Restricted accessed nanoparticles for direct magnetic solid phase extraction of trace metal ions from human fluids followed by inductively coupled plasma mass spectrometry detection

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Supplemental Materials

Fig. S1. (a) Nitrogen adsorption-desorption isotherms. (b) Pore size distribution of prepared restricted accessed Fe_3O_4@SiO_2@PAR.

Fig. S2. Magnetic hysteresis loops of $Fe_3O_4$and restricted accessed Fe_3O_4@SiO_2@PAR.

Fig. S3. Effect of the pH on the extraction of metal ions on Fe_3O_4@SiO_2@PAR. Conditions: materials, 10 mg; sample volume, 5 mL; $C_{Cr, Cd, La, Nd, Pb}$, 10 μg L^{-1}; extraction time, 20 min.

Fig. S4. Effect of concentration of HNO_3 on the recovery of metal ions. Conditions: materials, 10 mg; sample volume, 5 mL; $C_{Cr, Cd, La, Nd, Pb}$, 10 μg L^{-1}; extraction time, 20 min; elution time, 20 min.

Fig. S5. Effect of volume of eluent on the recovery of metal ions. Conditions: materials,10 mg; sample volume, 5 mL; $C_{Cr, Cd, La, Nd, Pb}$, 10 μg L^{-1}; extraction time, 20 min ; elution time, 20 min.

Fig. S6. Effect of sample volume on the recovery of metal ions. Conditions: materials,10 mg; $M_{Cr,, Cd, La, Nd, Pb}$, 50 ng; elution volume, 500 μL; extraction time, 20 min; elution time, 20 min.

Fig. S7. Matrix effect of serum (a) and urine (b) on MSPE-ICP-MS procedure.

Sample volume, 10 mL; Eluent, 2 mol L^{-1} HNO_3. The signal intensities of La and Pb refer to the right Y axis, and the other ions refer to the left Y axis. The spiked concentration of each target ions in the original serum and urine sample are 40 ng mL^{-1} and 20 ng mL^{-1}, respectively.

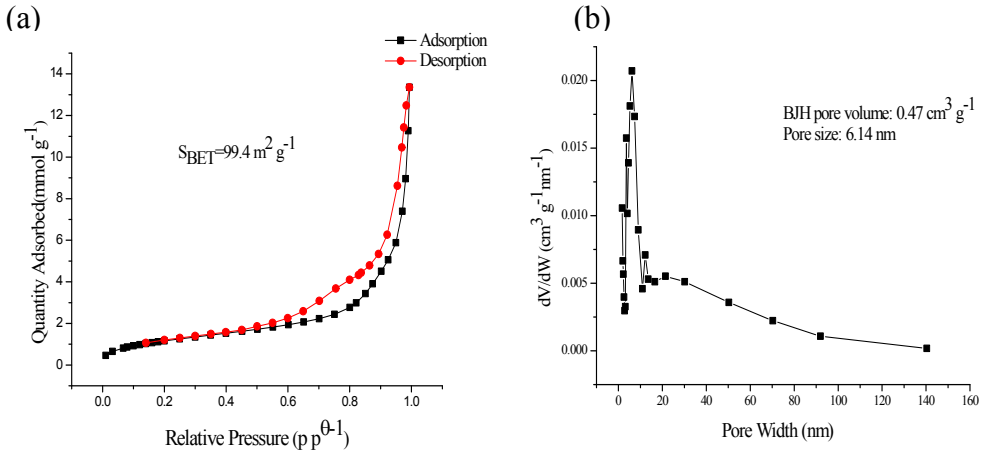
(a)
Adsorption
Desorption
S_{BET}=99.4 $m^2 g^{-1}$
Quantity Adsorbed(mmol g^{-1})
Relative Pressure (p $p^{\theta-1}$)
(b)
BJH pore volume: 0.47 $cm^3 g^{-1}$
Pore size: 6.14 nm
dV/dW ($cm^3 g^{-1} nm^{-1}$)
Pore Width (nm)

Fig. S1.

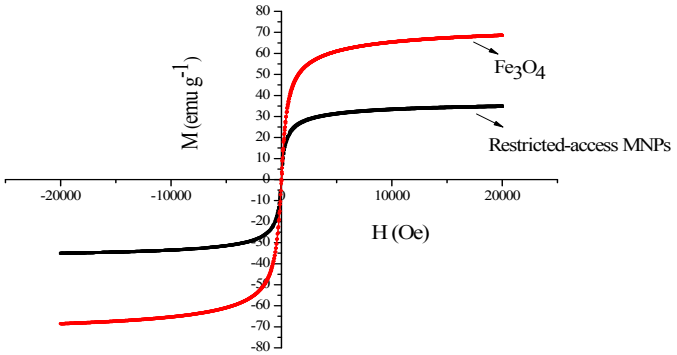
M (emu g-1)
H (Oe)
Fe3O4
Restricted-access MNPs

Fig. S2.

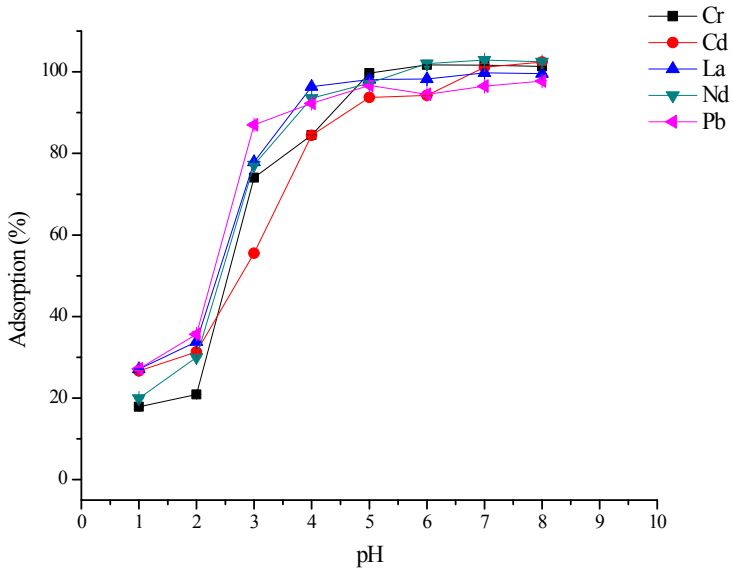
Cr
Cd
La
Nd
Pb
Adsorption (%)
pH

Fig. S3

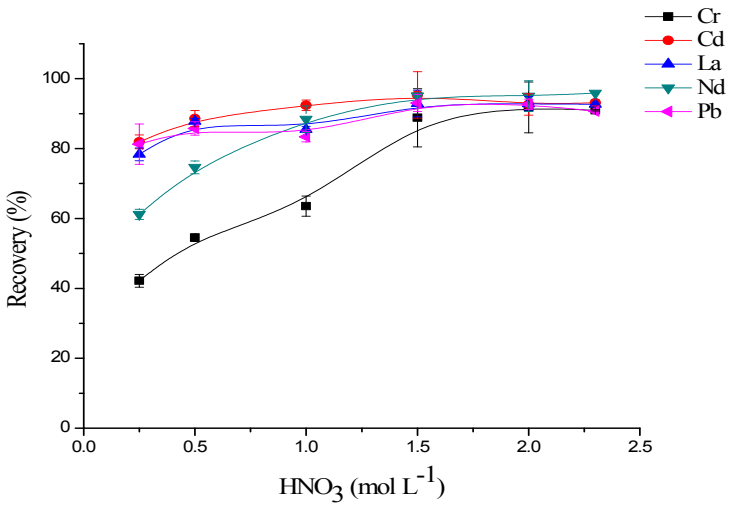
Cr
Cd
La
Nd
Pb
Recovery (%)
HNO3 (mol L-1)

Fig. S4.

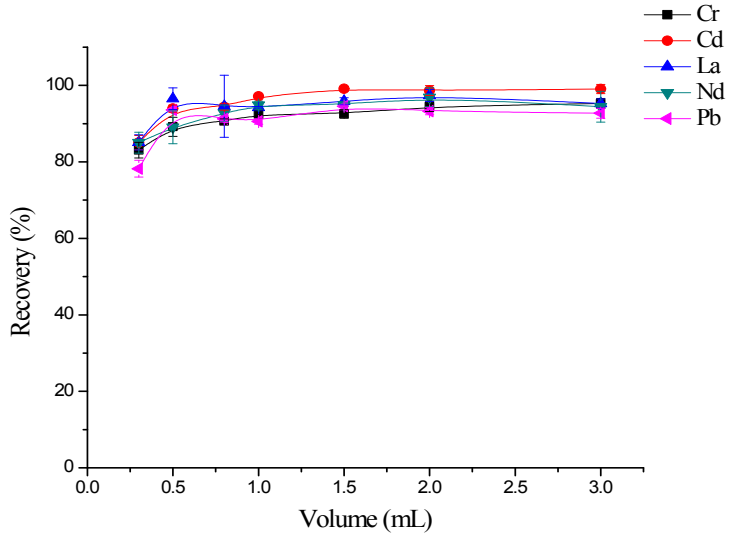
Cr
Cd
La
Nd
Pb
Recovery (%)
Volume (mL)

Fig. S5.

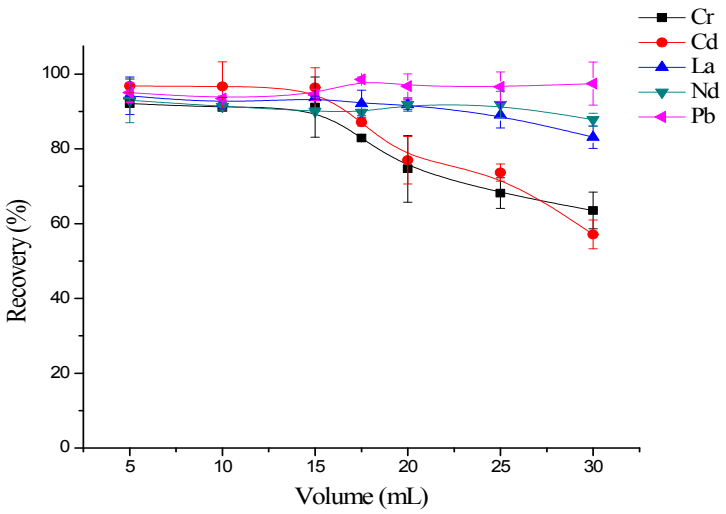

Fig. S6.

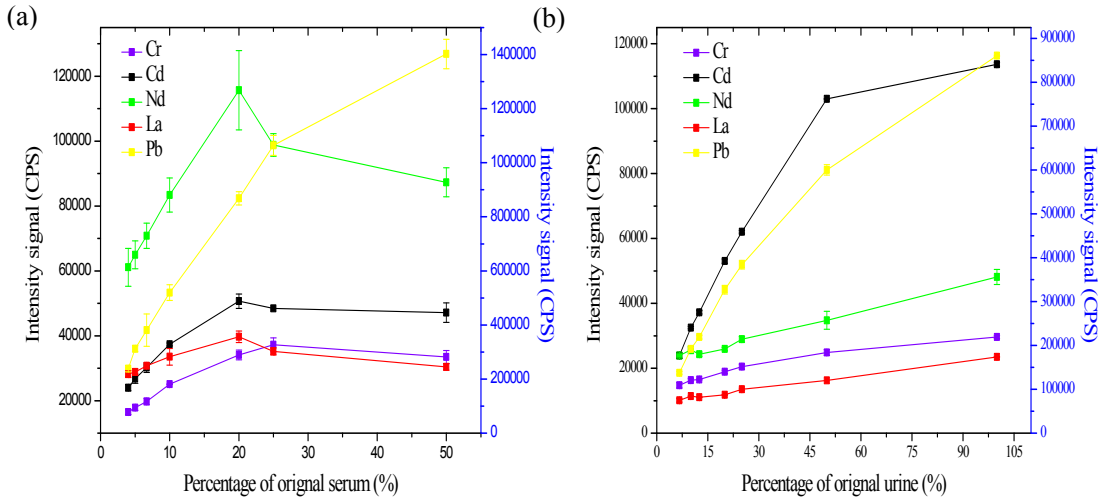
(a)
Cr
Cd
Nd
La
Pb
Intensity signal (CPS)
Intensity signal (CPS)
Percentage of orignal serum (%)
(b)
Cr
Cd
Nd
La
Pb
Intensity signal (CPS)
Intensity signal (CPS)
Percentage of orignal urine (%)

Fig. S7.