Large-Scale Fabrication and Application of Magnetite Coated Ag NWs-Core Water-Dispersible Hybrid Nanomaterials

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Preparation of Ag NWs.

Ag NWs were synthesized according to the method reported previously. First, 2.93 g of PVP (K30) and 95 mL of glycerol were added into the flask. The composites were heated at 90°C, when the PVP fully dissolved and the solution was cooled down to 50°C. Then, 0.79 g $AgNO_3$ powder was added. Subsequently, a solution containing 5 mL of glycerol, 29.5 mg of NaCl and 0.25 mL of H_2O was added into the above solution and the solution temperature was raised from 50°C to 210°C in 25 min under gentle stirring (70 rpm). When the solution temperature reached 210°C, the heating was stopped and the obtained gray-green solution was transfer immediately into a beaker. When the solution temperature returned to room temperature 100 mL deionized water was added. After stabilized for one week, upper layer solution was poured out to remove silver nanoparticles (Ag NPs) and a layer of sediment at the bottom of the beaker was collected and washed with ethanol three times to remove the rest PVP, and the Ag NWs were collected and dispersed into an aqueous solution of 10 mg/mL.

PZS coated Magnetic silver nanowires

The PZS coated magnetic silver nanowires nanostructures were prepared as follows. 10 mL of the Ag NWs/Fe_3O_4 ethanol solution were concentrated by centrifugal and washed with acetonitrile. Then the above composites was dispersed in a mixture with 60 mL of acetonitrile and 2 mL of TEA under ultrasonic irradiation for 5 min. Subsequently, HCCP (0.135 g) and DDE (0.189 g) were added the mixture above. And the above reaction was carried out at 60 °C for 10 h to obtain amine-terminated magnetic Ag NWs. The resulting product was collected via a magnet and washed with ethanol and deionized water 3 times. Finally, the composites was dried in a vacuum at 45°C for 24 h.

PFR coated Magnetic silver nanowires

The PFR coated magnetic silver nanowires were prepared by a surfactant-assistant sol–gel coating method. Briefly,

10 mL of the Ag NWs/Fe_3O_4 ethanol solution were dispersed in the mixture of 60 mL deionized water and 15mL ethanol by ultrasonication. Followed by the addition of 50 mg CTAB, the mixed solution was homogenized for 30 min to form a uniform dispersion. Then 21.3 mg Resorcinol and 24 μL formaldehyde were added to the dispersion with continuous ultrasonication for 10 min. After the addition of 0.4 mL ammonia solution, the above mixture was stirred at room temperature for 12 h. The resulting product was collected via a magnet and washed with deionized water and ethanol for 3 times to remove by-products. And finally the composites was dried in a vacuum at 45°C for 24 h.

PDA coated Magnetic silver nanowires

PDA coated Magnetic silver nanowires were prepared as follows. Briefly, 2 mL of the Ag NWs/Fe_3O_4 ethanol solution and 20 mg dopamine hydrochloride were dispersed in 22ml tris-HCl buffer (PH=8.5) solution, and allowed to proceed for 12 h at room temperature under stirring. The resulting product was washed with deionized water and ethanol for several times to remove by-products. And finally the composites was dried in a vacuum at 45°C for 24 h.

SiO_2 coated Magnetic silver nanowires

For coating of the silica shell on the Ag NWs/Fe_3O_4 surface, a certain amount of synthesized 2 mL of the Ag NWs/Fe_3O_4 ethanol solution were dispersed in a mixture of 38 mL ethanol, 10 mL water and 1.5 mL aqueous ammonia in a round bottomed flask. Finally, 600 uL TEOS was added slowly with gentle stirring(320 rpm) at room temperature for 10 h. The resulting product was collected via a magnet and washed with deionized water and ethanol for 3 times to remove by-products. And finally the composites was dried in a vacuum at 45°C for 24 h.

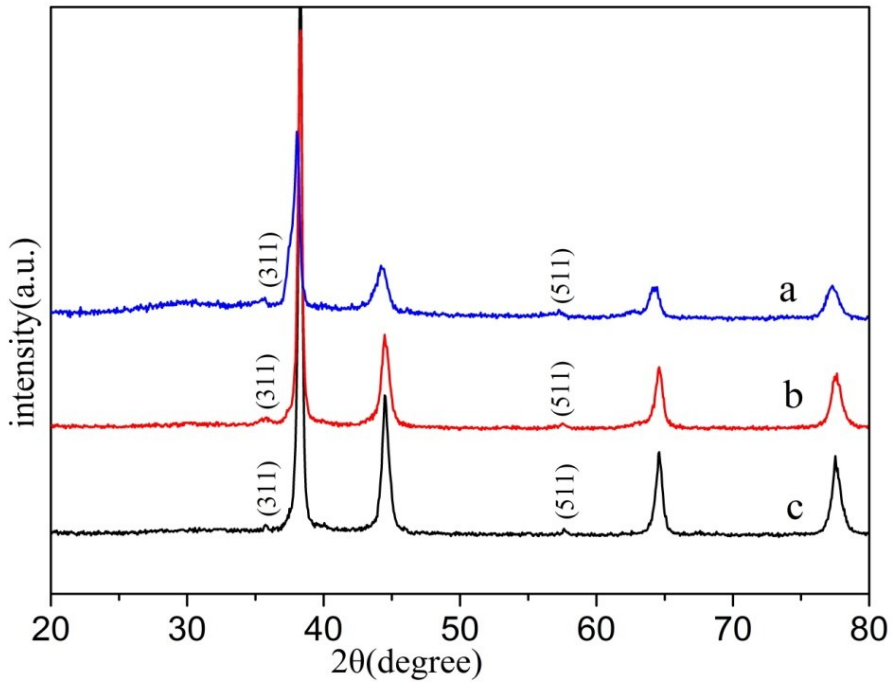

Fig. S1 The X-Ray diffraction patterns of Ag NWs/Fe_3O_4 NPs composites with different mass ratio of Ag NWs and $Fe(acac)_3$ (a) 1 : 3, (b) 2:3, (c) 2:1.

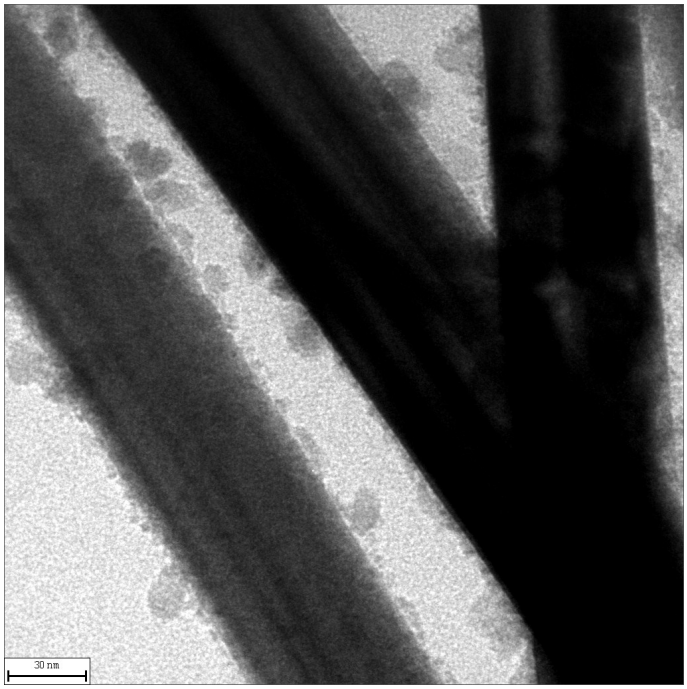

Fig. S2 The enlarged TEM images of the Ag NWs/Fe_3O_4 NPs composites (Fig. 1(c,d))

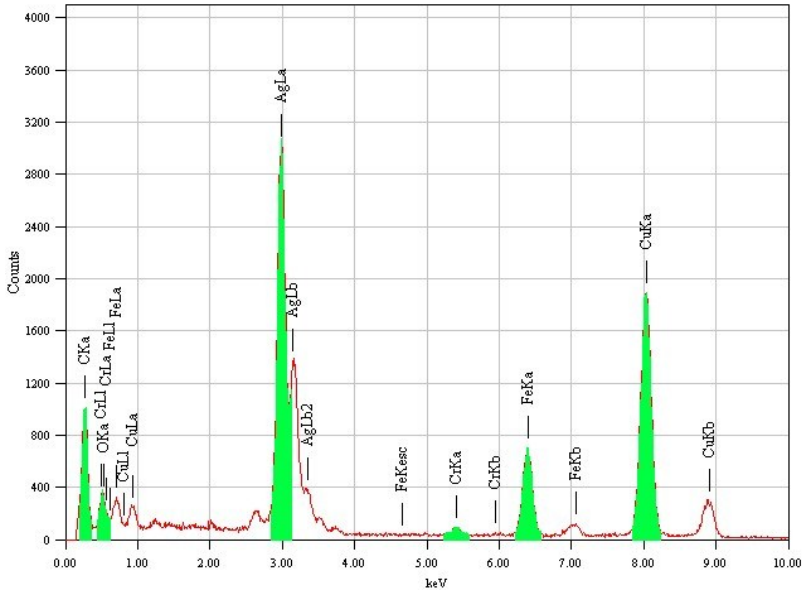

Fig. S3 Energy-disperse X-ray spectrum (EDX) taken on the selected area of the Ag NWs/Fe_3O_4 NPs composites prepared in the mass ratio to 1:2 for silver nanowire and $Fe(acac)_3$.

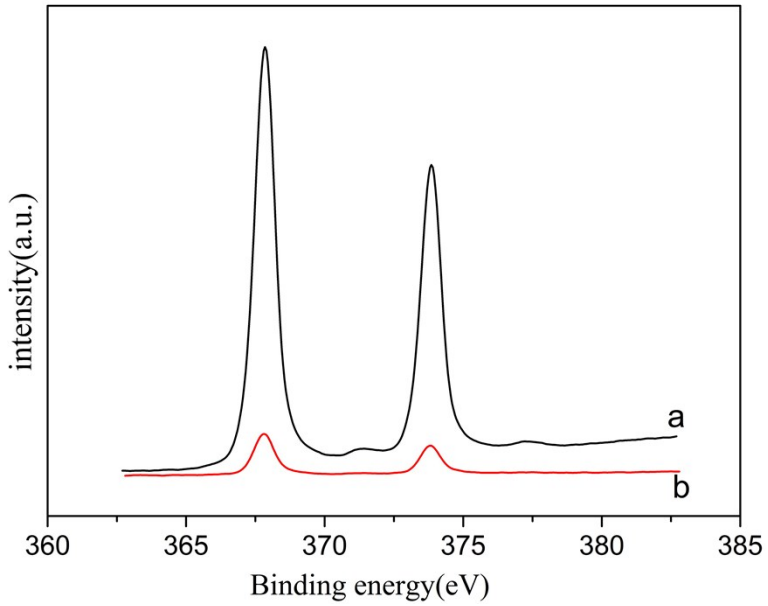

Fig. S4 The XPS spectra wide scan of the Ag 3d5/2 and Ag 3d3/2, a: Ag NWs, b: Ag NWs/Fe_3O_4 NPs composites.

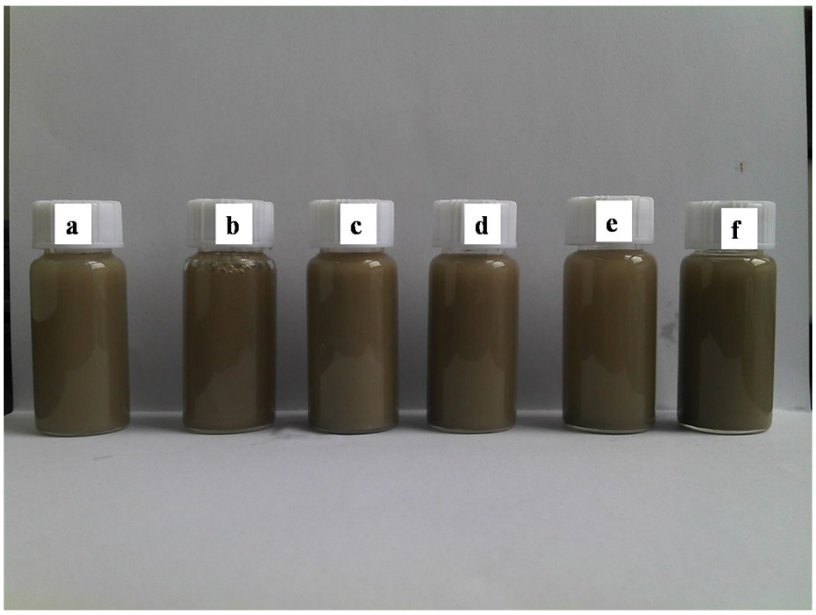

Fig. S5 The photo of Ag NWs/Fe_3O_4 NPs composites which could be dispersed in various reagents such as A: Water, B: Ethanol, C: Acetonitrile, D: THF, E: Acetone, F: DMF.

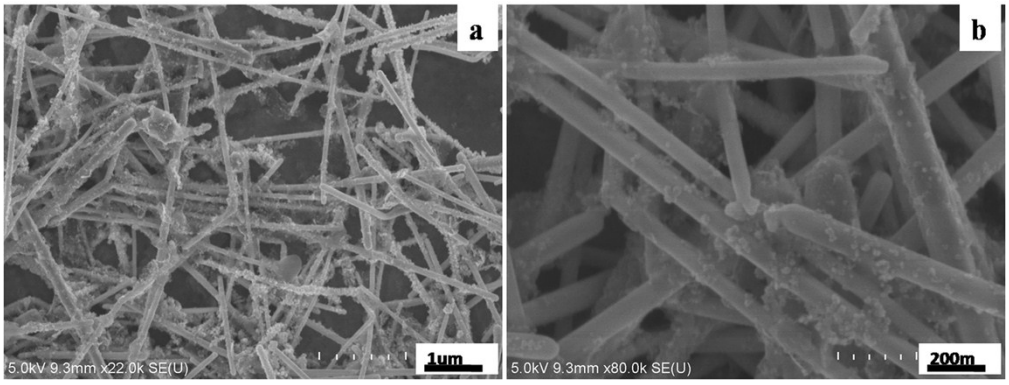

Fig. S6. SEM images of Ag NWs/Fe_3O_4 NPs composites after six recyclable experiment ((a)–(b)).

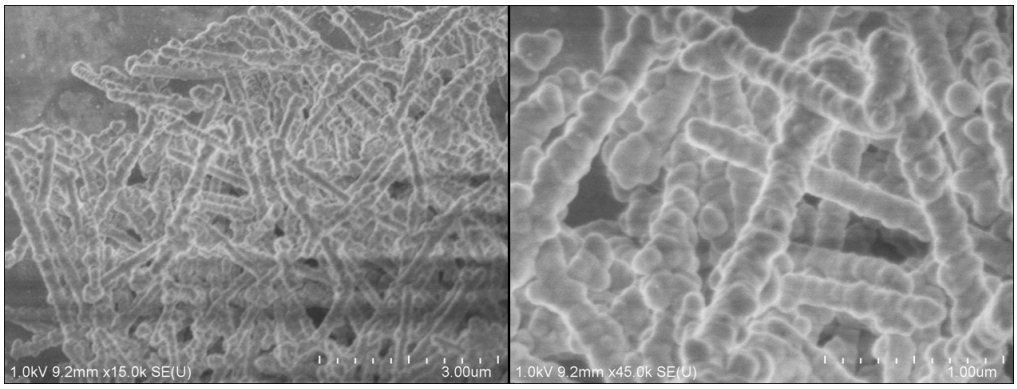

Fig. S7 The SEM images of the magnetic hollow nanotube with different magnification

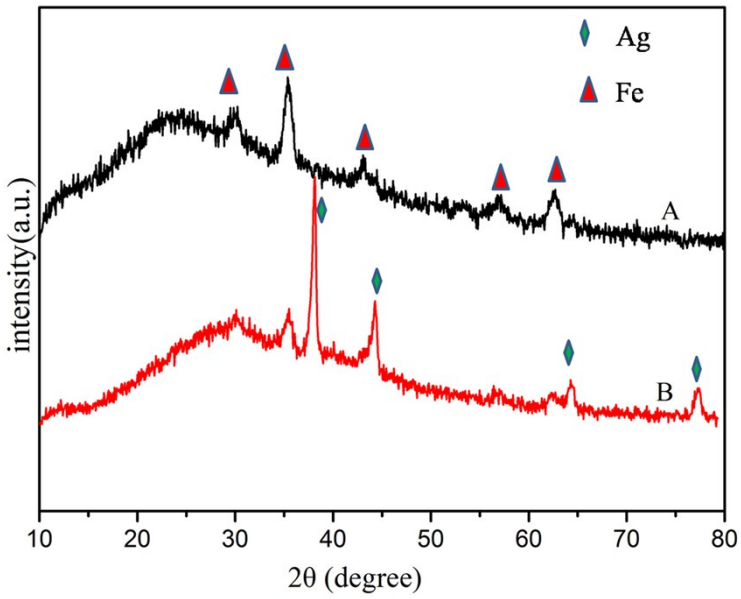

Fig. S8 X-Ray diffraction patterns of the hollow magnetic silica nanotube with different times of etching Ag NWs in ammonia and H_2O_2: (A) three days, (B)One day.