

## **Supplementary Information**

### **Comparative investigation of the spectroscopic behavior based on high-concentrated solution in nitrogen and air atmospheres**

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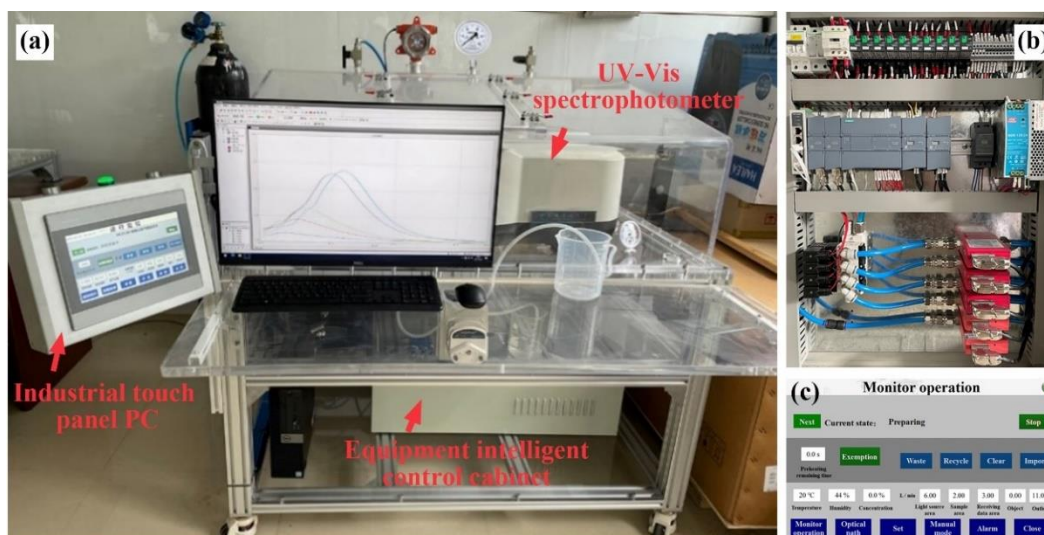
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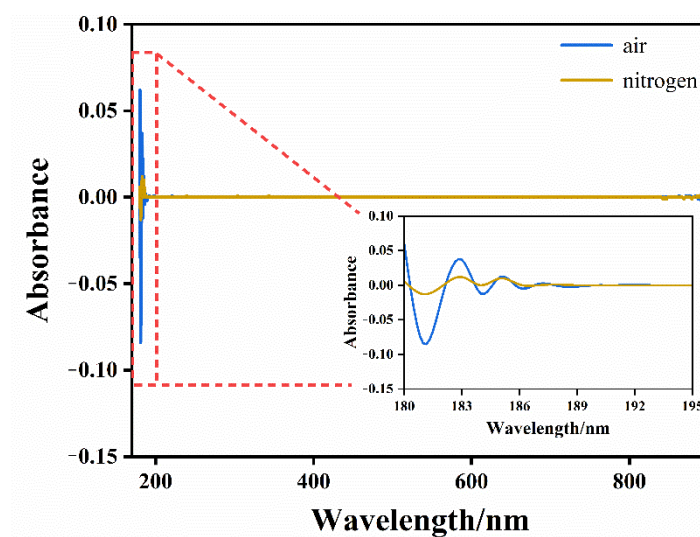
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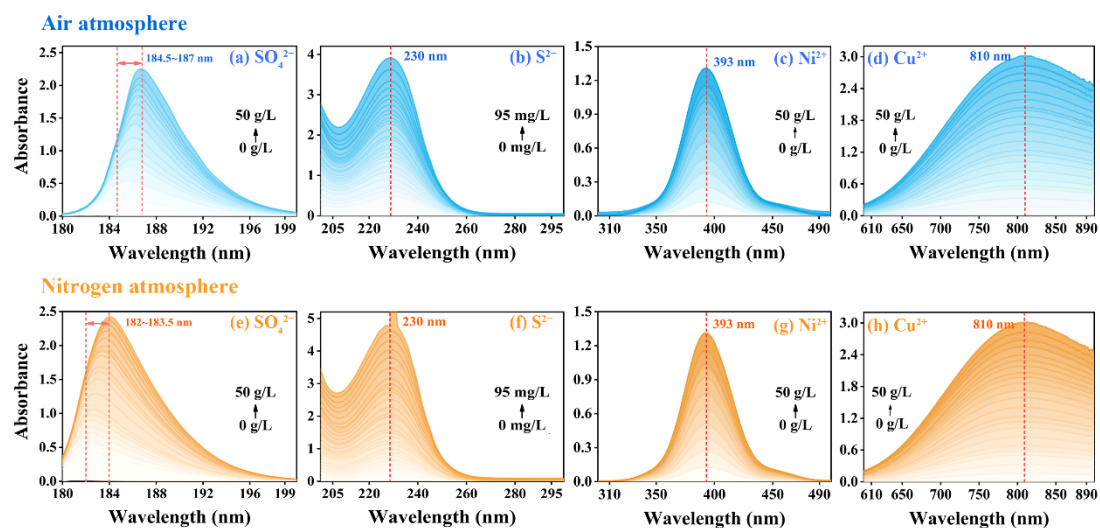
**The supplementary materials include 9 pages.**



**Figure S1** Configuration diagram of the whole set (a) picture of real products, (b) PLC integrated control and (c) upper computer operation monitoring interface

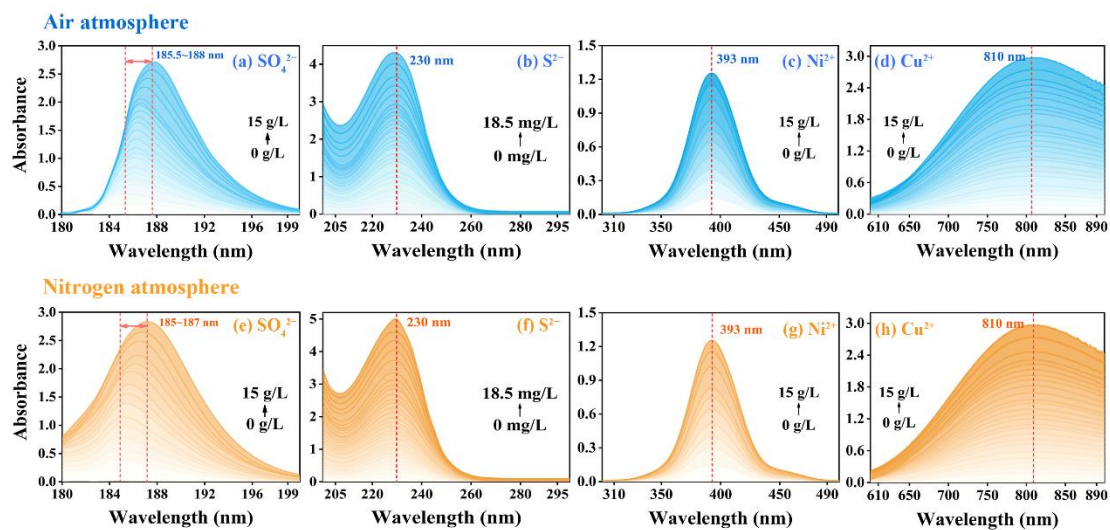


**Figure S2** Comparison of baseline flatness under air and nitrogen atmospheres



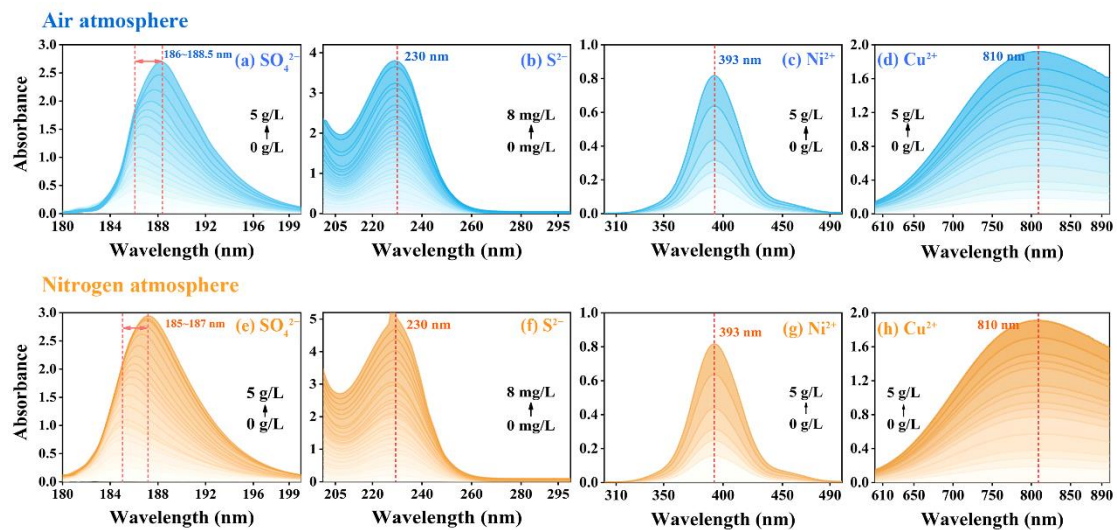
**Figure S3.** Spectral curves of  $\text{SO}_4^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{Ni}^{2+}$  and  $\text{Cu}^{2+}$  respectively in air atmosphere

(a~d, blue curve) and nitrogen atmosphere (e~h, yellow curve) when  $b=3$  mm



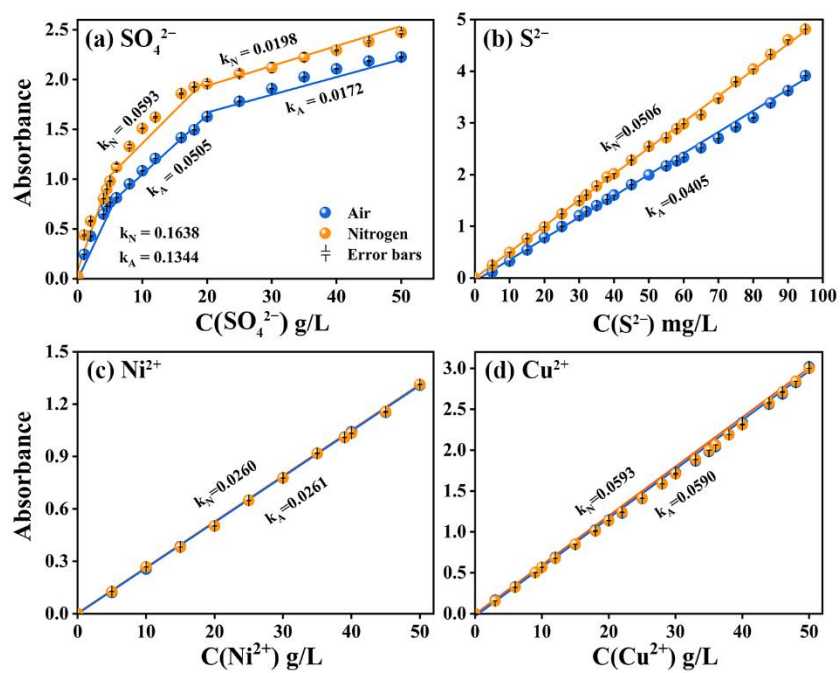
**Figure S4.** Spectral curves of  $\text{SO}_4^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{Ni}^{2+}$  and  $\text{Cu}^{2+}$  respectively in air atmosphere

(a~d, blue curve) and nitrogen atmosphere (e~h, yellow curve) when  $b=10$  mm

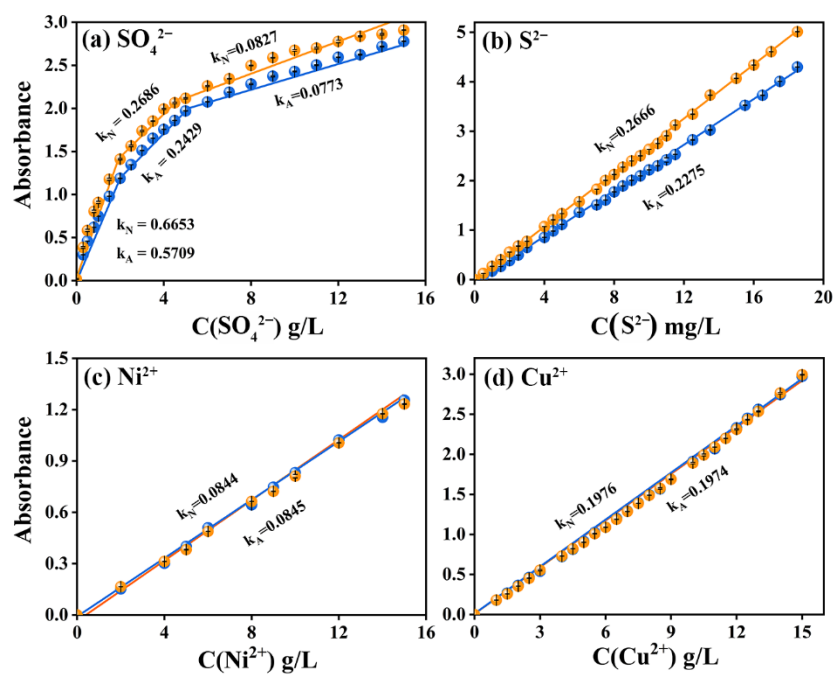


**Figure S5.** Spectral curves of  $\text{SO}_4^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{Ni}^{2+}$  and  $\text{Cu}^{2+}$  respectively in air atmosphere

(a~d, blue curve) and nitrogen atmosphere (e~h, yellow curve) when  $b=20$  mm

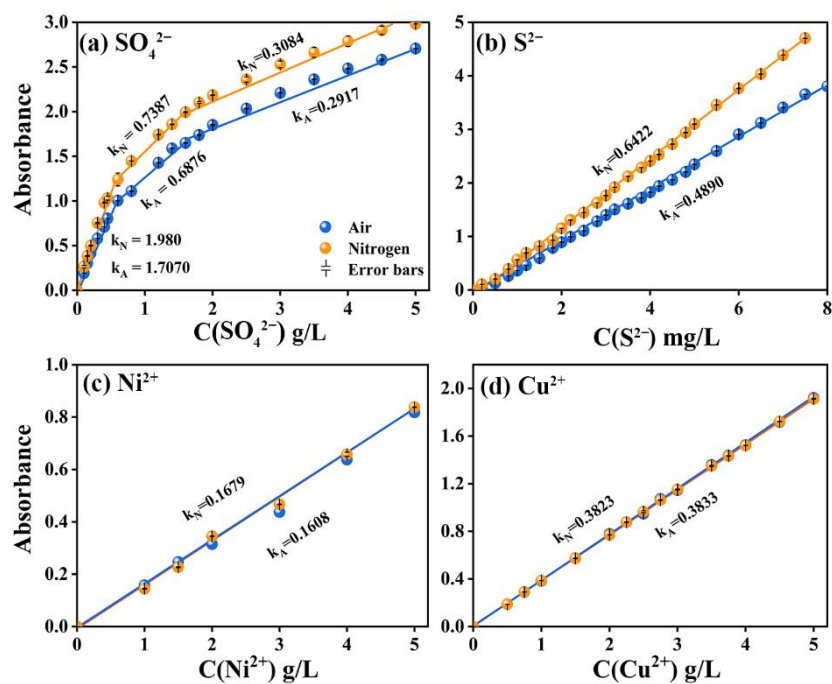


**Figure S6.** C-A curves of  $\text{SO}_4^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{Ni}^{2+}$  and  $\text{Cu}^{2+}$  respectively in air (blue curve) and nitrogen atmosphere (yellow curve) when  $b=3$  mm

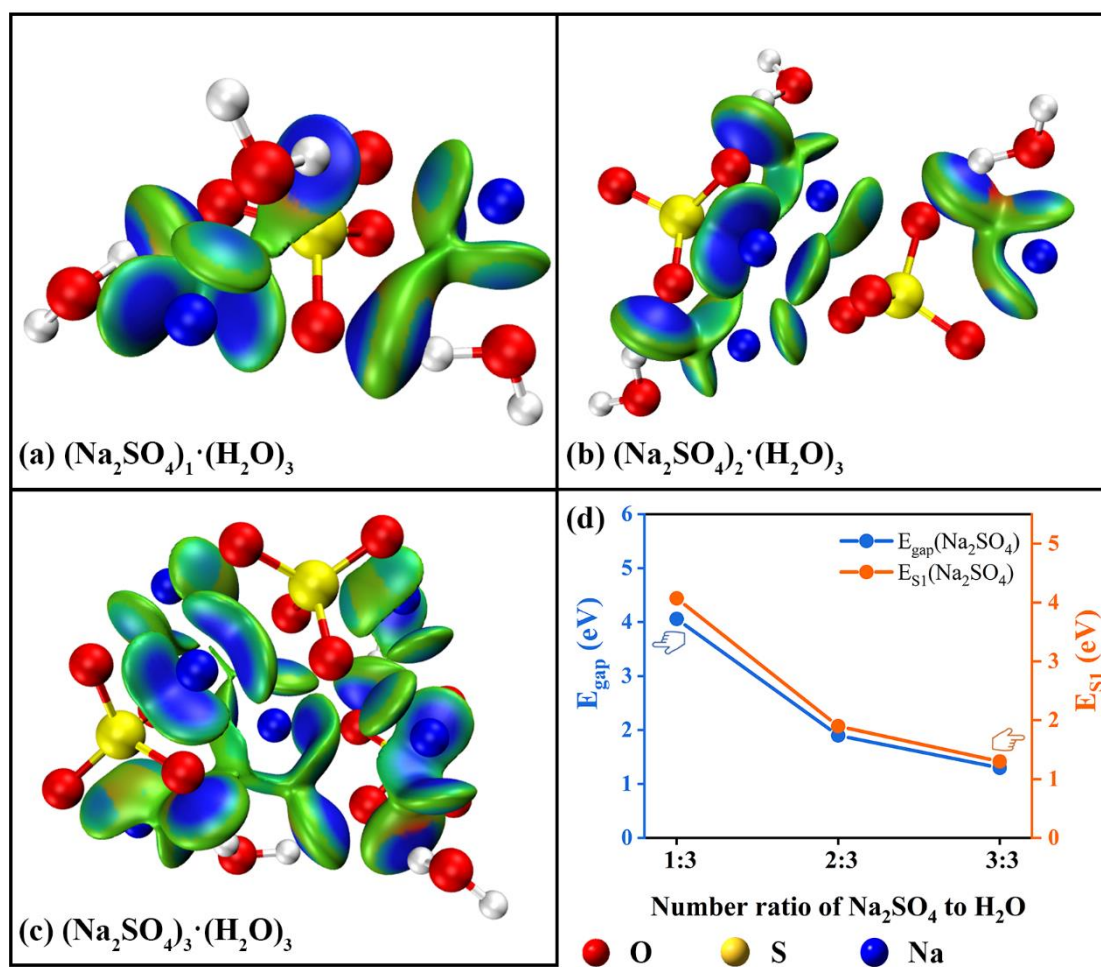


**Figure S7.** C-A curves of  $\text{SO}_4^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{Ni}^{2+}$  and  $\text{Cu}^{2+}$  respectively in air (blue curve) and nitrogen atmosphere (yellow curve) when  $b=10$  mm





**Figure S8.** C-A curves of  $\text{SO}_4^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{Ni}^{2+}$  and  $\text{Cu}^{2+}$  respectively in air (blue curve) and nitrogen atmosphere (yellow curve) when  $b=20$  mm



**Figure S9.** The variation law of forces and energy along with concentration within  $(\text{Na}_2\text{SO}_4)_i \cdot (\text{H}_2\text{O})_3$  ( $i=1\sim3$ ) systems