

Supporting Information

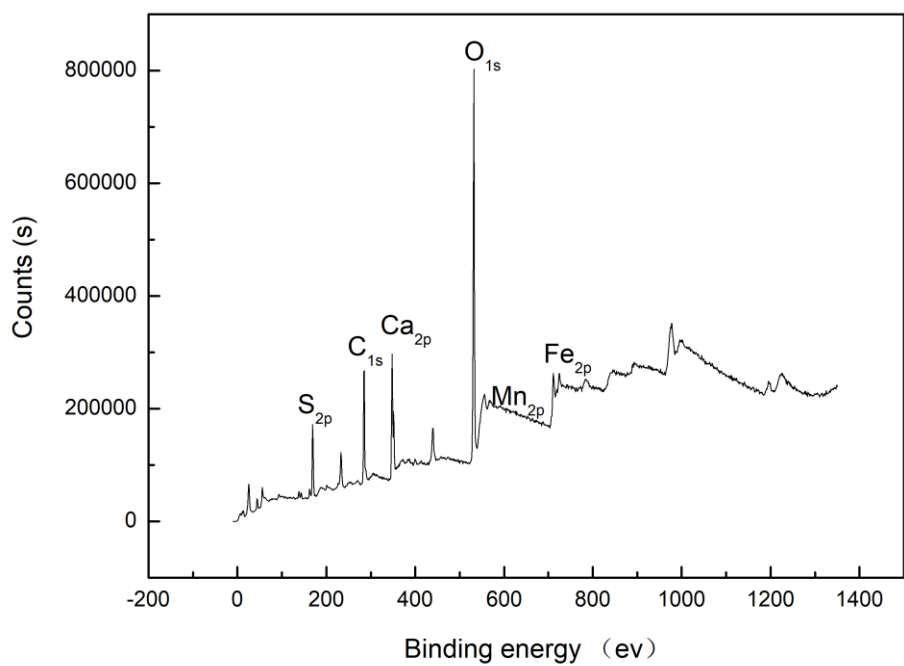
Table 1 The experimental data for Fig 4 (a)

Conditions	pH	Formula of Eh-pH
$C_{\text{Fe}}=0.1\text{mol/L}$, $C_{\text{s}}=0.1\text{mol/L}$ $T=25^{\circ}\text{C}$	$\text{pH}(\text{Fe}^{3+}/\text{FeOOH})=0.4638$	—
	From -2.00 to 0.46	$\varphi(\text{Fe}^{3+}/\text{Fe}^{2+})=0.7704\text{ V}$
	From 0.46 to 4.59	$\varphi(\text{FeO}\cdot\text{OH}/\text{Fe}^{2+})=0.8527\text{-}0.1775\text{pH}$
	From 4.59 to 10.00	$\varphi(\text{FeO}\cdot\text{OH}/\text{FeS}_2)=0.3824\text{-}0.0749\text{pH}$
	From -2.00 to 4.59	$\varphi(\text{Fe}^{2+}/\text{FeS}_2)=0.3326\text{-}0.0641\text{pH}$
	$\text{pH}(\text{HSO}_4^-/\text{SO}_4^{2-})=1.92$	—
	From 1.92 to 10.00	$\varphi(\text{HSO}_5^{2-}/\text{SO}_4^{2-})=1.7828\text{-}0.0296\text{pH}$
	From -2.00 to 1.92	$\varphi(\text{HSO}_5^{2-}/\text{HSO}_4^-)=1.8396\text{-}0.0592\text{pH}$

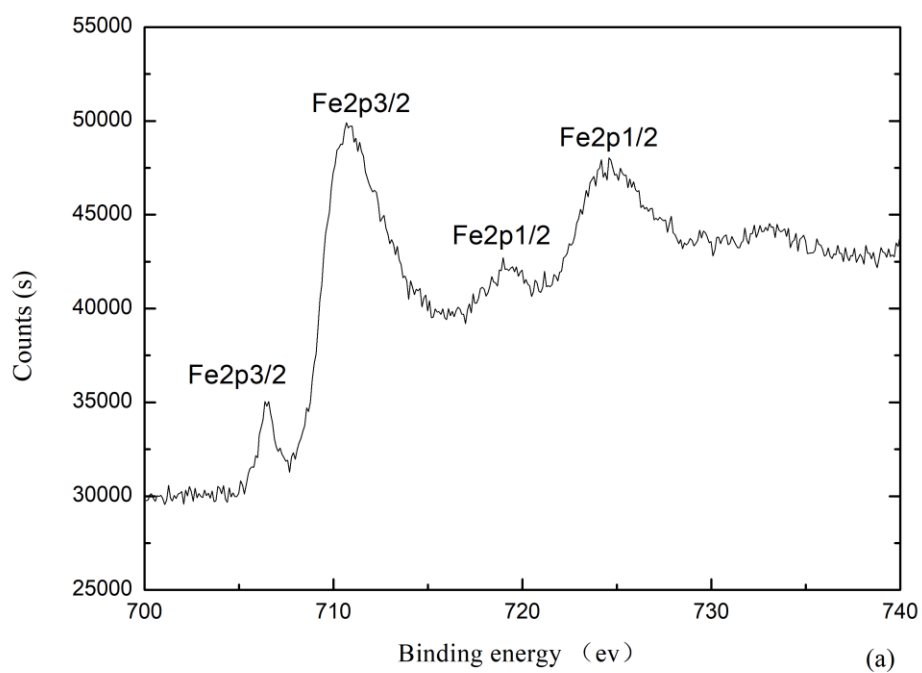
Table 2 The experimental data for Fig 4 (b)

Conditions	pH	Formula of Eh-pH
$C_{\text{Mn}}=1\text{mol/L}$, $C_{\text{s}}=0.1\text{mol/L}$ $T=25^{\circ}\text{C}$	From 2.0 to 3.08	$\varphi(\text{MnO}_2/\text{Mn}^{2+})=1.2184\text{-}0.1183\text{pH}$
	From 3.08 to 6.94	$\varphi(\text{MnO}\cdot\text{OH}/\text{Mn}^{2+})=1.4007\text{-}0.1775\text{pH}$
	From 6.94 to 7.58	$\varphi(\text{Mn}_3\text{O}_4/\text{Mn}^{2+})=1.8111\text{-}0.2366\text{pH}$
	$\text{pH}(\text{Mn}(\text{OH})_2/\text{Mn}^{2+})=7.58$	—
	From 7.58 to 10.00	$\varphi(\text{Mn}_3\text{O}_4/\text{Mn}(\text{OH})_2)=0.4663\text{-}0.0591\text{pH}$
	From 6.94 to 10.00	$\varphi(\text{MnO}\cdot\text{OH}/\text{Mn}_3\text{O}_4)=0.5258\text{-}0.0514\text{pH}$
	From 3.08 to 10.00	$\varphi(\text{MnO}_2/\text{MnO}\cdot\text{OH})=1.0323\text{-}0.0591\text{pH}$
	$\text{pH}(\text{HSO}_3^-/\text{SO}_3^{2-})=7.20$	—

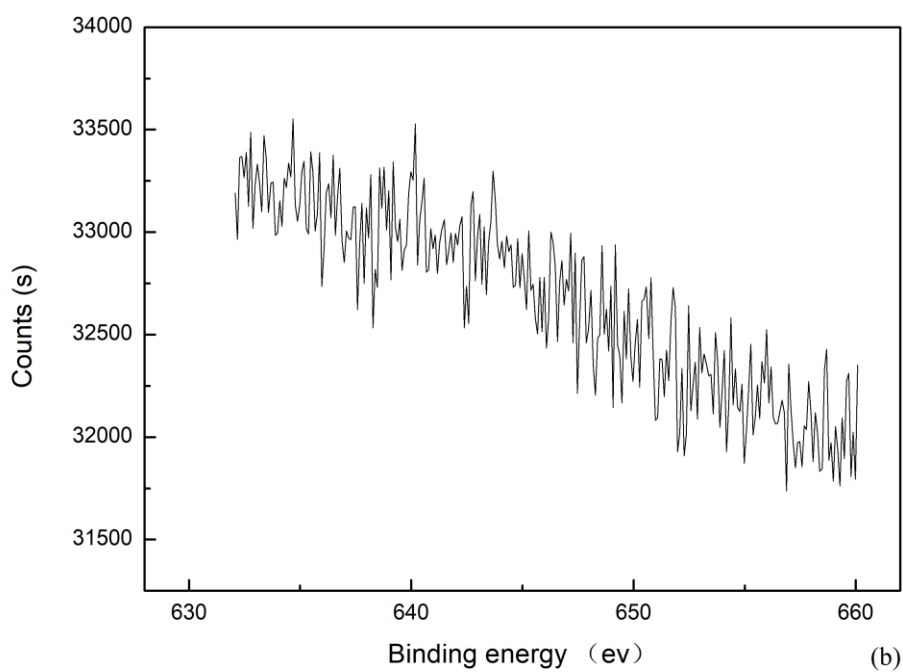
	From 2 to 7.20	$\varphi(\text{SO}_4^{2-}/\text{HSO}_3^-) = 0.1057 - 0.0887\text{pH}$
	From 7.20 to 10.00	$\varphi(\text{SO}_4^{2-}/\text{SO}_3^{2-}) = -0.1073 - 0.0591\text{pH}$
	From 2 to 10.00	$\varphi(\text{HSO}_5^{2-}/\text{SO}_4^{2-}) = 1.7999 - 0.0381\text{pH}$



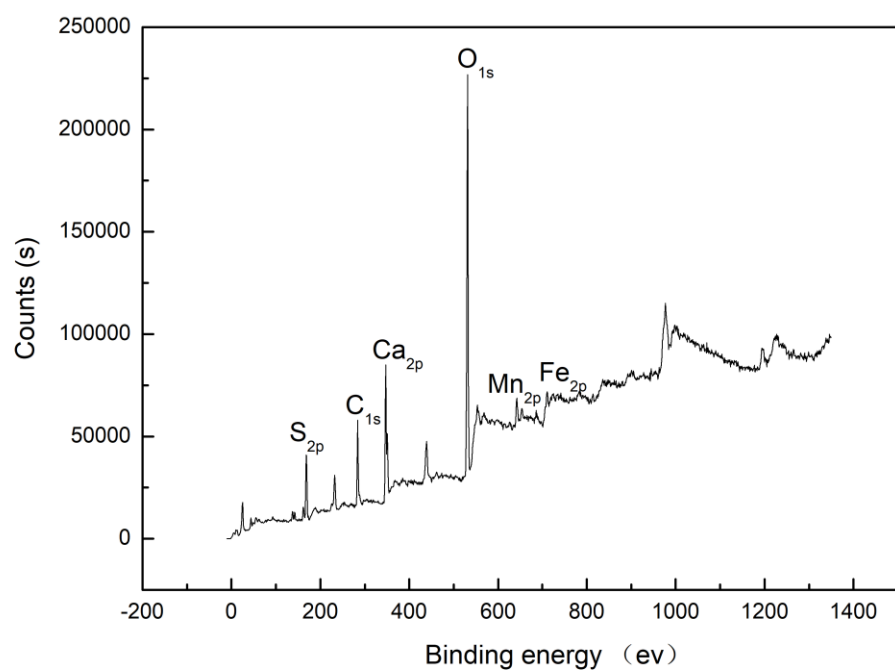
The XPS of the precipitate after iron removal



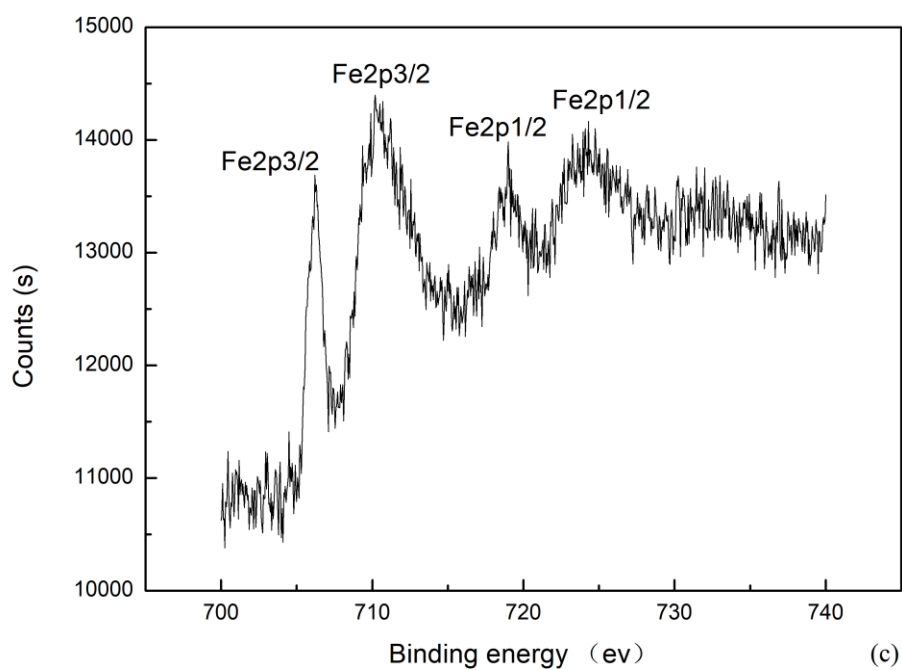
The Fe 2p spectrum of the precipitate after iron removal



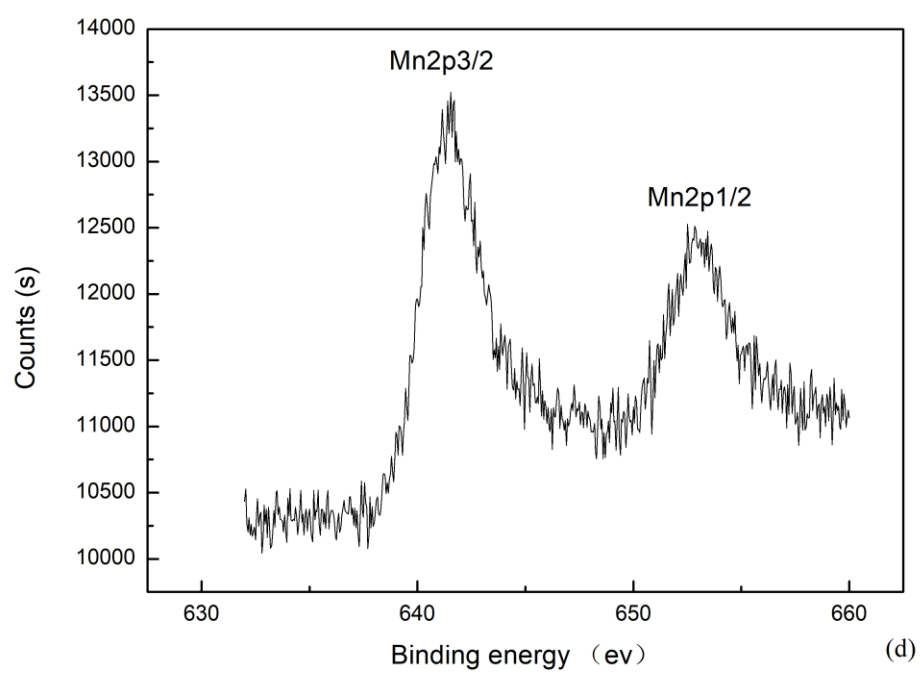
The Mn 2p spectrum of the precipitate after iron removal



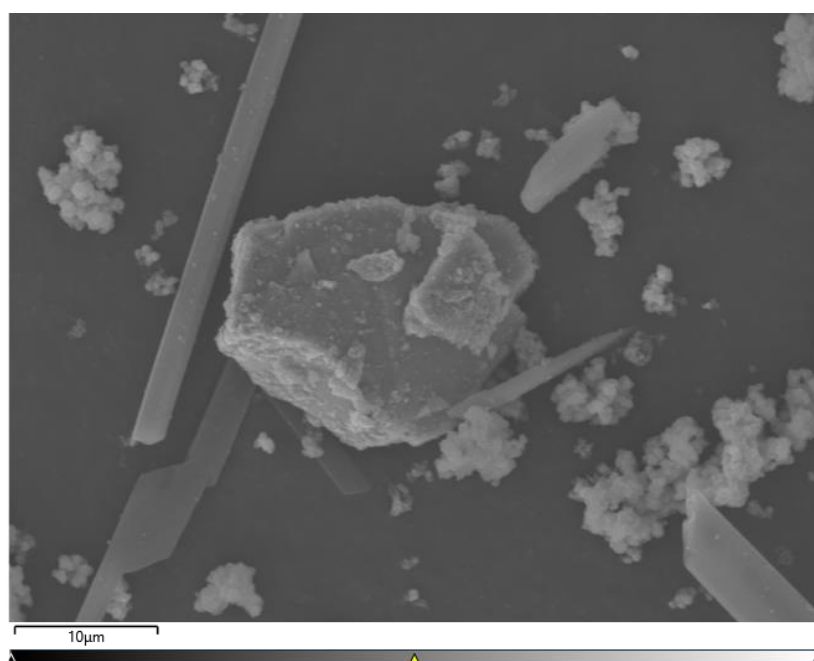
The XPS of the precipitate after iron and manganese removal



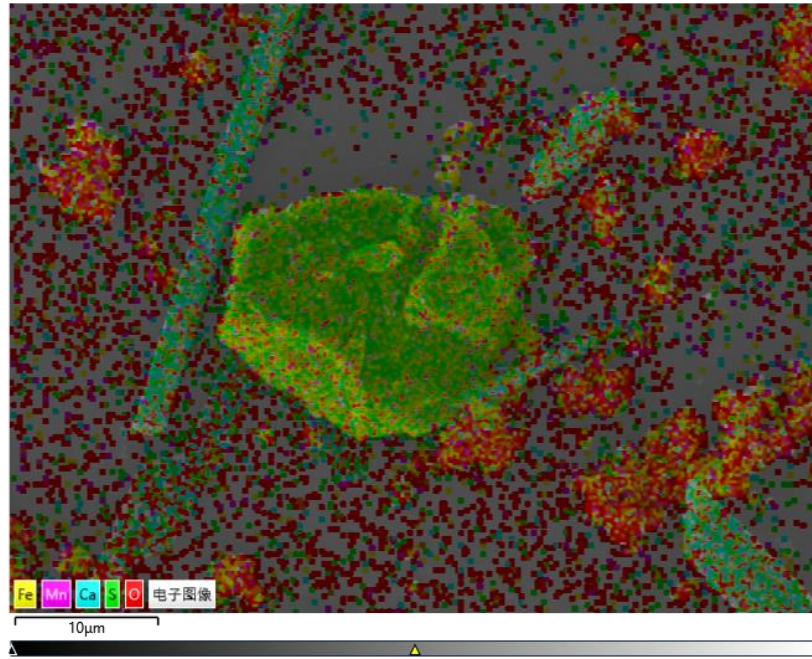
The Fe 2p spectrum of the precipitate after iron removal



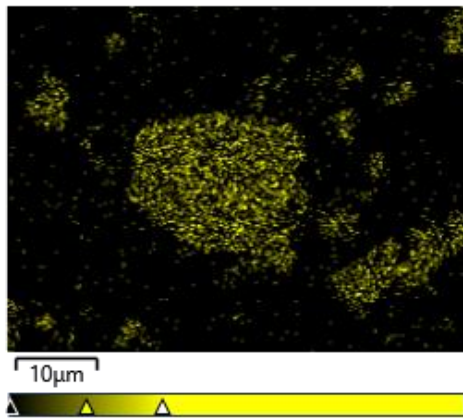
The Mn 2p spectrum of the precipitate after iron removal



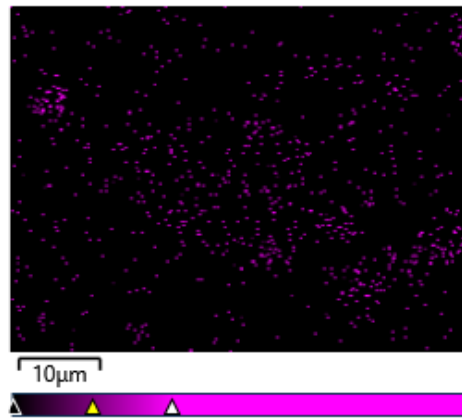
EDS 分层图像 2



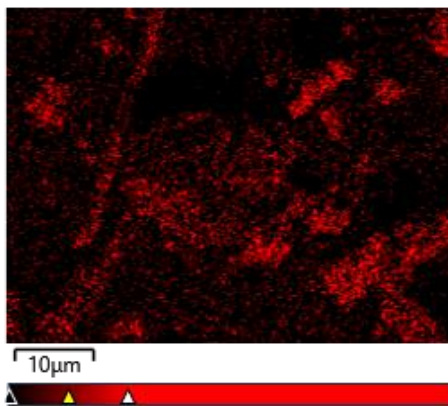
Fe K α 1



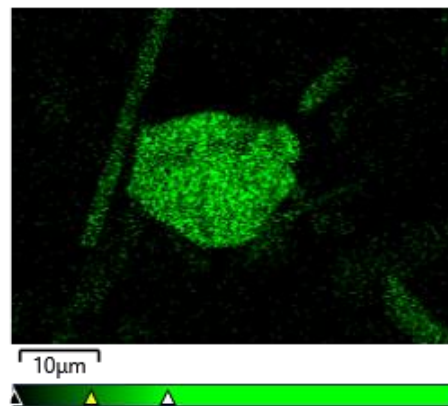
Mn K α 1

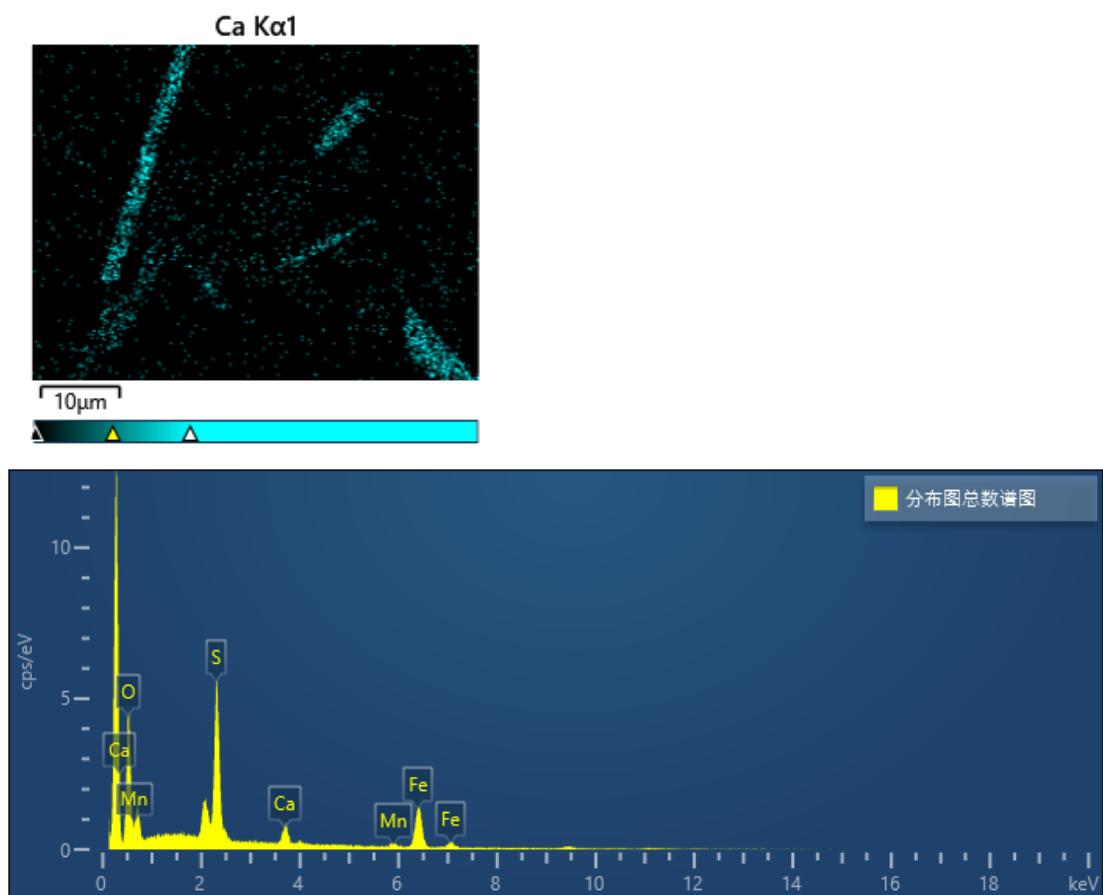


O K α 1



S K α 1





The SEM of the precipitate after iron and manganese removal