

Supporting Information

In situ growth ZnO nanorod arrays on cotton cloth for the removal of uranium (VI)

Lei Zhang,^a Liang Zhang,^a Tianhao Wu,^c Xiaoyan Jing,^a Rumin Li,^a Jingyuan Liu,^a Qi Liu^{*a} and Jun Wang^{*ab}

^a Key Laboratory of Superlight Material and Surface Technology, Ministry of Education, Harbin Engineering University, 150001, PR China.

^b Institute of Advanced Marine Materials, Harbin Engineering University, 150001, PR China.

^c Fundamental Science on Nuclear Safety and Simulation Technology Laboratory, Harbin Engineering University, 150001, PR China.

* Corresponding author: Tel.: +86 451 8253 3026; Fax: +86 451 8253 3026; E-mail: zhqw1888@sohu.com.

Tab S1 The change in weight of ZnO/CC after ultrasound.

Number	①	②	③
Weight of cotton cloth modified with zinc oxide seeded sol (g)	0.037	0.039	0.034
Weight of ZnO/CC (g)	0.049	0.051	0.048
Weight of ZnO/CC after ultrasound (g)	0.047	0.050	0.046

Tab.S2 Comparison of saturated adsorption capacity in the parallel experiment (m=0.010g, C₀=250.00 mg L⁻¹, pH=5.0, T=298K)

	Q _e (mg g ⁻¹)
Pure cotton cloth	35.21 (±0.50)
ZnO/CC grown without seeding	87.60 (±0.50)
ZnO/CC	428.76 (±0.50)

Tab S3 Isotherm parameters for the adsorption uranium (VI) onto ZnO/CC.

Langmuir constants				Freundlich constants		
T (K)	Q _m (mg g ⁻¹)	K _L (L g ⁻¹)	R ²	K _F (L g ⁻¹) ^{1/n}	1/n	R ²
298	431.03	1.79	0.99	340.32	0.050	0.77
308	444.44	1.79	0.99	350.21	0.051	0.85
318	460.83	2.68	0.99	373.56	0.047	0.88
328	476.19	3.31	0.99	399.65	0.093	0.95

Tab S4 Thermodynamic parameter for uranium adsorption on ZnO/CC.

ΔH ⁰ (kJ mol ⁻¹)	ΔS ⁰ (J mol ⁻¹ ·K ⁻¹)	ΔG ⁰ (kJ mol ⁻¹)			
		298 K	308 K	318 K	328 K
20.26	86.98	-5.66	-6.53	-7.40	-8.27

Tab S5 Kinetic parameters of different models for uranium (VI) adsorption onto ZnO/CC.

Kinetic model	T(K)	C ₀ (mg L ⁻¹)	Q _{cal} (mg g ⁻¹)	k ₁ (min ⁻¹)	R ²
				k ₂ (g · mg ⁻¹ min ⁻¹)	
Pseudo-first-order	298	200.00	487.01	0.13340	0.91
Pseudo-second-order	298	200.00	453.55	0.00032	0.99

Tab. S6 The maximum adsorption capacity of different adsorbents for uranium (VI).

Adsorbents	Conditions	Maximum adsorption capacity	Ref.
Functionalized carbon spheres	$C_{\text{initial}}=1-100 \text{ mg L}^{-1}$ pH=4.0	113.16 mg g^{-1}	[38]
CoFe ₂ O ₄ hollow spheres	$C_{\text{initial}}=20-140 \text{ mg L}^{-1}$ T=298 K pH=6.0	170.07 mg g^{-1}	[39]
Magnetic yolk-shell iron oxide @ magnesium silicate microspheres	$C_e=1 \times 10^{-6}-2 \times 10^{-5} \text{ mol L}^{-1}$ T=318 K pH=5.5 $C [\text{NaClO}_4]=0.01 \text{ mol L}^{-1}$	$1.51 \times 10^{-5} \text{ mol g}^{-1}$	[40]
Graphene oxide-supported chitosan	$C_{\text{initial}}=10-60 \text{ mg L}^{-1}$ T=303 K pH=4.0	225.78 mg g^{-1}	[41]
Mg ₂ CO ₃ (OH) ₂ /CC	$C_{\text{initial}}=20-220 \text{ mg L}^{-1}$ T=298K pH=5.0	370 mg g^{-1}	[10]
Hydrothermal carbon	$C_{\text{initial}}=10-90 \text{ mg L}^{-1}$ T=298 K pH=7.92	273 mg g^{-1}	[42]
CaAl double hydroxides	$C_{\text{initial}}=10-500 \text{ mg L}^{-1}$ T=298 K pH=6.0	257 mg g^{-1}	[43]
Nanoporous ZnO by microwave-assisted	$C_{\text{initial}}=20-80 \text{ mg L}^{-1}$ T=303 K pH=5.0	1111 mg g^{-1}	[22]
1.0PANI/GO	$C_{\text{eq}}=0-80 \text{ mg L}^{-1}$ T=293 K pH=5.0 $C [\text{NaCl}] = 0.01 \text{ mol L}^{-1}$	1960 mg g^{-1}	[44]
ZnO/CC	$C_{\text{initial}}=100-350 \text{ mg L}^{-1}$ T=298 K pH=5.0	431.03 mg g^{-1}	Our work

Tab. S7 The analyzed and calculated concentrations of zinc (II) at different contact times.

Different contact time (min)	10	20	30	40
$C [\text{Zn}^{2+}] (\text{mg L}^{-1})$	14.37	19.13	21.31	22.03
$n [\text{Zn}^{2+}+2\text{H}^+] (\text{mol})$	0.611	0.814	0.907	0.921

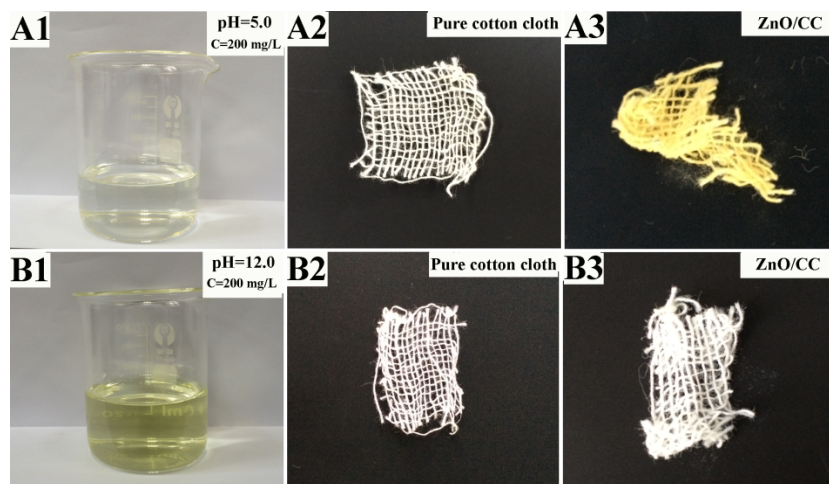


Fig. S1 The change in color of pure cotton cloth and ZnO/CC at different pH.

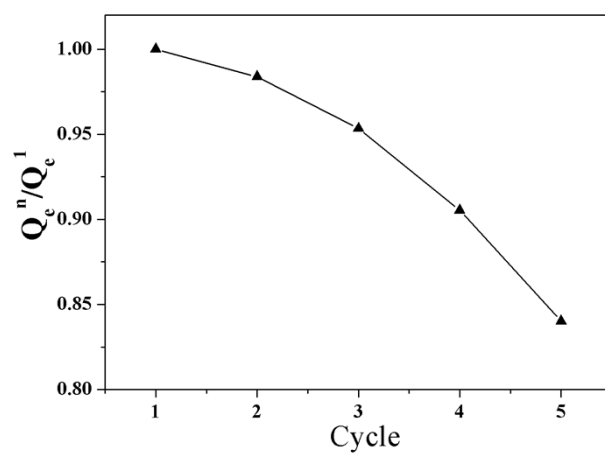


Fig. S2 The adsorption capacity with the reuse cycle.