Chrysanthemum-like α-FeOOH microspheres produced by a simple green method and its outstanding ability in heavy metal ions removal

Hui Li,[a,b] Wei Li,[a,b] Yanjun Zhang,[a,b] Taishan Wang,[a,b] Bao Wang,[a,b] Wei Xu,[a,b] Li Jiang,[a] Weiguo Song,[a] Chunying Shu*[a] and Chunru Wang*[a]

[a]*Beijing National Laboratory for Molecular Sciences, Institute of Chemistry, Chinese Academy of Sciences, Beijing 100190, E-mail: crwang@iccas.ac.cn, shucy@iccas.ac.cn.*
[b]*Graduate School of Chinese Academy of Sciences, Beijing 100039, China*
Tel/Fax: 86-10-62652120
E-mail: crwang@iccas.ac.cn

Received (in XXX, XXX) Xth XXXXXXXXX 200X, Accepted Xth XXXXXXXXX 200X
First published on the web Xth XXXXXXXXX 200X
DOI: 10.1039/b000000x

Fig. S1 The photograph of the as-obtained chrysanthemum-like α-FeOOH nanomaterials.

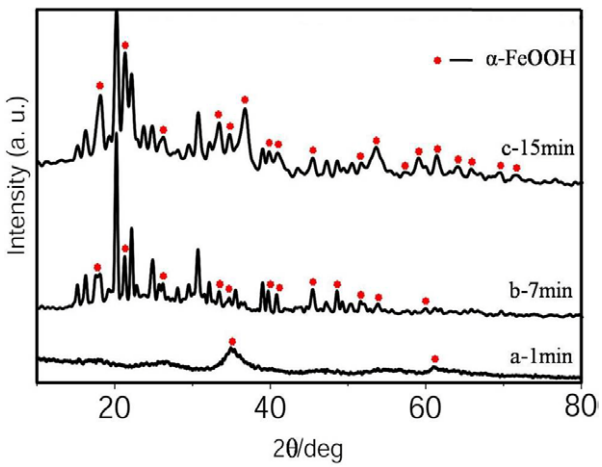

Fig. S2 XRD patterns of the intermediate products obtained at different reaction times after the reaction mixture just became cloudy a) 1min b) 7 min, c) 15 min.

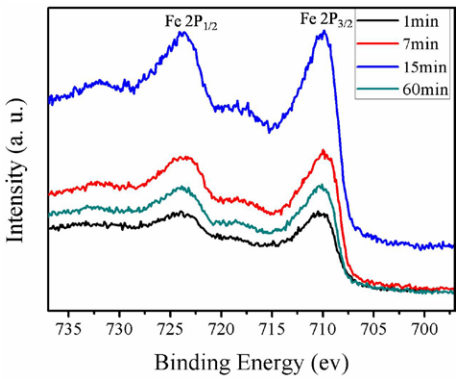

Fig. S3 The high-resolution XPS spectra of Fe element in the samples collected at different time. The centroids of Fe 2p3/2 peaks are located at ca. 711 eV (α-FeOOH) and the centroids of Fe 2p1/2 peaks are located ca. 724 eV (α-FeOOH).

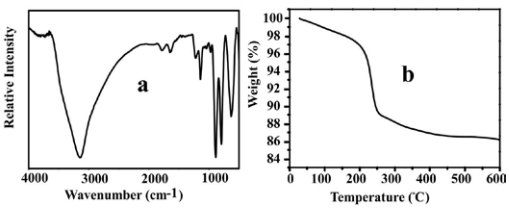

Fig. S4 The FTIR spectrum (a): the wide and strong vibration of OH at 3147 cm^{-1}, and a weak of H_2O vibration at 1653 cm^{-1} and the characteristic strong vibration peak of FeOOH at 1120 cm^{-1}, 894 cm^{-1}, 797 cm^{-1}, 629 cm^{-1} and the TGA curve (b) of the as-prepared chrysanthemum-like α-FeOOH. The TGA data was investigated at air atmosphere with a heating rate of 10 ^{o}C/min.

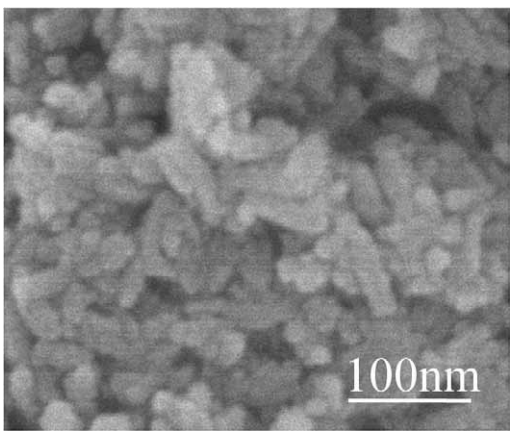

Fig. S5 The SEM image of the product obtained when water as the only solvent.

Assistant experiment :

Experiment 1 : 10 g of $FeSO_4 \cdot 7H_2O$ was dissolved in 40 mL of deionized water and then was stirred at room temperature for 20 minutes, subsequently the solution was refluxed at 100 ^{o}C under air atmosphere. After about 7minutes the reaction completed, and the morphology of the product is shown in Fig. S5. The result shows some ruless short nanorods congeries and nanoparticles.

Experiment 2 : Slow oxidation and hydrolysis of ferrous ions under the protection of EG---10 g of $FeSO_4 \cdot 7H_2O$ was dissolved in 40 mL of deionized water followed by the addition of 10 mL of EG. The resulting solution was stirred for 20 minutes at room temperature, and then was refluxed at 100 ^{o}C under air atmosphere for 60 minutes. After about 40minutes, the reaction solution was centrifugated, and then NaOH was added into the upper supernatant; we found that only white precipitation formed immediately. The result demonstrates that even after 40minutes reaction the valence state of irons remaining in the solution is still the second price. If deionized water as the only solvent, the result is that all the ferrous ions could be oxidized and hydrolyzed in about 7minutes.

Experiment 3: water treatment experiment------solutions containing different concentrations of As (V) (10, 20, 50, 100, 200, 500, 1000, 1500 mg/L) and Pb (II) (10, 20, 50, 100, 200, 500, 1000 mg/L) were prepared using $Na_2HAsO_4 \cdot 7H_2O$ and Pb $(NO_3)_2$ as the sources of heavy metal ions, respectively. To obtain the adsorption isotherms, 15 mg of the chrysanthemum-like α-FeOOH was added to the above solution under stirring at room temperature. After the specified time, the solid and liquid were separated immediately and inductively coupled plasma-optical emission spectroscopy (Shimazu ICPE-9000) was used to measure the concentration of metal ions in the remaining solution.