

# Supporting Information for

## Highly Selective Capture and Efficient Concentration of Trace Titanium Dioxide Nanoparticles in Environmental Waters by Phosphorylated Ferroferric Oxide

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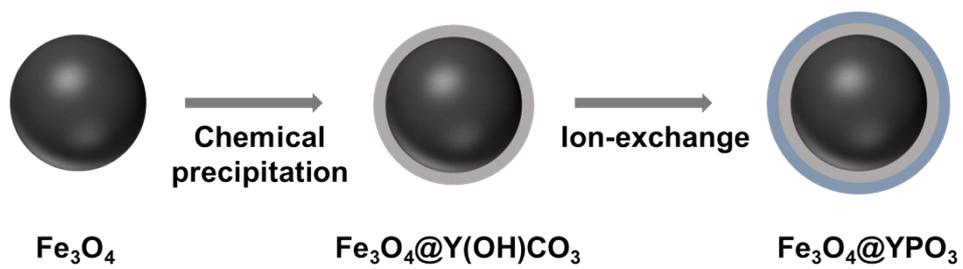
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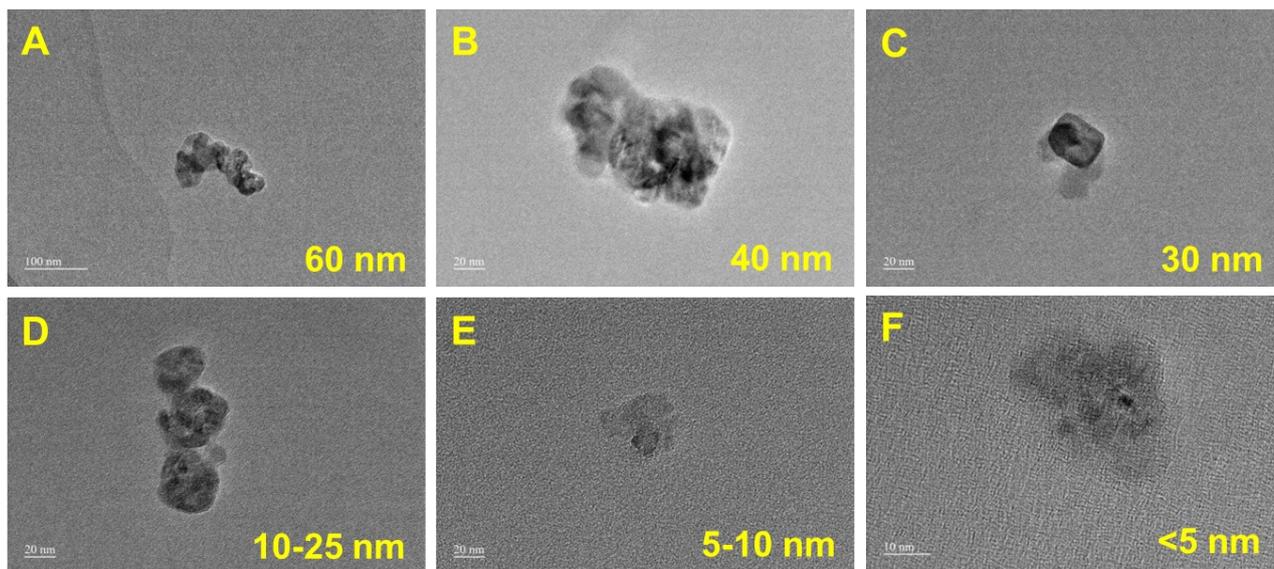
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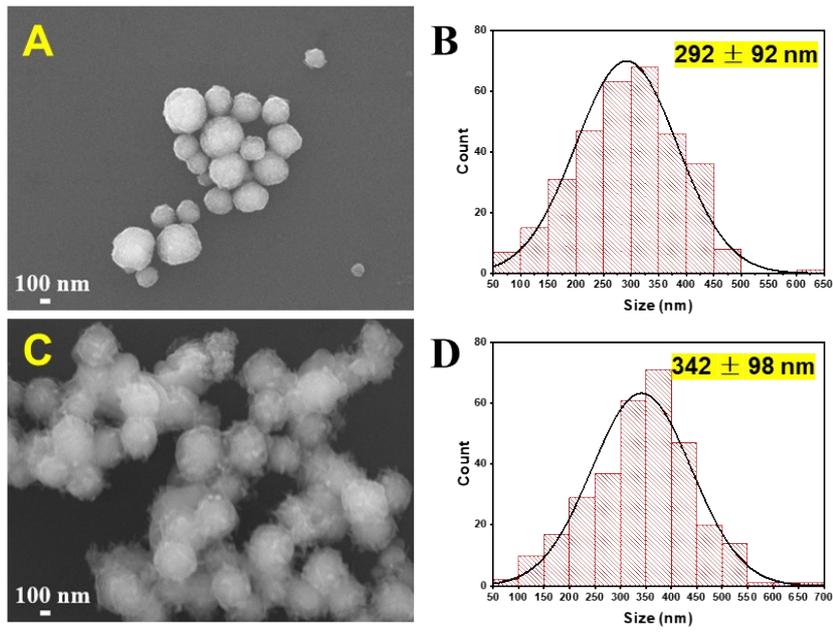
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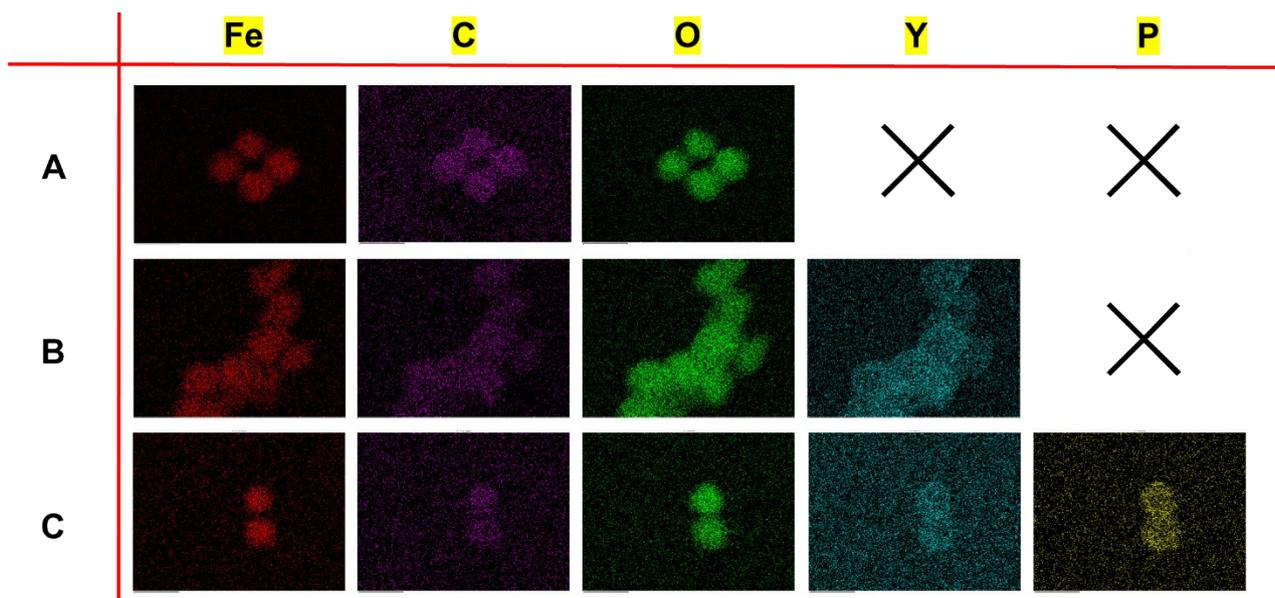
**Figure S1.** The synthesis process of phosphorylated  $\text{Fe}_3\text{O}_4$ .



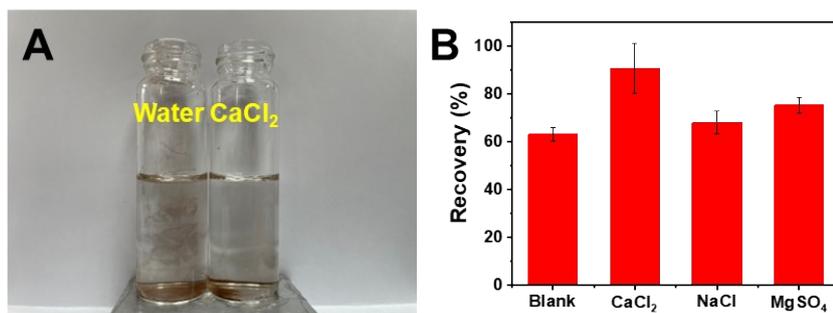
**Figure S2.** TEM images of TiO<sub>2</sub>NPs with different size: (A) 60 nm; (B) 40 nm; (C) 30 nm; (D) 10–25 nm; (E) 5–10 nm, and (F) <5 nm.



**Figure S3.** SEM images and size distributions of pristine  $\text{Fe}_3\text{O}_4$  (A and B) and phosphorylated  $\text{Fe}_3\text{O}_4$  (C and D).



**Figure S4.** EDS spectra of  $\text{Fe}_3\text{O}_4$  particles at different synthesis stages: (A) pristine  $\text{Fe}_3\text{O}_4$ ; (B)  $\text{Fe}_3\text{O}_4$  modified with  $\text{Y}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$  and urea; (C) phosphorylated  $\text{Fe}_3\text{O}_4$ .



**Figure S5.** (A) Digital photo of TiO<sub>2</sub>NPs extracted in deionized water (left) and solutions with CaCl<sub>2</sub> (right). (B) Recoveries of TiO<sub>2</sub>NPs by adding different ions.

**Table S1.** ICP-MS instrumental parameters for the determination of Ti.

Parameter	Parameter value
Instrument	Agilent 8900 ICP-MS
RF power	1500 W
Sampling depth	8 mm
Carrier gas	1.05 L/min
Reaction gas	O <sub>2</sub> (25%)
Monitored isotopes (m/z)	<sup>48</sup> Ti <sup>16</sup> O <sup>+</sup>

**Table S2.** Analytical performance of the proposed method.

Species	Linear range ( $\mu\text{g/L}$ )	$R^2$	Recovery (%)	RSD (%, $n=3$ )	LOD ( $\text{ng/L}$ )	LOQ ( $\text{ng/L}$ )
TiO <sub>2</sub> NPs	0.001–500	0.9998	91.6	3.8	0.4	1.4

**Table S3.** Comparison of analytical performance of this method with other analytical methods.

Method	Size (nm)	Time	Enrichment factor	LOD ( $\mu\text{g/L}$ )	Ref.
Solvent microextraction-ICP-MS	19	> 2 h	83	0.07	1
Magnetic solid phase extraction-ICP-AES	25-100	22 min	-	20	2
Capillary microextraction-ICP-MS	5-100	10 min	10	0.63	3
Magnetic solid phase extraction-ICP-MS	5-100	25 min	400	0.017	4
Magnetic microextraction-ICP-MS	<5-100	-	1000	0.0004	This work

**Table S4.** The detailed characteristics of real water samples.

Sample	pH	K <sup>+</sup> (mg/L)	Na <sup>+</sup> (mg/L)	Ca <sup>2+</sup> (mg/L)	Mg <sup>2+</sup> (mg/L)	DOM (mg C/L)
Drinking water	7.8	0.32	1.73	0.13	0.04	0.04
Spring water	8.1	4.58	6.90	40.95	13.72	1.43
River 1	8.1	12.55	58.24	77.36	27.73	4.81
River 2	8.6	6.75	59.33	54.96	33.83	15.53
Lake 1	8.2	5.50	32.38	75.03	45.89	12.71

**Table S5.** Elemental content in filtrate after deionized water is filtered by stainless steel membranes.

Element	Monitored isotopes (m/z)	Content ( $\mu\text{g/L}$ )
Al	$^{27}\text{Al}^{16}\text{O}^+$	ND <sup>a</sup>
Ti	$^{48}\text{Ti}^{16}\text{O}^+$	ND
V	$^{51}\text{V}^{16}\text{O}^+$	0.003
Ga	$^{71}\text{Ga}^{16}\text{O}^+$	ND
Nb	$^{93}\text{Nb}^{16}\text{O}^+$	0.022
Eu	$^{153}\text{Eu}^{16}\text{O}^+$	ND
Ho	$^{165}\text{Ho}^{16}\text{O}^+$	ND
Er	$^{166}\text{Er}^{16}\text{O}^+$	ND
Tm	$^{169}\text{Tm}^{16}\text{O}^+$	ND
Yb	$^{174}\text{Yb}^{16}\text{O}^+$	ND
Ta	$^{181}\text{Ta}^{16}\text{O}^+$	ND

<sup>a</sup>: Below the LOD.

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