Electronic Supplementary Material (ESI) for RSC Advances.

# Supporting Information

# Removal of arsenic(V) from aqueous solutions using sulfur-doped $Fe_3O_4$ nanoparticles

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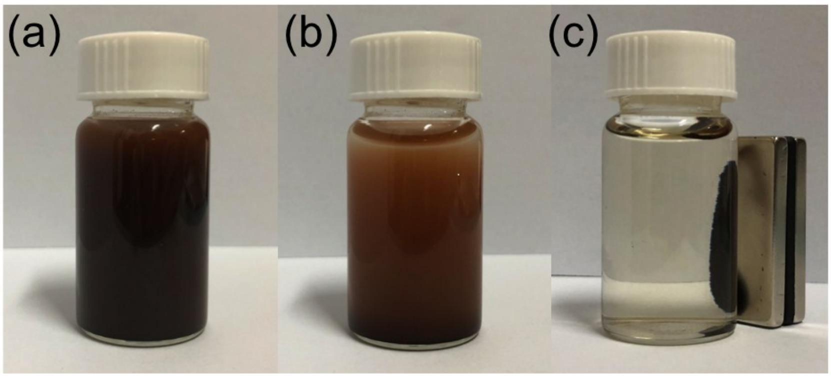

**Fig. S1** (a) Adsorbent dispersed in aqueous solution; (b) Adsorbent naturally precipitated for 30 min; (c) Adsorbent separated with permanent magnet within 1 min.

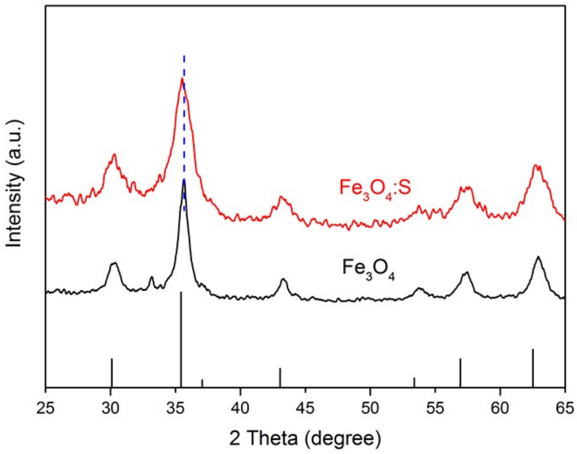

**Fig. S2** XRD patterns of the prepared $Fe_3O_4$ NPs and $Fe_3O_4$:S NPs.

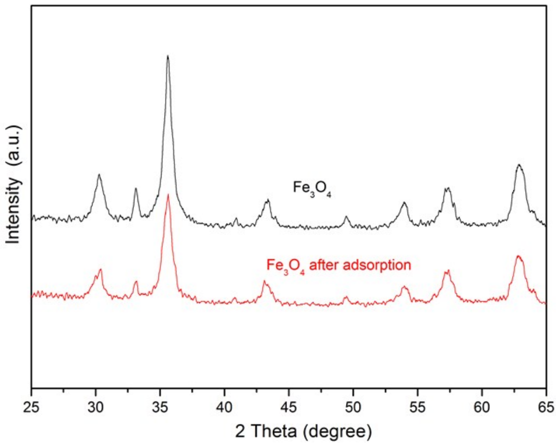

**Fig. S3** XRD spectra of $Fe_3O_4$ NPs before and after As(V) adsorption.

As shown in Fig. S3, the characteristic diffraction peaks of prepared nanoparticles at 30.28°, 35.60°, 43.38°, 53.94°, 57.40°, and 62.86° matched well with the (220), (311), (400), (422), (511), and (440) lattice planes of the standard magnetite $Fe_3O_4$ (JCPDS 19-0629), respectively. It proved that $Fe_3O_4$ NPs were successfully prepared and well crystallized. Compared with the $Fe_3O_4$ NPs before adsorption, it was clear that there was not any shift of characteristic peaks and no new peak occurred after As(V) adsorption, which meant the well crystallized $Fe_3O_4$ nanoparticles were stable in the As(V) removal process.

The comparison of XRD spectra of $Fe_3O_4$ NPs and $Fe_3O_4$:S NPs was shown in Fig. S2. It was notable that the characteristic peaks of $Fe_3O_4$:S NPs shifted to smaller angles compared with $Fe_3O_4$ NPs, which might attribute to the doping of sulfur.[1,2]

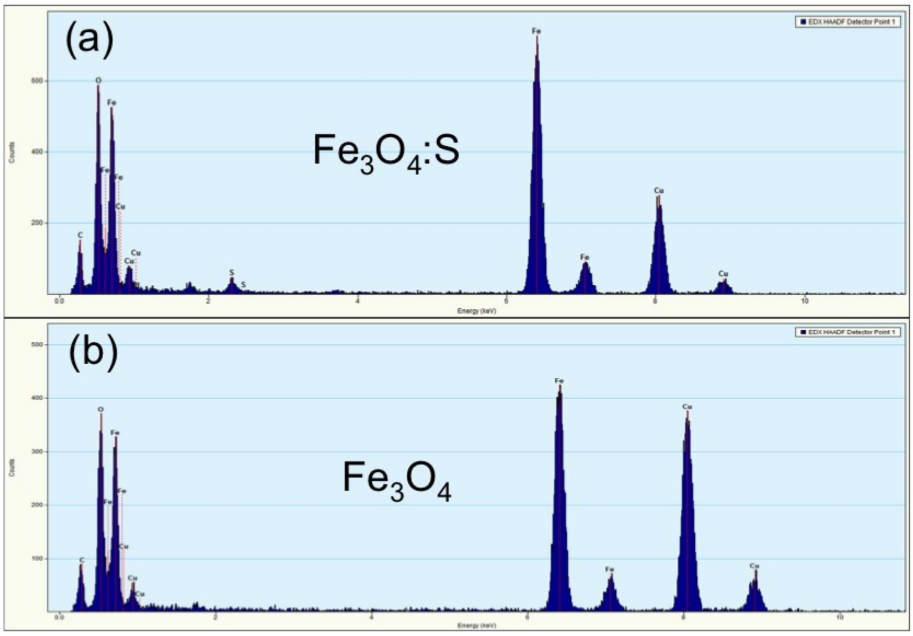

**Fig. S4** EDX patterns of $Fe_3O_4$ NPs and $Fe_3O_4$:S NPs.

As shown in Fig. S4, sulfur had successfully doped into $Fe_3O_4$ NPs, since we could observe the peaks of sulfur in the EDX pattern of $Fe_3O_4$:S NPs.

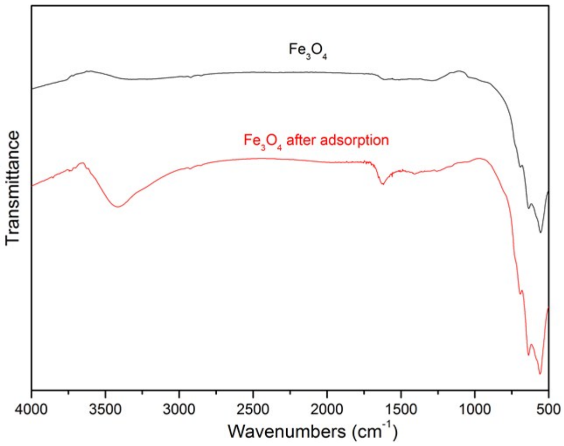

**Fig. S5** FTIR spectra of $Fe_3O_4$ NPs before and after As(V) adsorption.

The FTIR spectra of $Fe_3O_4$ NPs before and after As(V) adsorption were shown in Fig. S5. There were only small shifts of the peaks that could be observed in the spectra. In addition, the peak corresponded to the stretching vibration of As-O at 822 cm$^{-1}$ could not be observed obviously. This might attribute to the small adsorption amount of As(V).

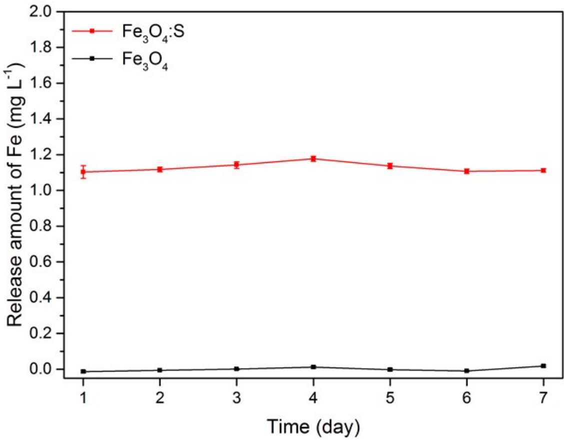

**Fig. S6** Fe releasing kinetics of $Fe_3O_4$:S NPs and $Fe_3O_4$ NPs during one week.

As shown in Fig. S6, the release amount of Fe almost maintained an equilibrium state from one day to one-week. It supported our theory that the release of Fe from $Fe_3O_4$:S NPs was from Fe-S on the surface, which is easier to break than Fe-O. Herein, $Fe_3O_4$:S NPs could release more Fe ions in water than pure $Fe_3O_4$ NPs. In addition, the stability of the adsorbent was confirmed.

## References:

[1] S. O. Hwang, C. H. Kim, Y. Myung, S. H. Park, J. Park, J. Kim, C. S. Han and J. Y. Kim, *J. Phys. Chem. C.*, 2008, **112**, 13911–13916.

[2] A. B. Patil, K. R. Patil and S. K. Pardeshi, *J. Hazard Mater.*, 2010, **183**, 315–323.