Electronic Supplementary Material (ESI) for Environmental Science: Nano.

Enrichment of Uranium from Wastewater with nanoscale Zero-Valent Iron (nZVI)

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Content of this Supplementary material

This ESI contains additional data and figures to support the interpretation made in the results and discussion section. In total, this ESI includes 11 pages with 5 figures, and 3 tables.

Table S1 Characteristics of uranium tailings wastewater

Elements	Concentration (mg/L)
U	**0.31 ± 0.03**
Mn	30.81 ± 1.95
Ni	2.38 ± 0.45
Mo	0.64 ± 0.09
Cd	0.16 ± 0.04
Co	0.10 ± 0.02
Cr	0.09 ± 0.01
Se	0.04 ± 0.01
Zn	0.98 ± 0.05
CO_3^{2-}	565.70 ± 5.24
NO_3^-	80.88 ± 7.00
SO_4^{2-}	98.59 ± 7.74
PO_4^{3-}	2.30 ± 0.46
C^{l-}	99.38 ± 6.86
F^-	1.65 ± 0.34
Turbidity	1.05 ± 0.35
Eh (V)	0.50 ± 0.02
pH	6.0 ± 0.1

Table S2 XEDS quantifications[1] of spent nZVI particles sampled from two-stage continuous flow stirred tank reactor

Figure	Elements	Circle 1 (wt.%)	Circle 2 (wt.%)	Circle 3 (wt.%)
Figure 4a	**U**	**0.68**	**0.50**	**0.14**
	Fe	**57.27**	**56.48**	**33.13**
	O	**23.52**	**26.83**	**49.91**
	Co	2.72	1.91	1.68
	Ni	0.74	0.51	0.67
	Mo	0.62	1.91	1.49
	Cd	0.35	0.42	0.20
	Cr	0.52	0.44	0.55
	Se	0.95	0.78	0.89
	Mn	5.34	3.02	3.43
	As	0.69	0.52	0.63
	Others	6.60	6.68	7.28
	Total	100.00	100.00	100.00

Figure	Elements	Circle 1 (wt.%)	Circle 2 (wt.%)	Circle 3 (wt.%)	Circle 4 (wt.%)
Figure 4e	**U**	**1.05**	**1.07**	**1.09**	**1.48**
	Fe	**66.66**	**69.63**	**70.22**	**71.73**
	O	**3.76**	**2.97**	**2.98**	**2.70**
	Co	4.86	4.87	4.85	4.62
	Ni	1.91	1.59	1.54	1.60
	Mo	0.51	0.52	0.51	0.64
	Cd	1.15	1.23	1.23	1.02
	Cr	0.89	0.88	0.85	0.73
	Se	3.38	2.45	2.25	2.21
	Mn	4.22	4.01	4.04	3.18
	As	2.05	1.59	1.46	1.29
	Others	9.56	9.19	8.98	8.80
	Total	100.00	100.00	100.00	100.00

Note: other elements include K, Na, Ca, Mg, S, P, N, Cl and F.

Table S3 Effects of CSTR operational parameters on uranium enrichment.

No.	nZVI (g/L)	HRT (h)	R	Removal (%)	U/nZVI wt%
1	1.97	4	1	85.44	0.36
2	5.45	4	1	94.60	0.12
3	9.85	4	1	99.34	0.08
4	9.85	2	1	99.57	0.15
5	9.85	1	1	99.23	0.18
6	9.85	1	2	65.52	0.11
7	9.85	1	3	54.13	0.10

Figure S1 Concentrations of dissolved metal and metalloid ions in the influent and effluent of nZVI reactor

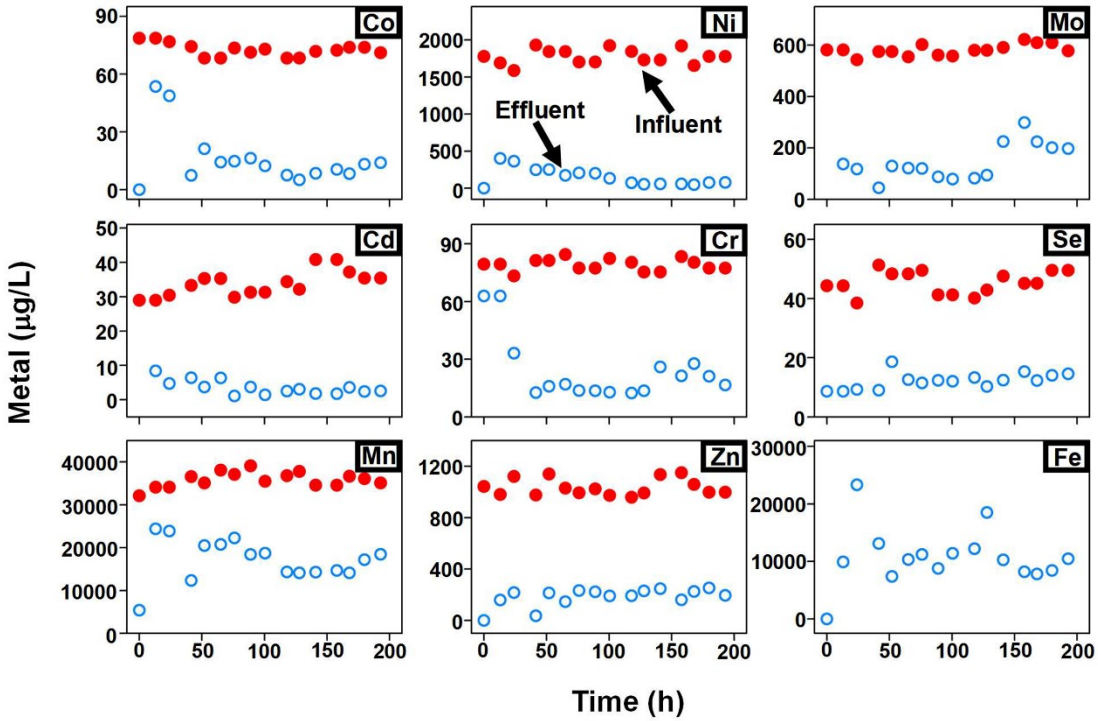


Figure S2 The separation factors (Kd) for U and other concerned contaminants, and metal concentrations in effluent and reacted nZVI particles (inner chart).

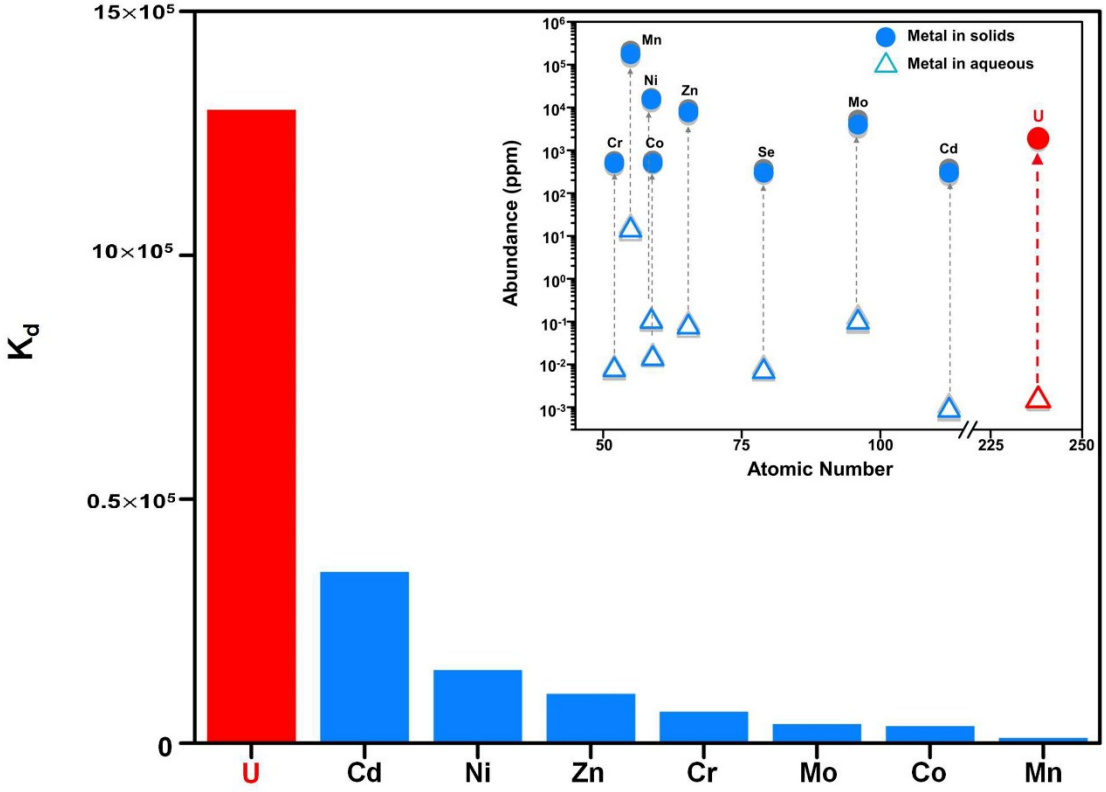


Figure S3 XRD spectra of fresh and reacted nZVI particles.

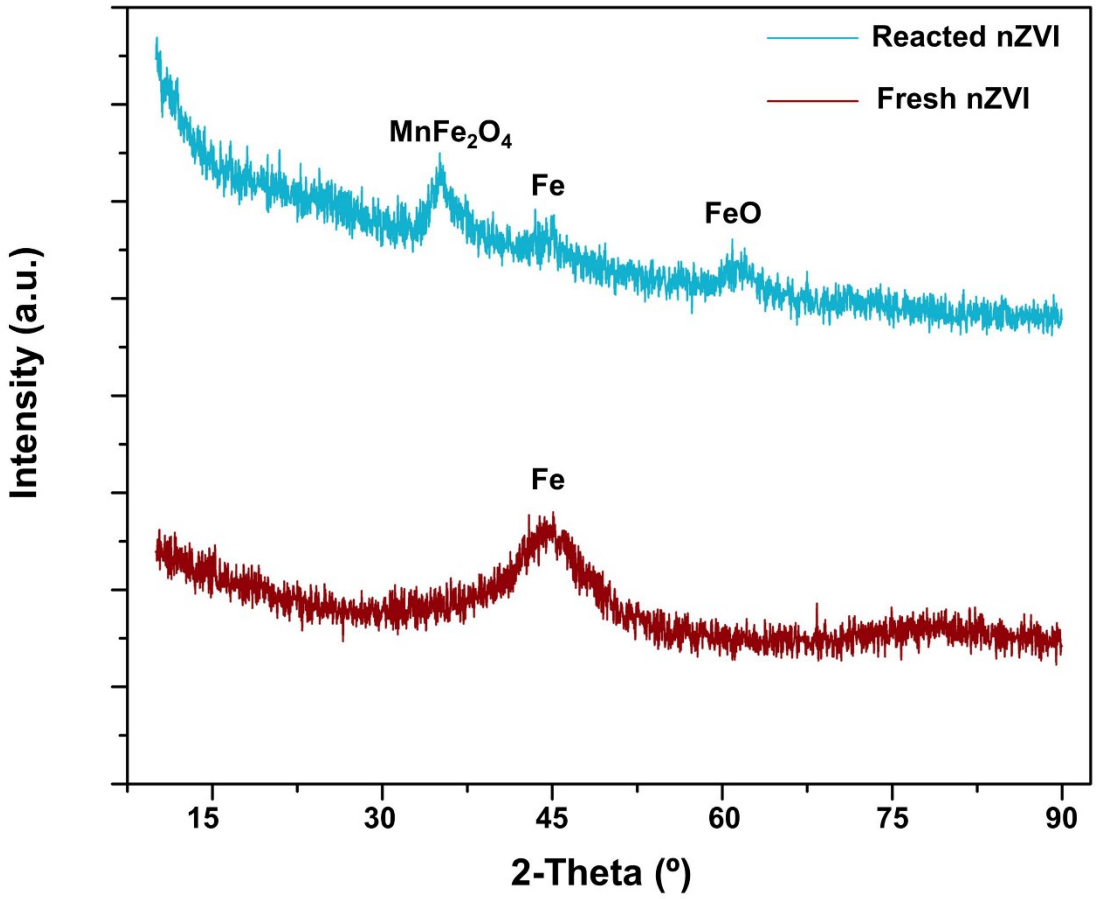


Figure S4 E_h-pH diagram for U-C-O-H system (25 ºC). [U(VI)] $_T$=0.13 μM, [CO2- 3]$_T$=10 mM.

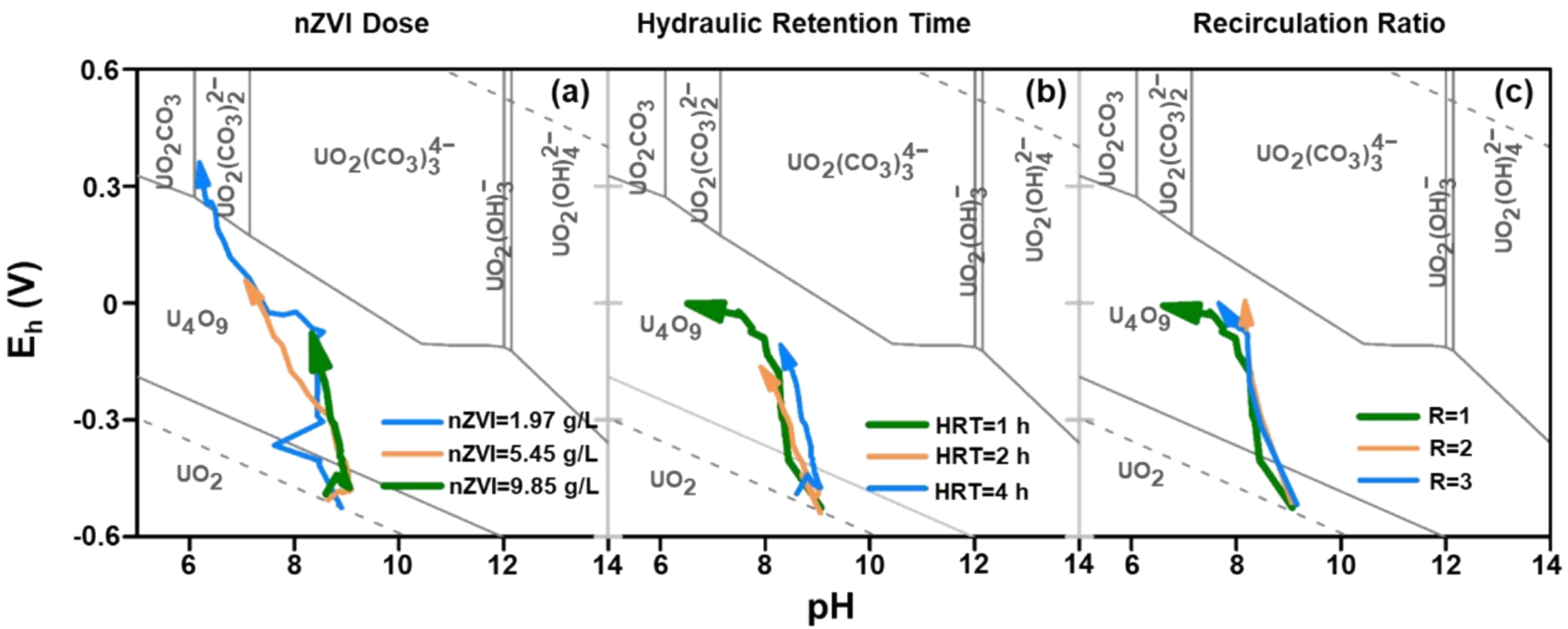
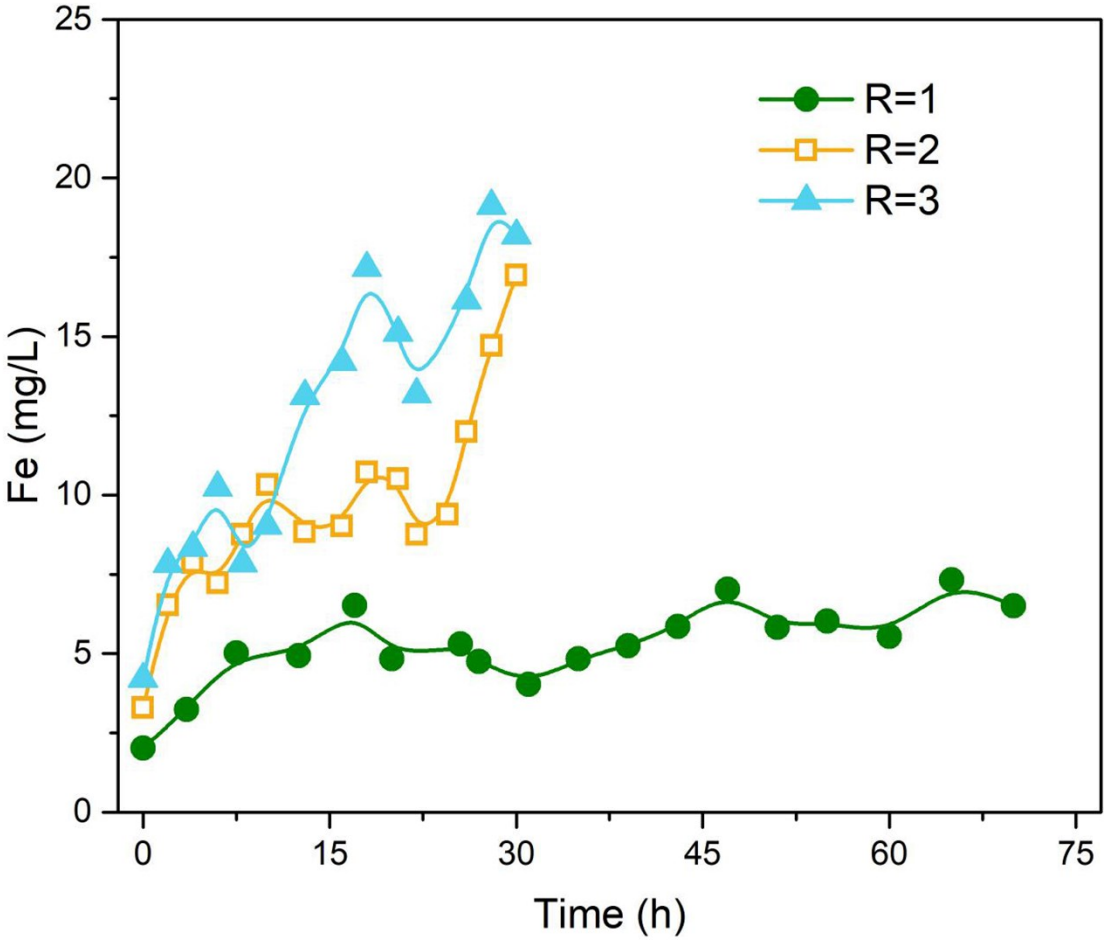


Figure S5 Concentrations of iron in the effluent of nZVI reactor under different recirculation ratio (R) conditions



References

1 L. Ling and W. X. Zhang, Visualizing arsenate reactions and encapsulation in a single zero-valent iron nanoparticle, *Environ. Sci. Technol.*, 2017, 51, 2288-2294.