Fabrication and magnetic properties of hierarchical porous hollow nickel microspheres

Yong Wang,[ab] Qingshan Zhu*[a] and Huigang Zhang[ab]

[a] *Multiphase Reaction Laboratory, Institute of Process Engineering, Chinese Academy of Sciences, Beijing 100080, China. E-mail: qszhu@home.ipe.ac.cn; Fax: 86-10-62536108*

[b] *Graduate School of Chinese Academy of Sciences, Beijing 100039, China.*

Supplementary Information

S1. SEM images of $Ni(OH)_2$ precursor spheres

In addition to the description in the main text, this supplementary material provides the information about $Ni(OH)_2$ hollow microspheres which were fabricated via a hydrothermal approach in strong alkaline solution of glycine. Typical experiment can be summarized: 5.0 mmol of $Ni(NO_3)_2{\cdot}6H_2O$ and 2.0 g of glycine as well as 2.0 g of Na_2SO_4 salt were dissolved in 25 mL of deionized water, then 10 mL of NaOH solution (5 M) was added dropwise into the above solution under magnetic stirring to form a clear blue solution. The solution was then sealed into a Teflon-lined autoclave, followed by hydrothermal treatment at 100-180 °C for 24 h in an electric oven. After the treatment, green $Ni(OH)_2$ products were collected by filtration, successively washed three times with deionized water, and dried at room temperature for 24 h. Fig. S1 shows the typical SEM images of the $Ni(OH)_2$ precursor microspheres synthesized at 160°C for 24 h.

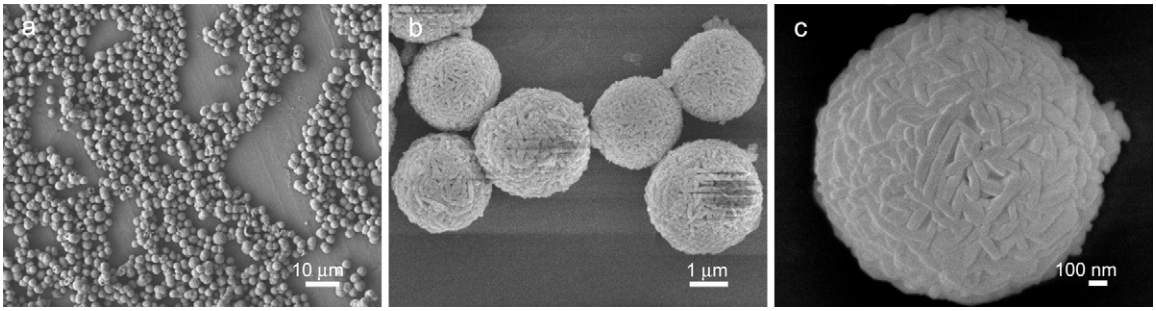

Fig. S1 (a)-(c) SEM images of $Ni(OH)_2$ precursor microspheres observed under different magnifications.

S2. Individual nanoparticles that form the hierarchical hollow nickel microspheres.

In order to investigate the influence of hollow structure on magnetic properties, individual nickel nanoparticles that form the hierarchical hollow nickel microspheres can be obtained by sonication (1 h in an ultrasonic water bath). Fig. S2a-b and S2c show the typical FESEM image of the nickel nanoparticles and its corresponding XRD pattern respectively. As shown in Fig. S2a-b, no hierarchical microspheres are observed, indicating that hierarchical nickel microspheres are mostly broken into individual nanoparticles. In Fig. S2c, the nanoparticles are identified as the single-phase nickel with face-centered cubic (fcc) structure (a=0.35238 nm, JCPDS file No. 04-0850), and no peaks from other phases are found.

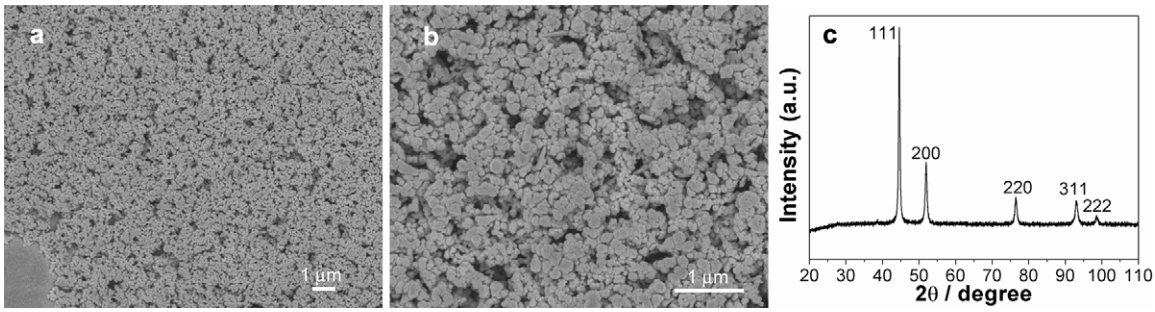

Fig. S2 (a)-(b) FESEM of the Ni nanoparticles, obtained by sonication, as the formed building units of hollow microspheres under different magnifications; (c) XRD pattern of the Ni nanoparticles.