Supporting Information for

CO_2-assisted template synthesis of porous hollow bi-phased γ-/α-Fe_2O_3 nanoparticles with high sensor property

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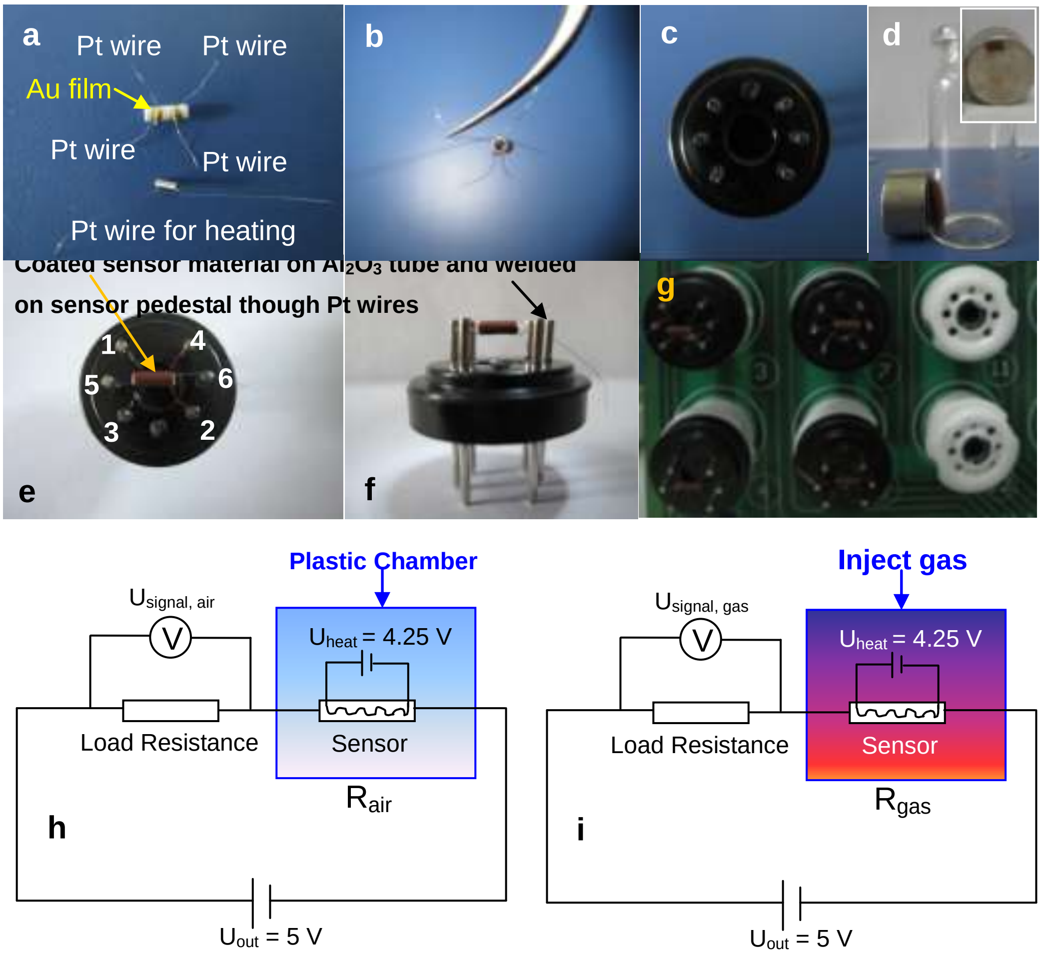

Fig. S2 (a) Structure of Al_2O_3 tube and different Pt wires used for connection or heating. (b) Pt wire pass through the Al_2O_3 tubes for heating. (c) Sensor pedestal. (d) Primary sensor material of hollow γ-/α-Fe_2O_3 nanoparticles with magnetic properties. (e, f) As prepared sensor device. The ports of 1, 2, 3, 4 were used to connect with circuit for test, the ports of 5, 6 were used to connect with heating electric power (U_{heat}). (g) The situation and connection of sensor device during the test. (h, i) Working principle and procedure of sensor test. The procedure is as follows:

(I) Set a working voltage (*e.g.*, 5V) and a suitable Load Resistance (R_{load}) to make the $U_{signal,\ air}$ around 0~0.2 V. The resistance of sensor in air represents R_{air}, which was calculated from the equation of R_{air} = $(U_{out}-U_{signal,air})/R_{load}$.

(II) Inject a certain amount of gas into the chamber or *in-situ* evaporate the liquid (*e.g.*,ethanol) in plastic chamber to mix with air homogeneously.

(III) Collect the information of $U_{signal,\ gas}$, and calculate the value of R_{gas} $=(U_{out}-U_{signal,\ gas})/R_{load}$

(IV) Estimate the sensitivity of sensor through the equation of Sensitivity = R_{air}/R_{gas}

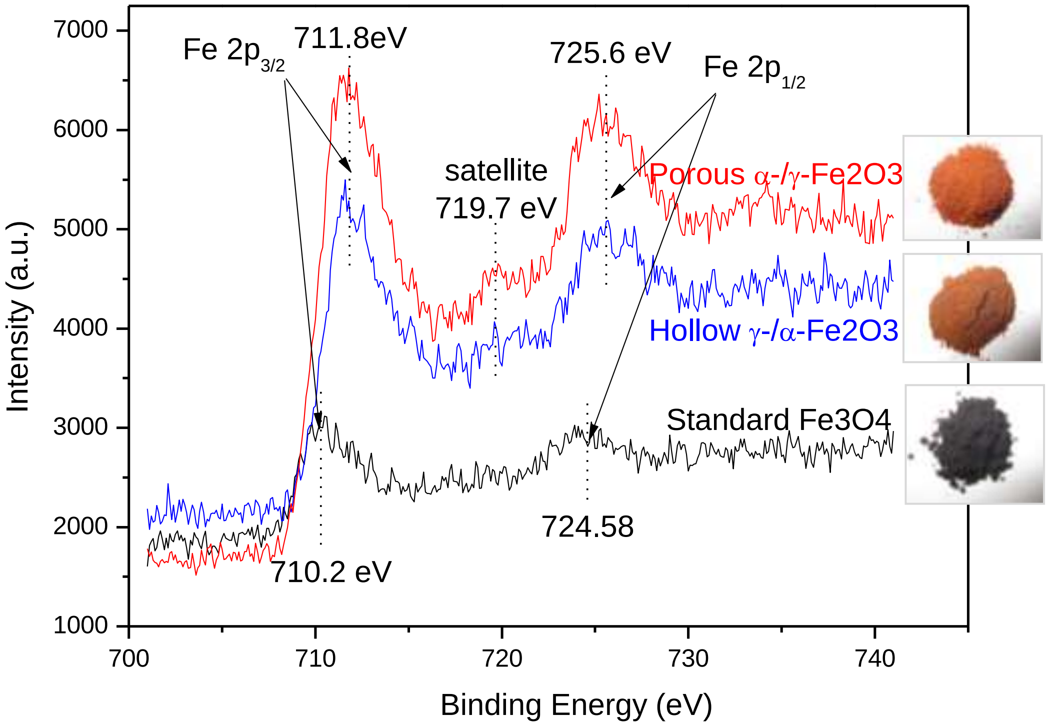

Fig. S2 XPS spectrum of standard magnetite Fe_3O_4 powders, hollow γ-/α-Fe_2O_3 nanoparticles and porous α-/γ-Fe_2O_3.

As shown in Fig. S2, it is clear that the obtained materials are the Fe_2O_3 not the magnetite Fe_3O_4, because they showed higher binding energy of Fe $2p_{3/2}$ (711.8 eV) and Fe $2p_{1/2}$ (725.6 eV) than that of standard magnetite Fe_3O_4 (Fe $2p_{3/2}$, 710.2 eV; Fe $2p_{1/2}$, 724.58 eV) due to the existence of Fe^{2+} ions in Fe_3O_4.[S1-S3] Moreover, the satellite peak of Fe $2p_{3/2}$ at 719.7 eV is distinguishable for the samples and is absent for the magnetite Fe_3O_4, further demonstrating they are Fe_2O_3 not the Fe_3O_4.[S1-S3] Visually, the colors of the sample also confirmed that they are red Fe_2O_3 not the black Fe_3O_4.

References:

S1 T. Yamashita and P. Hayes, *Appl. Surf. Sci.*, 2008, **254**, 2441.

S2 H. Kong, J. Song and J. Jang, *Chem. Commun.*, 2010, **46**, 6735.

S3 T. Fujii, F. M. F. de Groot, G. A. Sawatzky, F. C. Voogt, T. Hibma and K. Okada, *Phys. Rev. B.*, 1999, **59**, 3195.

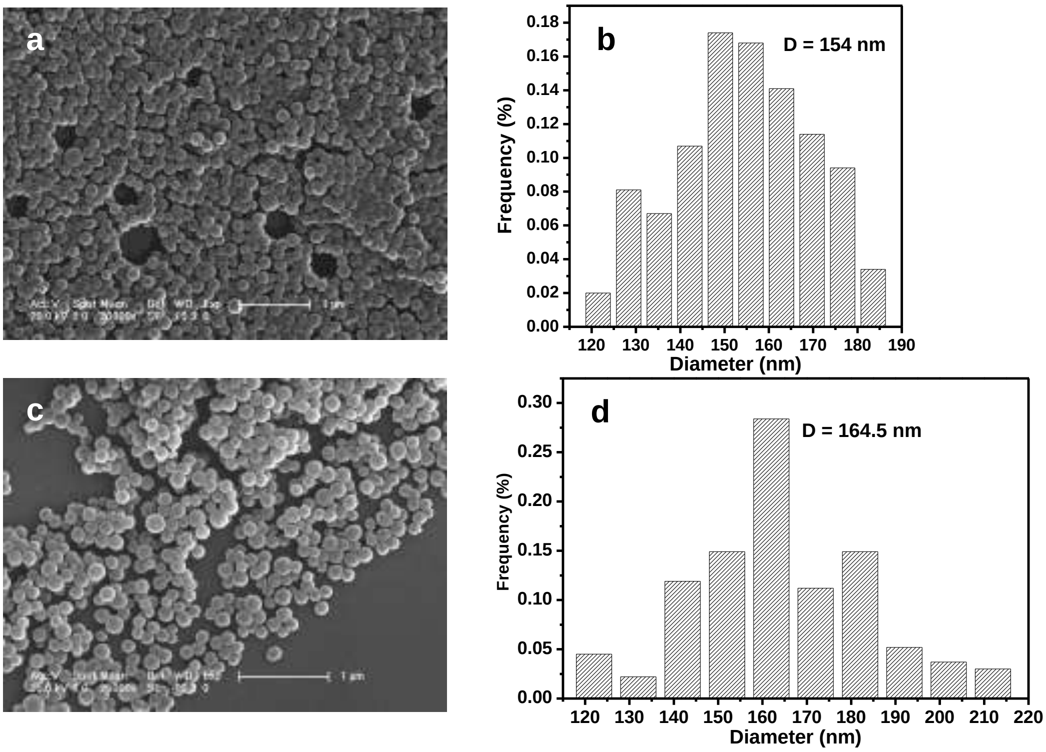

Fig. S3 FESEM images and size distribution of carbon cores (a, b) and core-shell structured C@Fe-salt particles (c,d).

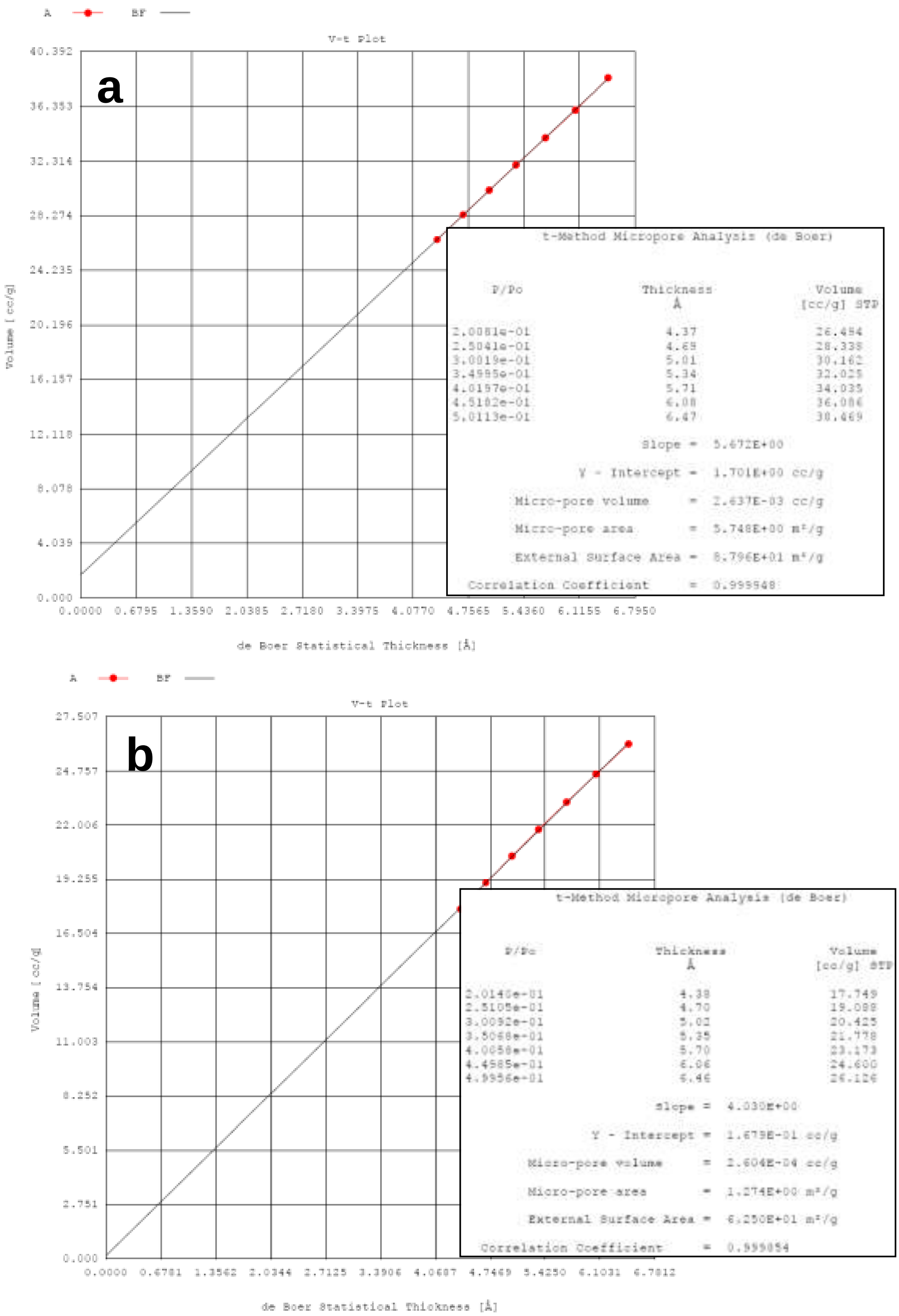

Fig. S4 The micropore volume of hollow γ-/α-Fe_2O_3 nanoparticles (a) and porous γ-/α-Fe_2O_3 (b) calculated with using t-Method Micropore Analysis.