Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Rapid Fabrication of Hollow and Yolk-shell α-Fe_2O_3 Particles with Applications to Enhanced Photo-Fenton Reactions

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S1. The photo-Fenton reactions on Fe_2O_3 hollow microspheres and Fe_2O_3 yolk-shell microspheres, with evolution of pH during reaction.

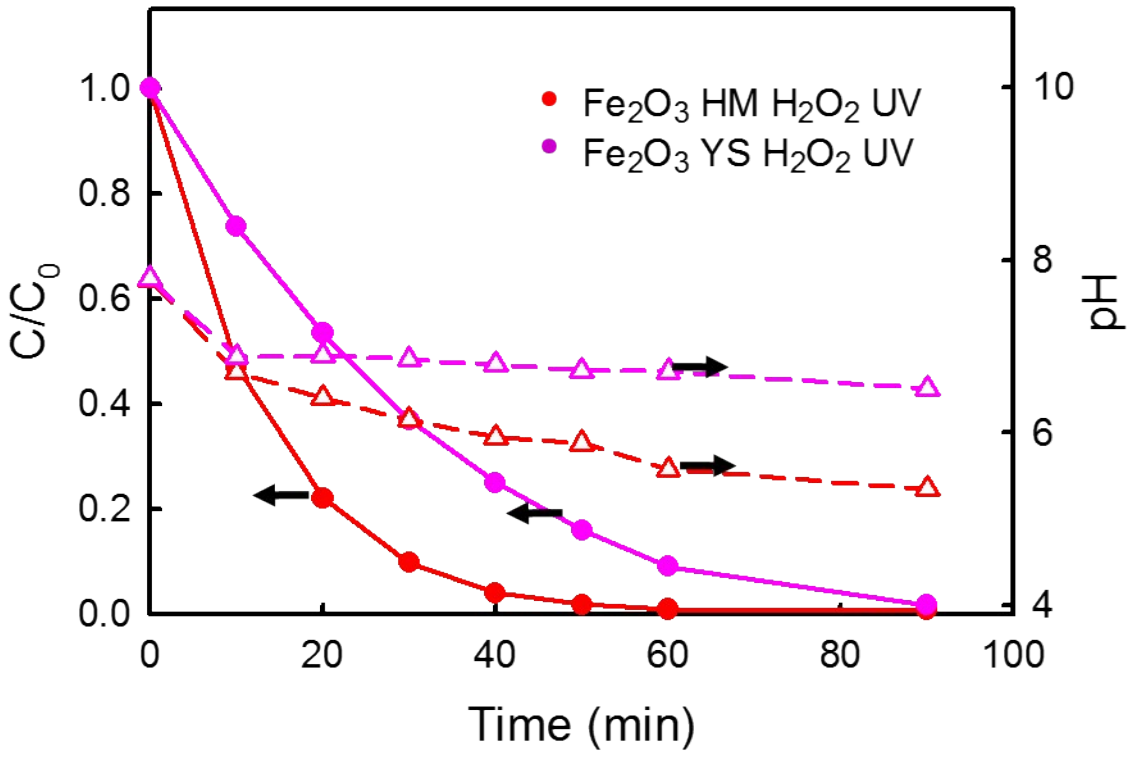

Fig. S1. Curves of photo-catalytical reactions on H_2O_2+Fe_2O_3 hollow microspheres (HM)+UV (red), and H_2O_2+Fe_2O_3 yolk shell (YS) microspheres+UV systems (pink), and the corresponding pH during the photocatalytic reactions.

The pH changes were monitored throughout the photo-Fenton reaction. All the experiments started with pH at 7.8 prior to the addition of the heterogeneous catalyst. The pH decreases from 7.8 at the start of the reaction to about 5.4 at the end of reaction due to acidic reaction intermediates and the final evolution of CO_2 and H_2O. [1]

S2. Measurement of ·OH radicals generated during the photo-Fenton reaction with Fe_2O_3 hollow microspheres as catalysts.

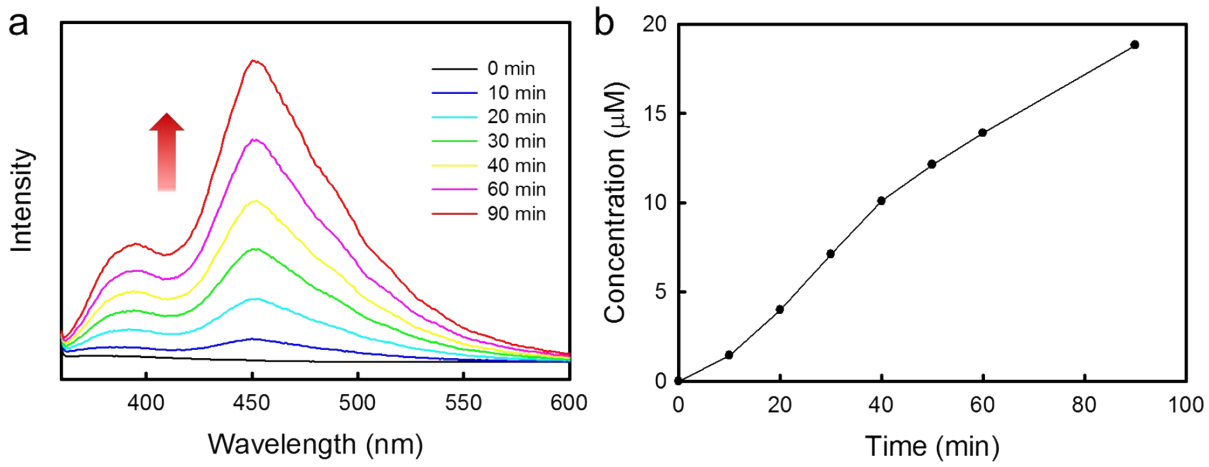

Fig. S2. (a) Fluorescence spectral changes during the irradiation of the Fe_2O_3 hollow microspheres in 10^{-3} M coumarin solution. (b) ·OH radicals generated during the irradiation of the Fe_2O_3 hollow microspheres in 10^{-3} M coumarin solution.

The ·OH produced during the photo-Fenton reaction was monitored using coumarin as a scavenger. [2, 3] Coumarin is a non-fluorescent molecule, which reacts with ·OH to form the highly fluorescent molecule 7-hydroxycoumarin. The measurement was done in the same manner as the degradation of MB through photo-Fenton with Fe_2O_3 microspheres, except that MB solution was replaced by 10 ml 10^{-3} M coumarin solution.[2] Aliquots taken at different times were centrifuged, and the supernatant was diluted twice with ethanol. The fluorescence spectra of 7-hydroxycoumarin were obtained on a PTI Felix 32 MD-5020 spectrofluorimeter with an excitation wavelength of 332 nm. The concentration of ·OH produced in the system was calculated from a calibration curve generated by 7-hydroxycoumarin standard solutions at different concentrations.

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Fig. S2a shows the changes of fluorescence spectra from suspension of Fe_2O_3 hollow microspheres with 10^{-3} M coumarin under UV irradiation. Fig. S2b shows the rate of production of ·OH over a 90-minute reaction period.

S3. XPS survey spectrum of SiO_2@Fe_2O_3 microspheres.

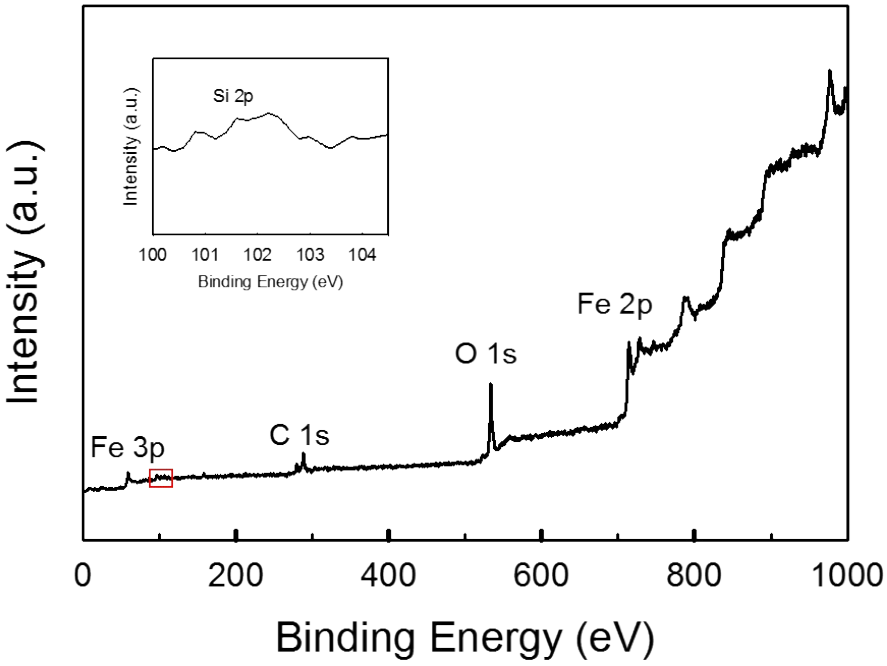

Fig. S3. XPS survey spectrum of SiO_2@Fe_2O_3 microspheres. The inset shows the weak peak of Si 2p.

XPS characterization of the particle surface is shown in Figure S3 to provide additional evidence of the encapsulation of SiO_2 in the SiO_2@Fe_2O_3 yolk-shell microsphere. The experiment was done on a VG Scientific MKII system using an Al Kα anode as excitation source (hν = 1486.6 eV). The pressure in the chamber during analysis was $<5\times10^{-8}$ mbar. Fig. S3 shows that the Si signal is very weak, indicating the encapsulation of SiO_2 nanoparticles within the Fe_2O_3 shell.

References

1 Q. Wang, S. Tian and P. Ning, *Ind Eng Chem Res*, 2014, **53**, 643-649.

2 Q. Xiang, J. Yu and P. K. Wong, *J Colloid Interface Sci*, 2011, **357**, 163-167.

3 H. Czili and A. Horváth, *Appl Catal B*, 2008, **81**, 295-302.