

Supporting materials



Fig. S1 Pilot plant for Tl removal from Zn oxide production industrial wastewater

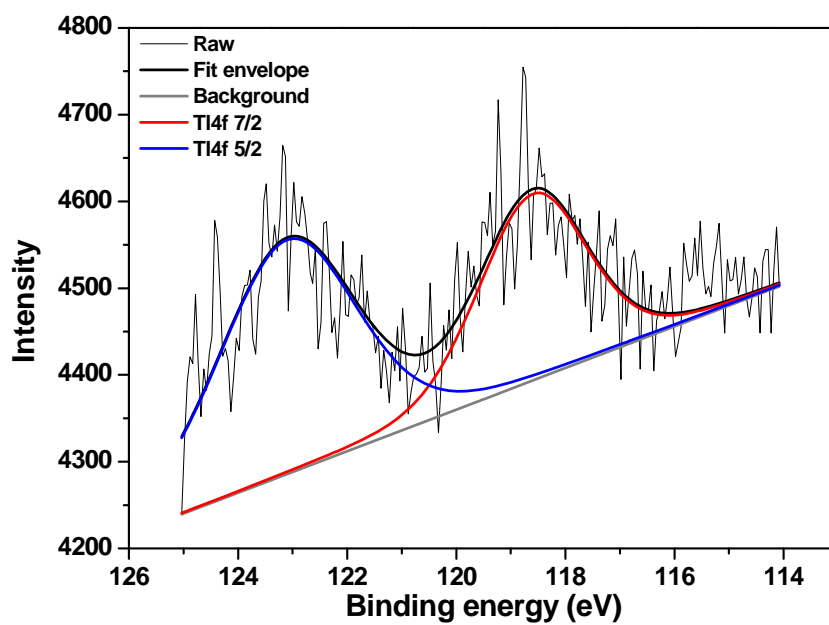


Fig. S2 XPS spectra for Tl4f core level region of the third precipitates during sulfide precipitation

Table S1 Concentrations of other major toxic heavy metals (Cd, Cu, Pb, and Zn) in the effluent during caustic sedimentation for low and high strength wastewater

Wastewater	pH	Cd (mg/L)	Cu (mg/L)	Pb (mg/L)
Low strength	8	22.5 ± 0.37	0.21 ± 0.06	0.88 ± 0.04
	9	21.4 ± 0.29	0.26 ± 0.05	0.74 ± 0.04
	10	8.33 ± 0.19	0.36 ± 0.05	0.87 ± 0.09
	11	2.18 ± 0.10	0.17 ± 0.03	0.65 ± 0.05
	12	1.14 ± 0.07	0.09 ± 0.03	0.53 ± 0.14
High strength	8	536 ± 52.61	1.65 ± 0.12	3.59 ± 0.31
	9	482 ± 60.76	1.59 ± 0.07	3.55 ± 0.18
	10	309 ± 97.94	1.50 ± 0.09	2.67 ± 0.35
	11	50.0 ± 2.66	1.76 ± 0.06	2.46 ± 0.40
	12	48.4 ± 7.26	0.91 ± 0.42	0.93 ± 0.14

Table S2 Concentrations of other major toxic heavy metals (Cd, Cu, Pb, and Zn) in the effluent during Fenton treatment for low and high strength wastewater (effects of H₂O₂ dosage)

Wastewater	H ₂ O ₂ (mL/L)	Cd (mg/L)	Cu (mg/L)	Pb (mg/L)	Zn (mg/L)
Low strength	0	1.52 ± 0.23	0.13 ± 0.01	0.13 ± 0.01	2.34 ± 0.16
	0.5	0.75 ± 0.05	0.09 ± 0.01	0.09 ± 0.01	1.34 ± 0.11
	1.0	0.85 ± 0.06	0.06 ± 0.01	0.07 ± 0.01	0.50 ± 0.13
	2.0	0.55 ± 0.08	0.03 ± 0.01	0.05 ± 0.01	0.45 ± 0.09
	4	0.67 ± 0.08	0.05 ± 0.01	0.05 ± 0.01	0.41 ± 0.09
	8	0.59 ± 0.14	0.03 ± 0.01	0.07 ± 0.01	0.40 ± 0.05
	16	0.78 ± 0.11	0.03 ± 0.01	0.06 ± 0.01	0.38 ± 0.04
High strength	0	4.79 ± 0.32	0.46 ± 0.03	0.09 ± 0.01	83.51 ± 8.35
	0.5	2.75 ± 0.36	0.25 ± 0.01	0.08 ± 0.01	69.09 ± 6.38
	1.0	1.59 ± 0.40	0.16 ± 0.01	0.06 ± 0.01	46.02 ± 4.45
	2.0	0.34 ± 0.07	0.11 ± 0.02	0.03 ± 0.08	25.82 ± 4.29
	4	0.34 ± 0.13	0.08 ± 0.01	0.03 ± 0.01	24.36 ± 4.12
	8	0.32 ± 0.20	0.12 ± 0.01	0.03 ± 0.01	32.76 ± 2.84
	16	0.45 ± 0.22	0.13 ± 0.01	0.04 ± 0.01	35.95 ± 3.46

Table S3 Concentrations of other major toxic heavy metals (Cd, Cu, Pb, and Zn) in the effluent during Fenton treatment for low and high strength wastewater (effects of coagulation pH)

Wastewater	pH	Cd (mg/L)	Cu (mg/L)	Pb (mg/L)	Zn (mg/L)
Low strength	8	1.84 ± 0.24	0.07 ± 0.06	0.26 ± 0.02	0.69 ± 0.14
	9	1.39 ± 0.10	0.09 ± 0.01	0.12 ± 0.01	0.61 ± 0.17
	10	0.95 ± 0.11	0.08 ± 0.02	0.09 ± 0.01	0.65 ± 0.20
	11	0.55 ± 0.10	0.06 ± 0.01	0.05 ± 0.01	0.52 ± 0.20
	12	0.08 ± 0.032	0.06 ± 0.01	0.04 ± 0.01	0.56 ± 0.08
High strength	8	0.79 ± 0.14	0.12 ± 0.02	0.56 ± 0.05	31.63 ± 1.70
	9	0.23 ± 0.02	0.11 ± 0.02	0.23 ± 0.03	23.94 ± 2.22
	10	0.13 ± 0.01	0.10 ± 0.01	0.13 ± 0.02	23.62 ± 2.53
	11	0.09 ± 0.02	0.10 ± 0.01	0.05 ± 0.03	24.52 ± 2.36
	12	0.05 ± 0.01	0.09 ± 0.02	0.05 ± 0.01	25.29 ± 1.74

Table S4 Concentrations of other major toxic heavy metals (Cd, Cu, Pb, and Zn) in the effluent during the third treatment for low and high strength wastewater (effects of Na₂S dosage)

Wastewater	Na ₂ S (mL/L)	Cd (mg/L)	Cu (mg/L)	Pb (mg/L)	Zn (mg/L)
Low strength	0.35	0.26 ± 0.032	0.05 ± 0.004	0.036 ± 0.005	0.34 ± 0.04
	0.70	0.12 ± 0.014	0.04 ± 0.007	0.012 ± 0.002	0.18 ± 0.02
	1.00	0.042 ± 0.011	0.02 ± 0.005	0.005 ± 0.002	0.13 ± 0.02
	1.30	0.014 ± 0.004	0.02 ± 0.004	0.002 ± 0.001	0.088 ± 0.01
	1.60	0.013 ± 0.003	0.01 ± 0.002	0.001 ± 0.0004	0.055 ± 0.007
	2.00	0.015 ± 0.003	0.01 ± 0.001	0.002 ± 0.0002	0.036 ± 0.007
High strength	0.35	0.070 ± 0.007	0.081 ± 0.007	0.011 ± 0.002	1.43 ± 0.44
	0.70	0.052 ± 0.008	0.070 ± 0.006	0.008 ± 0.001	0.99 ± 0.13
	1.00	0.023 ± 0.008	0.033 ± 0.006	0.004 ± 0.001	0.45 ± 0.07
	1.30	0.0010 ± 0.002	0.024 ± 0.009	0.001 ± 0.0004	0.19 ± 0.01
	1.60	0.011 ± 0.002	0.022 ± 0.005	0.001 ± 0.0003	0.11 ± 0.01
	2.00	0.014 ± 0.003	0.011 ± 0.005	0.001 ± 0.0004	0.060 ± 0.01

Table S5 Concentrations of other major toxic heavy metals (Cd, Cu, Pb, and Zn) in the effluent during the third treatment for low and high strength wastewater (effects of reaction pH)

Wastewater	pH	Cd (mg/L)	Cu (mg/L)	Pb (mg/L)	Zn (mg/L)
Low strength	8	0.14 ± 0.02	0.045 ± 0.005	0.038 ± 0.003	0.18 ± 0.02
	9	0.066 ± 0.009	0.032 ± 0.007	0.025 ± 0.004	0.17 ± 0.008
	10	0.035 ± 0.009	0.026 ± 0.005	0.014 ± 0.003	0.13 ± 0.01
	11	0.022 ± 0.006	0.021 ± 0.003	0.008 ± 0.004	0.12 ± 0.02
	12	0.020 ± 0.006	0.008 ± 0.004	0.004 ± 0.002	0.075 ± 0.009
High strength	8	0.066 ± 0.005	0.076 ± 0.010	0.019 ± 0.004	1.17 ± 0.30
	9	0.036 ± 0.005	0.055 ± 0.007	0.012 ± 0.003	0.87 ± 0.14
	10	0.035 ± 0.005	0.034 ± 0.005	0.007 ± 0.001	0.56 ± 0.04
	11	0.018 ± 0.005	0.023 ± 0.003	0.003 ± 0.002	0.44 ± 0.06
	12	0.010 ± 0.002	0.009 ± 0.003	0.002 ± 0.001	0.16 ± 0.03