Supplementary Information

Title: Synergistic removal of pollutants from sulfide ore flotation wastewater using composite oily sludge-based adsorbents

Author: Peng Fu[a], Huifen Yang*[a], Jingwen Zhao[b]

Affiliations: ***a*** School of Resources and Safety Engineer, University of Science and Technology Beijing, 30 Xueyuan Road, Haidian Distr Haidian District, Beijing 100083, China. E-mail: 358756757@qq.com.

b School of Mining and Coal Engineering, Inner Mongolia University of Science and Technology, Baotou 014010, China.

- **Supplementary Fig.S1:** The adsorption kinetic models of TSAM and RSAM for BX (a) PFO and PSO models; (b) Intra-particle diffusion model
- **Supplementary Fig.S2:** The adsorption kinetic models of TSAM and RSAM for BX (a) PFO and PSO models; (b) Intra-particle diffusion model
- **Supplementary Fig.S3:** Adsorption isotherms of TSAM and RSAM for Cd^{2+}(a), Cu^{2+}(b) and Zn^{2+}(c)
- **Supplementary Fig.S4:** Adsorption kinetics of TSAM and RSAM for Cd^{2+}(a), Cu^{2+}(b) and Zn^{2+}(c)
- **Supplementary Fig.S5:** ToF-SIMS positive fine spectrum of TSAM before and after simulated wastewater adsorption
- **Supplementary Table. S1:** The adsorption kinetic model parameters of RSAM and TSAM for butyl xanthate (BX)
- **Supplementary Table. S2:** The adsorption kinetic model parameters of RSAM and TSAM for butyl xanthate (BX)
- **Supplementary Table. S3:** Fitting parameters of adsorption isothermal of TSAM and RSAM adsorbing Cd^{2+}, Cu^{2+} and Zn^{2+}
- **Supplementary Table. S4:** Fitting parameters of adsorption kinetics of TSAM and RSAM adsorbing Cd^{2+}, Cu^{2+} and Zn^{2+}

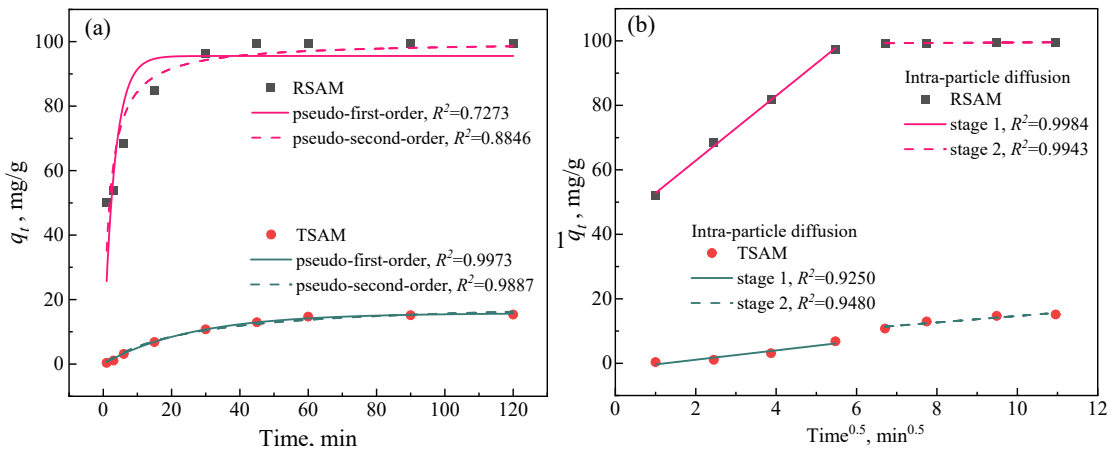

Fig.S1 The adsorption kinetic models of TSAM and RSAM for BX (a) PFO and PSO models; (b) Intra-particle diffusion model

Table S1 The adsorption kinetic model parameters of RSAM and TSAM for butyl xanthate (BX)

Parameters			RSAM	TSAM
Pseudo-first-order		q_e (mg/g)	95.56	15.77
		k_1 (1/min)	0.31	0.04
		R^2	0.7273	0.9973
Pseudo-second-order		q_e (mg/g)	100.09	19.86
		k_2(g/mg·min)	0.005	0.002
		R^2	0.8846	0.9887
Intra-particle diffusion	Stage 1	k_p (mg/g·min$^{1/2}$)	10.05	1.45
		C	42.76	-1.81
		R^2	0.9984	0.9250
	Stage 2	k_p (mg/g·min$^{1/2}$)	0.07	1.01
		C	98.86	4.61
		R^2	0.9943	0.9480

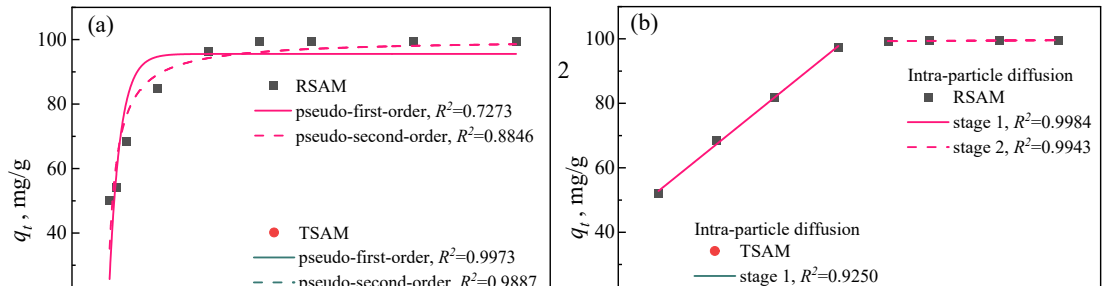

Fig.S2 The adsorption kinetic models of TSAM and RSAM for BX (a) PFO and PSO models; (b) Intra-particle diffusion model

Table S2 The adsorption kinetic model parameters of RSAM and TSAM for butyl xanthate (BX)

Parameters			RSAM	TSAM
Pseudo-first-order		q_e (mg/g)	95.56	15.77
		k_1 (1/min)	0.31	0.04
		R^2	0.7273	0.9973
Pseudo-second-order		q_e (mg/g)	100.09	19.86
		k_2(g/mg·min)	0.005	0.002
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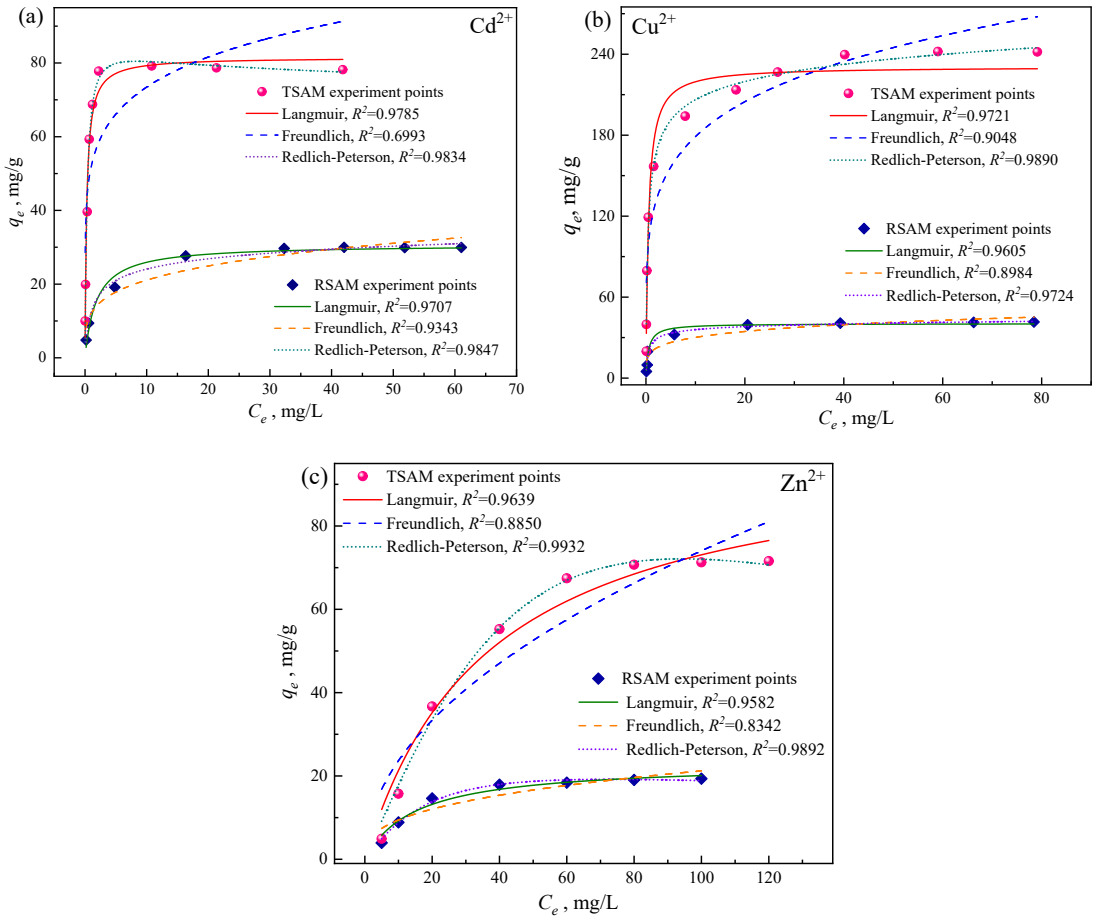

Fig.S3 Adsorption isotherms of TSAM and RSAM for Cd^{2+}(a), Cu^{2+}(b) and Zn^{2+}(c)

Table S3 Fitting parameters of adsorption isothermal of TSAM and RSAM adsorbing Cd^{2+}, Cu^{2+} and Zn^{2+}

Isothermal models		TSAM			RSAM		
		Cd^{2+}	Cu^{2+}	Zn^{2+}	Cd^{2+}	Cu^{2+}	Zn^{2+}
Langmuir	q_{max} (mg/g)	81.50	230.69	100.01	30.72	40.35	23.12
	K_L (L/mg）	3.55	1.97	0.03	0.54	1.90	0.07
	R^2	0.9785	0.9721	0.9639	0.9707	0.9605	0.9582
Freundlich	K_F (mg/g)	51.78	114.17	7.57	12.10	19.23	4.20
	$1/n$	0.1519	0.19	0.4952	0.2410	0.20	0.3516
	R^2	0.6993	0.9048	0.8850	0.9343	0.8984	0.8342
Redlich-Peterson	K_{RP} (L/g)	233.66	644.66	1.84	30.13	96.62	1.08
	A_{RP} (mg/L)$^{-g}$	2.42	3.55	5.95	1.46	2.98	0.01
	g	1.04	0.93	1.71	0.90	0.94	1.32
	R^2	0.9834	0.9890	0.9932	0.9847	0.9724	0.9892

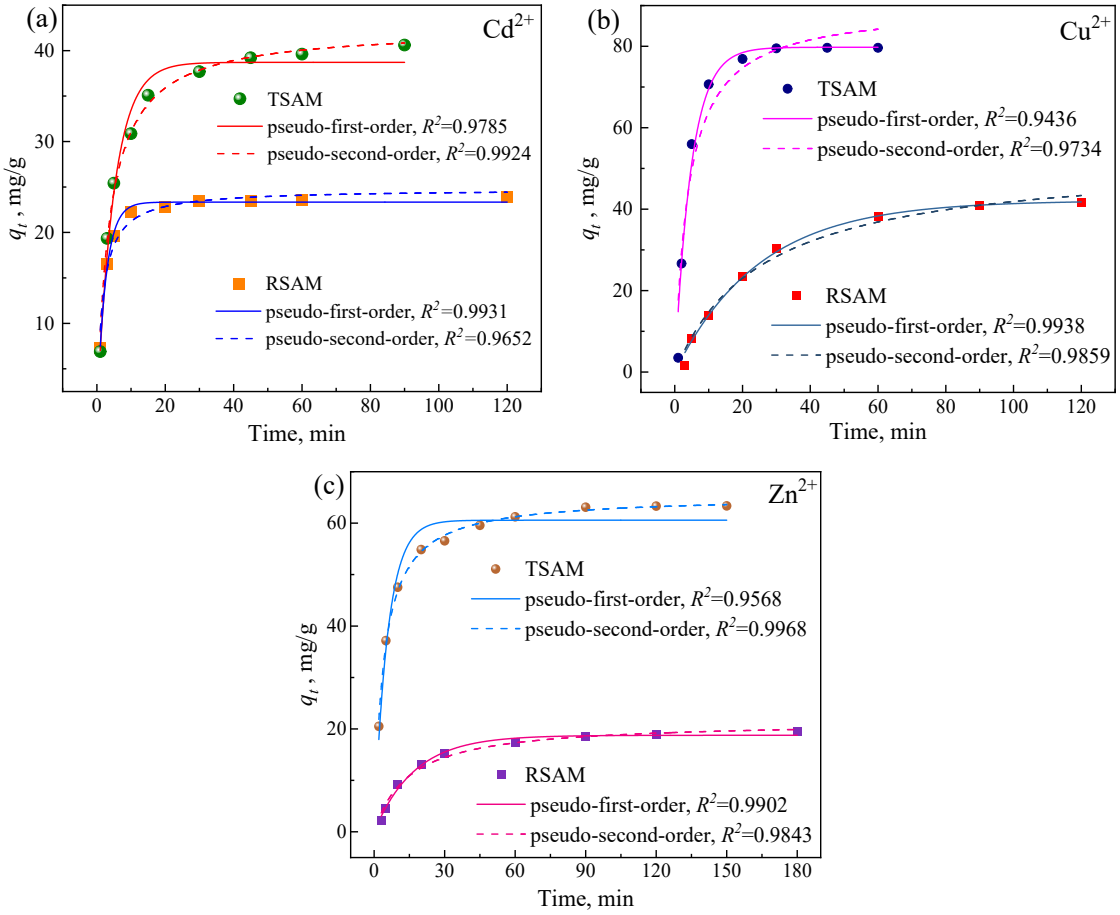

Fig.S4 Adsorption kinetics of TSAM and RSAM for Cd^{2+}(a), Cu^{2+}(b) and Zn^{2+}(c)

Table S4 Fitting parameters of adsorption kinetics of TSAM and RSAM adsorbing Cd^{2+}, Cu^{2+} and Zn^{2+}

Adsorption kinetic models		TSAM			RSAM		
		Cd^{2+}	Cu^{2+}	Zn^{2+}	Cd^{2+}	Cu^{2+}	Zn^{2+}
Pseudo-first-order	q_e (mg/g)	38.71	79.76	60.57	23.33	42.11	18.76
	k_1 (1/min)	0.20	0.21	0.18	0.39	0.04	0.06
	R^2	0.9785	0.9436	0.9568	0.9931	0.9938	0.9902
Pseudo-second-order	q_e (mg/g)	42.51	89.92	65.29	24.76	52.64	21.51
	k_2 (g/mg·min)	0.0064	0.0027	0.0039	0.0241	0.0007	0.0032
	R^2	0.9924	0.9734	0.9968	0.9652	0.9859	0.9843

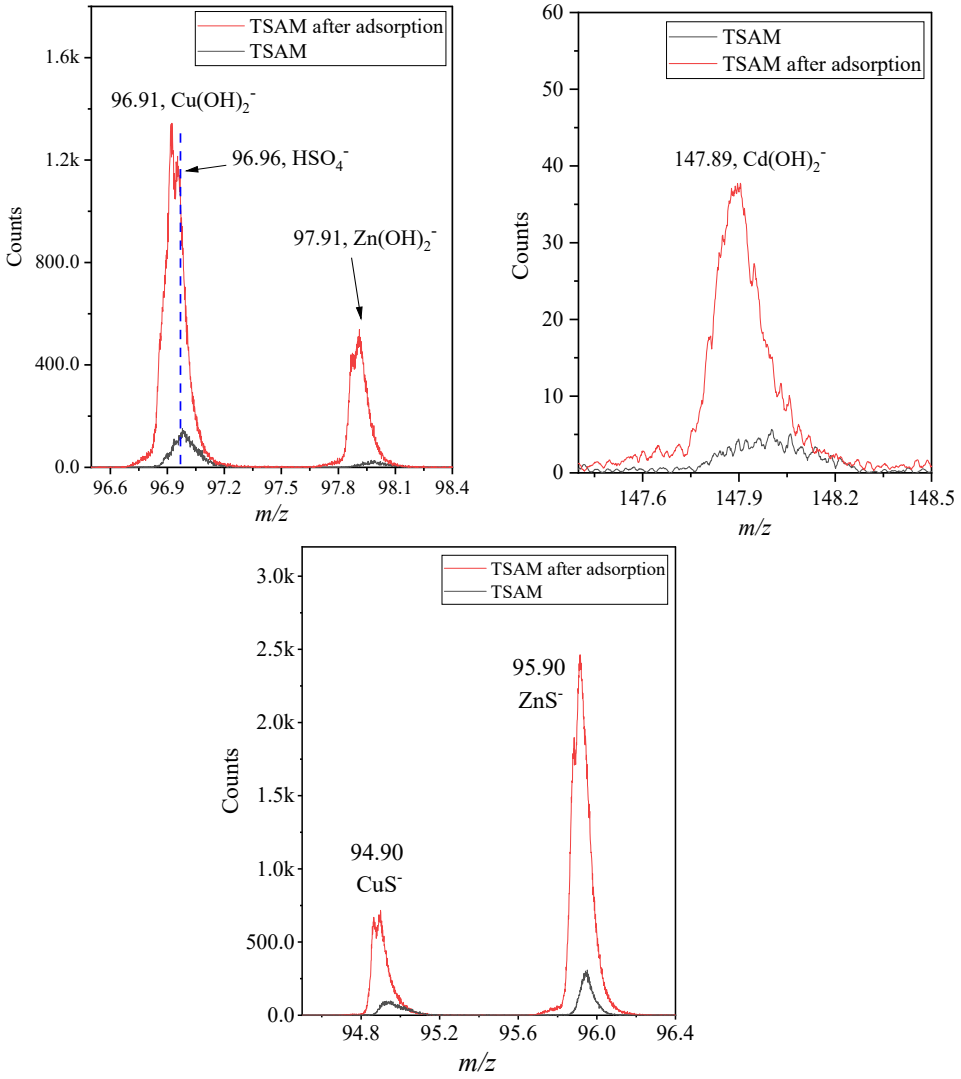

Fig.S5 ToF-SIMS positive fine spectrum of TSAM before and after simulated wastewater adsorption