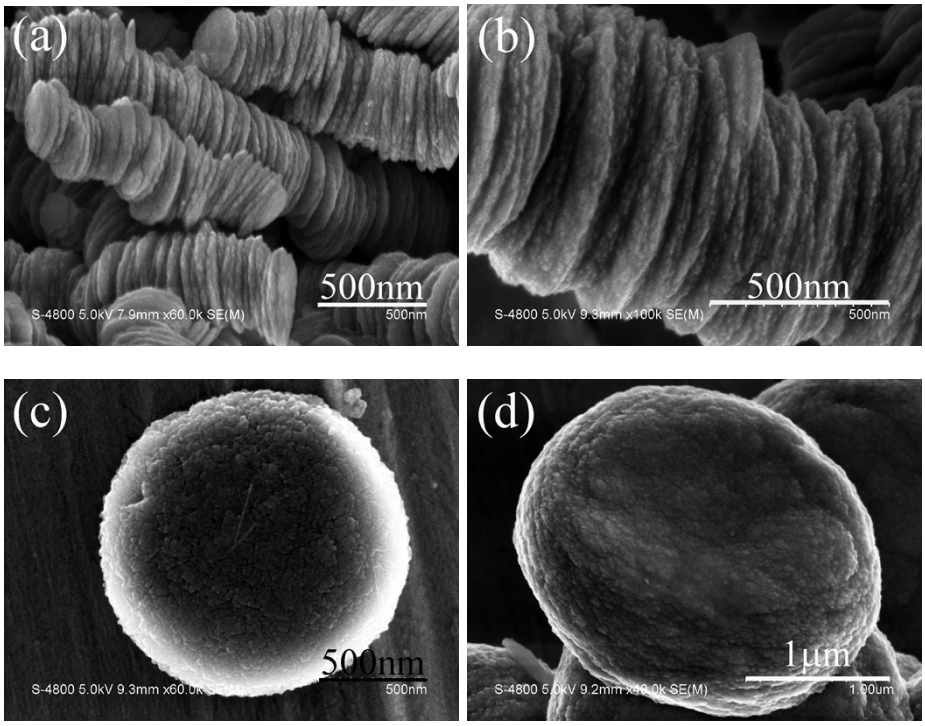

Fig. S2 High resolution SEM images of α-Fe_2O_3 crystals: (a) α-Fe_2O_3-2, (b) α-Fe_2O_3-3, (c) α-Fe_2O_3-5, and (d) α-Fe_2O_3-6.

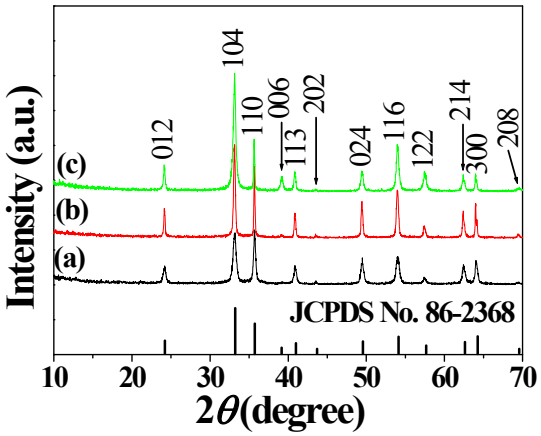

Fig. S3 XRD patterns of the obtained α-Fe_2O_3 crystals with different sizes: (a) α-Fe_2O_3-5, (b) α-Fe_2O_3-6, and (c) α-Fe_2O_3-1, respectively.

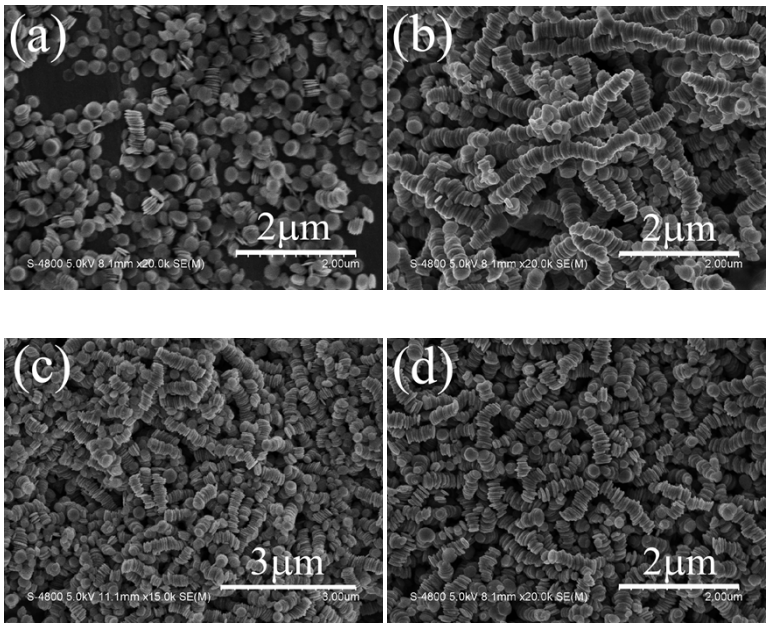

Fig. S4 SEM images of α-Fe_2O_3 crystals formed at different temperatures of (a) 120 °C, (b) 130 °C, (c) 150 °C, and (d) 160 °C with the same reaction time of 30 h.

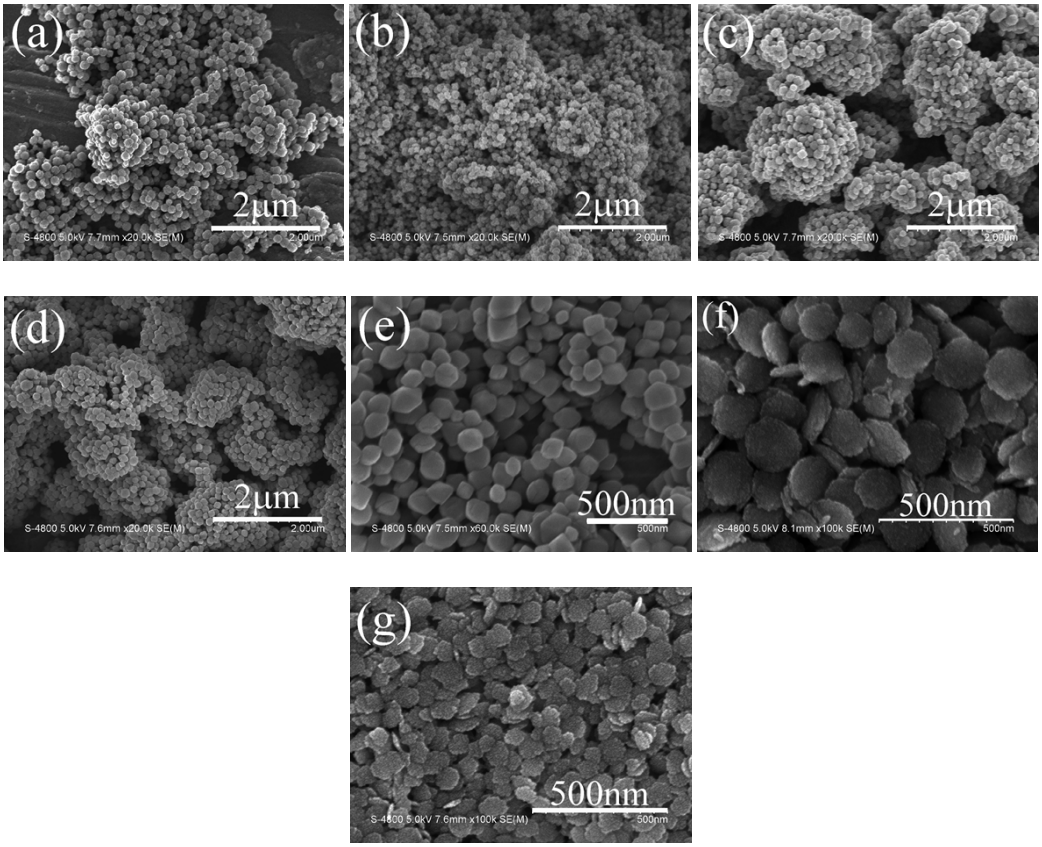

Fig. S5 SEM images of the samples obtained at different polyols of (a) EG, (b) DPE, (c) NPA, (d) PEG-200, (e) without polyol, (f) with glycerin/H_2O=2:38 (v/v), and (g) with glycerin/H_2O=5:35 (v/v), respectively, when keeping other conditions constant.

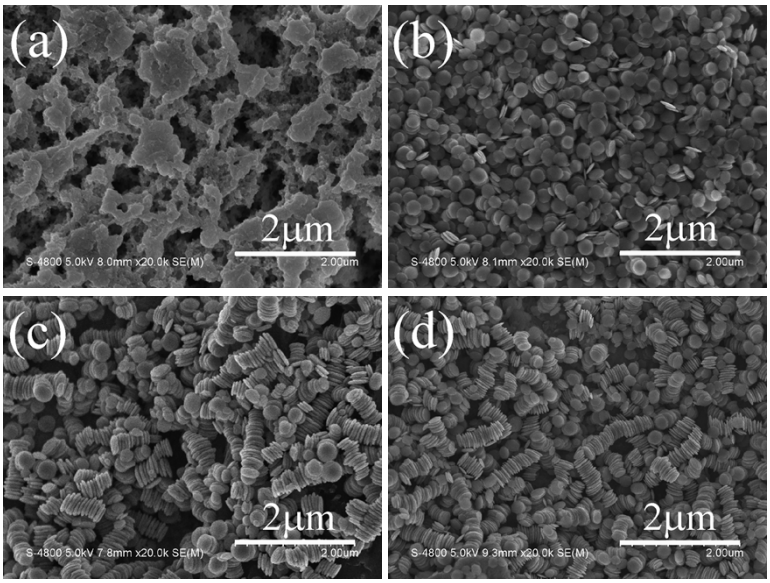

Fig. S6 SEM images of the α-Fe_2O_3 crystals obtained at 140 °C with different reaction times of (a) 2, (b) 5, (c) 10, and (d) 20 h, respectively.

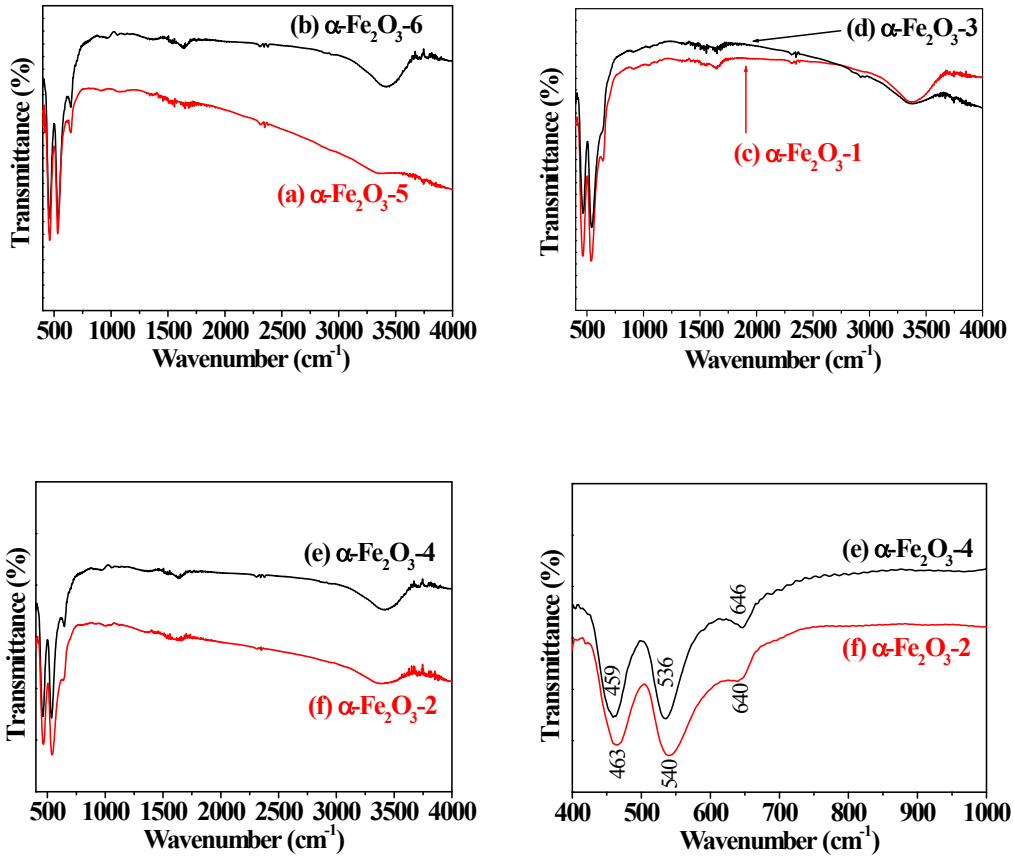

Fig. S7 FT-IR spectra of α-Fe_2O_3 crystals: (a) α-Fe_2O_3-5, (b) α-Fe_2O_3-6, (c) α-Fe_2O_3-1, (d) α-Fe_2O_3-3, (e) α-Fe_2O_3-4, and (f) α-Fe_2O_3-2.

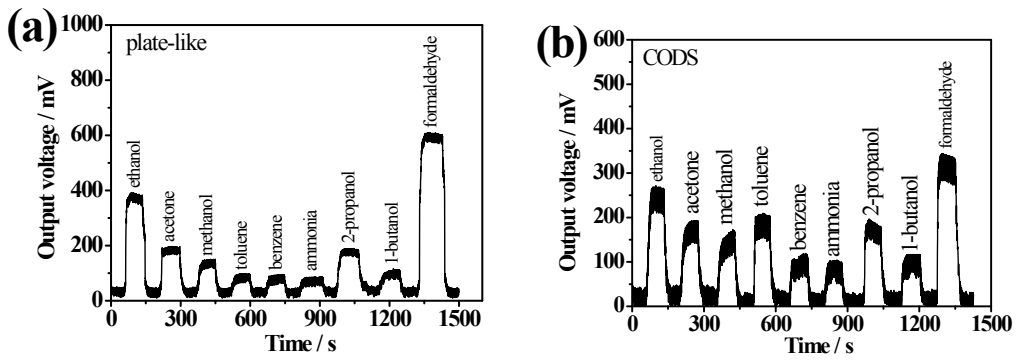

Fig. S8 Responses of the (a) plate-like α-Fe_2O_3 (α-Fe_2O_3-4) and (b) CODS α-Fe_2O_3 (α-Fe_2O_3-2) sensors upon exposure to nine kinds of organic vapors (100 ppm) at a working temperature of 280 °C, respectively.