

## Supporting Information

**Synthesis of core-shell magnetic nano-composite Fe<sub>3</sub>O<sub>4</sub>@ microbial extracellular polymeric substances for simultaneous redox sorption and recovery of silver ions as silver nanoparticles**

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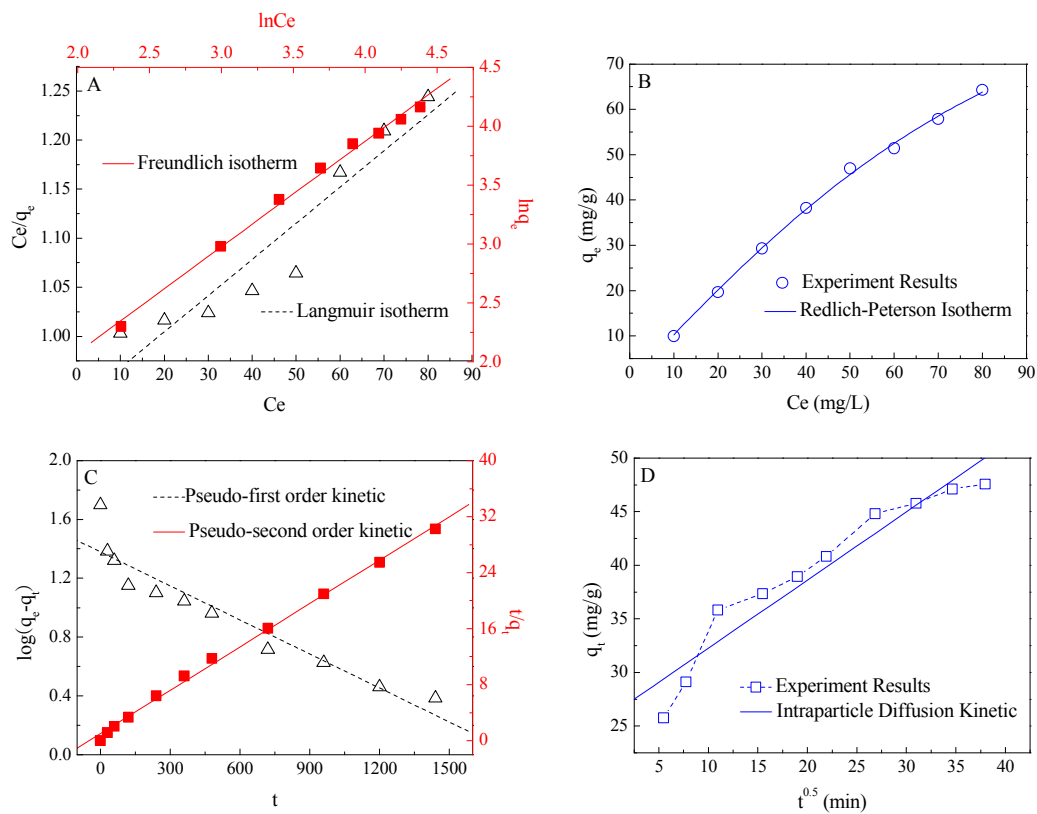
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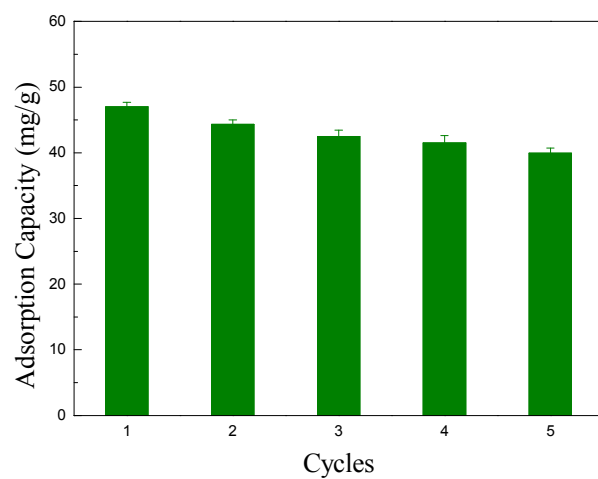
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**Figure S1.** Isotherm plots of Langmuir and Freundlich model(A), Redlich-Peterson model (B) for the adsorption of  $\text{Ag}^+$  onto  $\text{Fe}_3\text{O}_4@\text{EPS}$ ; Kinetic plots of pseudo first-order and pseudo second-order model (C), intraparticle diffusion model (D) for the adsorption of  $\text{Ag}^+$  onto  $\text{Fe}_3\text{O}_4@\text{EPS}$ .



**Figure S2.** Ag<sup>+</sup> adsorption capacities of magnetic Fe<sub>3</sub>O<sub>4</sub>@EPS at different regeneration cycles. The error bars indicate standard errors.

**Table S1.** The models and parameters used for the adsorption of Ag<sup>+</sup> by Fe<sub>3</sub>O<sub>4</sub>@EPS

	Model	Equation	Model parameters
Adsorption isotherm	Langmuir	$\frac{1}{q_e} = \frac{1}{q_m} + \frac{1}{bq_m C_e}$	q <sub>e</sub> = equilibrium capacity of Ag <sup>+</sup> adsorbed onto Fe <sub>3</sub> O <sub>4</sub> @EPS (mg g <sup>-1</sup> ), C <sub>e</sub> = equilibrium concentration of Ag <sup>+</sup> solution (mg L <sup>-1</sup> ), q <sub>m</sub> = maximum adsorption capacity of Ag <sup>+</sup> (mg g <sup>-1</sup> ), and b = energy of adsorption (L mg <sup>-1</sup> )
	Freundlich	$\log q_e = \log K_F + \frac{1}{n} \log C_e$	q <sub>e</sub> = equilibrium capacity of Ag <sup>+</sup> adsorbed onto Fe <sub>3</sub> O <sub>4</sub> @EPS (mg g <sup>-1</sup> ), C <sub>e</sub> = equilibrium concentration of Ag <sup>+</sup> solution (mg L <sup>-1</sup> ), K <sub>F</sub> = Freundlich constant (mg g <sup>-1</sup> ), n = adsorption intensity of the adsorbent
	Redlich-Peterson	$q_e = \frac{KC_e}{1 + \alpha C_e^\beta}$	K and α are the Redlich–Peterson isotherm constants and β is the exponent
Adsorption kinetics	Pseudo-first order	$\log (q_e - q_t) = \log q_e - \frac{k_1}{2.303} t$	q <sub>e</sub> = equilibrium adsorption capacity (mg g <sup>-1</sup> ), q <sub>t</sub> = adsorption capacity (mg g <sup>-1</sup> ) at any time t, k <sub>1</sub> = first-order rate constant (h <sup>-1</sup> )
	Pseudo-second order	$\frac{t}{q_t} = \frac{1}{k_2 q_e^2} + \frac{1}{q_e} t$	q <sub>e</sub> = equilibrium adsorption capacity (mg g <sup>-1</sup> ), q <sub>t</sub> = adsorption capacity (mg g <sup>-1</sup> ) at any time t, k <sub>2</sub> = the second-order rate constant (mg g <sup>-1</sup> h <sup>-1</sup> )
	Intraparticle diffusion	$q_t = k_i t^{0.5}$	q <sub>t</sub> = adsorption (mg g <sup>-1</sup> ) at any time t, k <sub>i</sub> = intra-particle diffusion rate constant (mg g <sup>-1</sup> h <sup>-0.5</sup> );

**Table S2.** Comparison of Ag<sup>+</sup> sorption capacity of Fe<sub>3</sub>O<sub>4</sub>@EPS with other reported adsorbents under similar experimental conditions.

adsorbents	pH	Initial Ag <sup>+</sup> concentration (mg L <sup>-1</sup> )	Uptake capacity (mg g <sup>-1</sup> )	Ref.
activated carbon	6.0	50	0.734	Hanzlık et al., 2004 <sup>1</sup>
coke	6.0	50	3.06	Li et al., 2010 <sup>2</sup>
bituminous coal	6.0	50	1.0-40.9	Hanzlık et al., 2004 <sup>1</sup>
raw vermiculite	4.0	10	0.5	Sarı and Tüzen, 2013 <sup>3</sup>
activated carbon nanospheres	5.0	50	38.7	Song et al., 2011 <sup>4</sup>
thiol-functionalized silica beads	6.0	300	42.3	Quang et al., 2013 <sup>5</sup>
<i>S. cerevisiae</i>	6.0	100	4.7	Wang, 2008 <sup>6</sup>
brewery waste biomass	4.0	108	42.8	Chen et al., 2008 <sup>7</sup>
cellulose nanocrystals	5.0	500	34.4	Liu et al., 2014 <sup>8</sup>
Fe <sub>3</sub> O <sub>4</sub> @EPS	5.0	50	47.6	This work

**Table S3.** Isotherm and kinetic constants for the adsorption of Ag<sup>+</sup> onto Fe<sub>3</sub>O<sub>4</sub>@EPS

Langmuir isotherm			Freundlich isotherm			Redlich-Peterson isotherm			
q <sub>m</sub>	B	R <sup>2</sup>	K <sub>F</sub>	n	R <sup>2</sup>	K	α	β	R <sup>2</sup>
270.27	0.004	0.901	1.327	1.114	0.984	1.035	0.001	1.693	0.999
Pseudo first-order kinetic			Pseudo second-order kinetic			Intraparticle diffusion kinetic			
k <sub>1</sub>	q <sub>e</sub>	R <sup>2</sup>	k <sub>2</sub>	q <sub>e</sub>	R <sup>2</sup>	k <sub>i</sub>	R <sup>2</sup>		
0.002	23.967	0.904	0.044	48.309	0.997	0.635	0.922		

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