# Supplementary Information

## 1. The absorbance spectrum graph for LCV before and after colorimetric reaction

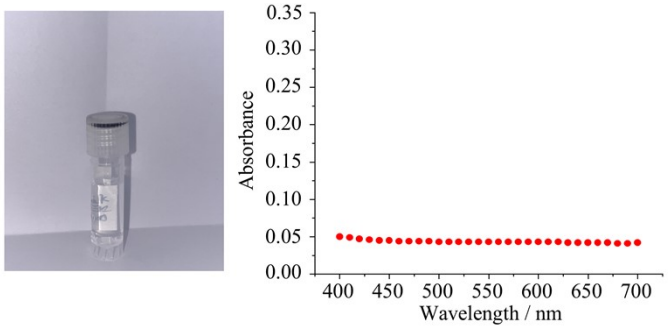


**Figure S1.** The absorbance spectrum graph for LCV before chromogenic reaction.

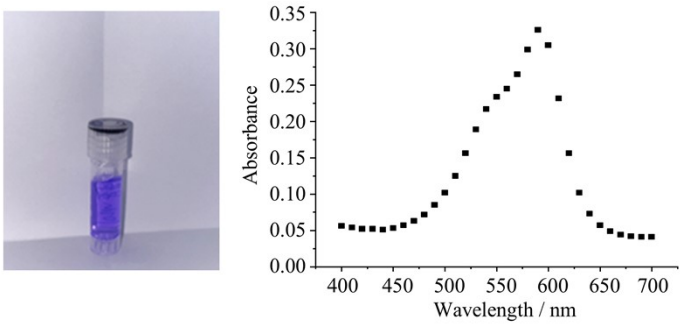


**Figure S2.** The absorbance spectrum graph for LCV after chromogenic reaction (10 μM $H_2O_2$).

## 2. The concentrations of $H_2O_2$ in iron-containing solutions measured by the LCV method under aerobic and anaerobic conditions

We used the LCV method[1] to measure the mix solution which containing both hydrogen peroxide and $Fe^{2+}$, the results are shown in the Fig. S1 and Table S2.

Specifically, under aerobic condition, when the concentration of ferrous ions was low, the LCV method indicated significantly higher hydrogen peroxide concentrations than observed. Conversely, when the ferrous ion concentration was high, the LCV method yielded markedly lower readings than expected.

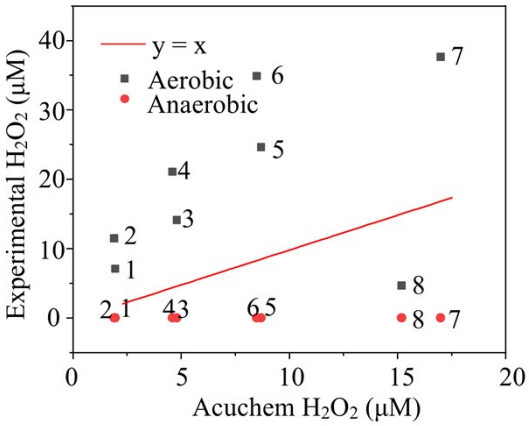


**Figure S3.** The results of $H_2O_2$ concentration from Acuchem simulationa and experiments after 30 s Fenton reaction; The initial reactant concentrations represented by each number are shown in supplementary Table. S1.

**Table S1** The initial reactant concentrations

| | **Initial $C_{(Fe2+)}$/μM** | **Initial $C_{(H2O2)}$/μM** |
|---|---|---|
| 1 | 10 | 2 |
| 2 | 20 | 2 |
| 3 | 20 | 5 |
| 4 | 40 | 5 |
| 5 | 40 | 10 |
| 6 | 80 | 10 |
| 7 | 80 | 20 |
| 8 | 200 | 20 |

**Table S2** The concentrations of $H_2O_2$ after 30s Fenton reaction

| | **Experimental under aerobic $C_{(H2O2)}$/μM** | **Experimental under anaerobic $C_{(H2O2)}$/μM** | **Acuchem simulation $C_{(H2O2)}$/μM** |
|---|---|---|---|
| 1 | 7.1 | 0 | 1.96 |
| 2 | 11.5 | 0 | 1.9 |
| 3 | 14. | 0 | 4.8 |
| 4 | 21.1 | 0 | 4.6 |
| 5 | 24.6 | 0 | 8.7 |
| 6 | 34.9 | 0 | 8.5 |
| 7 | 37.6 | 0 | 17 |
| 8 | 4.7 | 0 | 15.2 |

## 3. The chelating experiments of $Fe^{2+}$ by EDTA under anaerobic condition

A 60 μM $FeSO_4$ solution was prepared under both aerobic and anaerobic conditions. In each environment, 1 mL of this solution was dispensed into a 2 mL centrifuge tube. Following this, 100 mL of EDTA was introduced, preceding the addition of the 1,10-Phenanthroline reagent of the same volume. The progression of color change within the solution is illustrated in Fig. S2. The resultant red hue in the centrifuge tube corresponds to the complex formed between 1,10-Phenanthroline and ferrous ions. This suggests that under anaerobic conditions, the efficient of EDTA in complexing ferrous ions diminishes compared to its performance in an aerobic environment. Therefore, a specific ferrous ion complexing agent is necessitated for testing under anaerobic conditions.

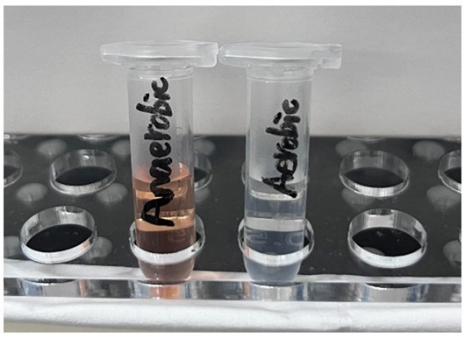


**Figure S4.** The color development after the addition of 100 μL of EDTA chelating reagent into a 1 mL solution containing 60 μM ferrous sulfate solution, followed by the addition of 100 μL of 1,10-Phenanthroline, under both aerobic and anaerobic conditions.

## 4. The chromogenic picture of 20 μM $H_2O_2$ using different pH of phosphate buffer in the LCV method.

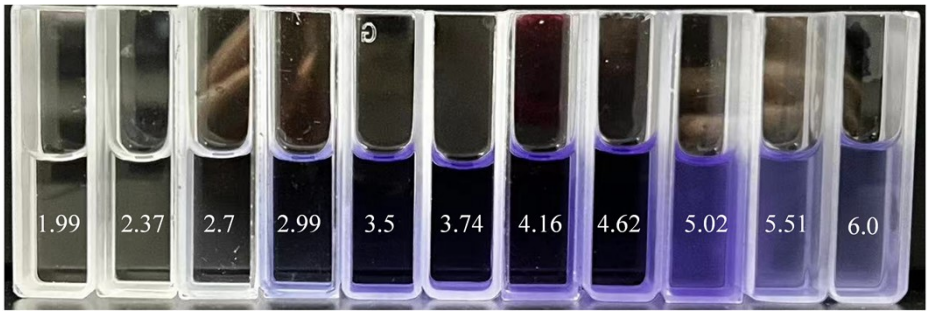


**Figure S5.** The chromogenic picture of 20 μM $H_2O_2$ using different pH of phosphate buffer in the LCV method (white number means the pH of buffer).

## 5. calibration curve of the concentrations of 1,10-Phenanthroline-Fe(II)

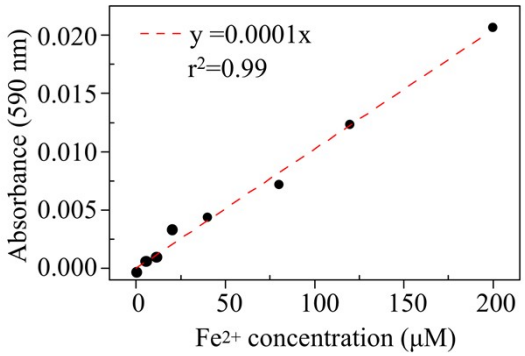


**Figure S6.** Figure S4. The calibration curve of $Fe^{2+}$ concentrations versus its absorbance at 590 nm after 10 min colorimetric reaction using 1,10-Phenanthroline method.

## 6. Effects of $SO_4^{2-}$ and $Cl^-$ in LCV chromogenic reactions with chelating reagents

The different concentrations of Cl- (Fig. S5, Green triangle) and $SO_4^{2-}$ (Fig. S5, Blue triangle) in solutions exhibit nearly identical absorbance at 590 nm after chromogenic reactions. Moreover, as the concentration of anions in the solution escalated from 10 to 100 μM, the absorbance at 590 nm after LCV chromogenic demonstrated no exaltation compared to the absorbance of the blank sample.

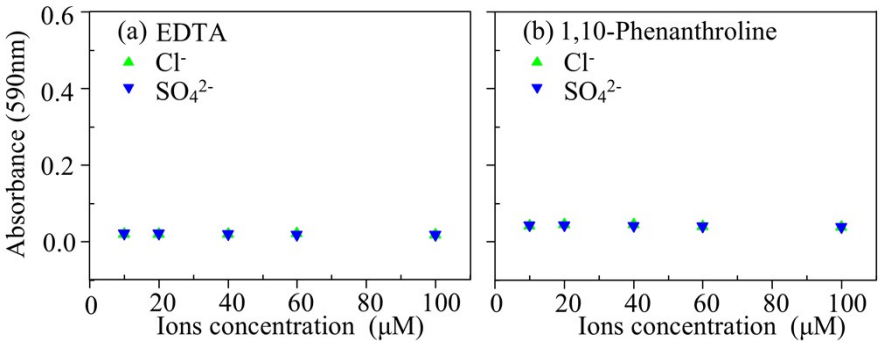


**Figure S7.** The absorbance at 590 nm versus the concentrations of $Fe^{2+}$ and $Fe^{3+}$, with EDTA(a), 1,10-Phenanthroline(b)

## 7. The calibration curve of $H_2O_2$ concentrations versus its absorbance at 590 nm after LCV colorimetric reaction.

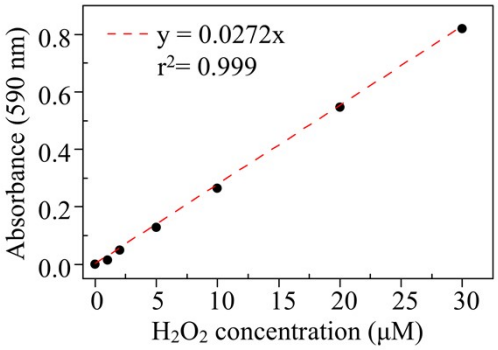


**Figure S8.** The calibration curve of $H_2O_2$ concentrations versus its absorbance at 590 nm after LCV colorimetric reaction.

## 8. Determination of iron ions

To determine the concentrations of $Fe^{2+}$, the reagents were sequentially added to a 2 mL tube as follows: 0.9 mL sample, 100 μL 1,10-Phenanthroline (100 g/L), and 0.5 mL $NH_4Ac$-HAc buffer (prepared by dissolving 40 g of $NH_4Ac$ in 50 mL of HAc and diluting to a final volume of 100 mL with DI water). The solution was then diluted to a final volume of 1.7 mL with DI water. After allowing the color to develop for 10 minutes, the absorbance at 510 nm was measured using a spectrometer. To determine the concentrations of $Fe^{3+}$, by adding 100 μL hydroxylamine hydrochloride (100 g/L) to samples before adding chemogenic reagents.

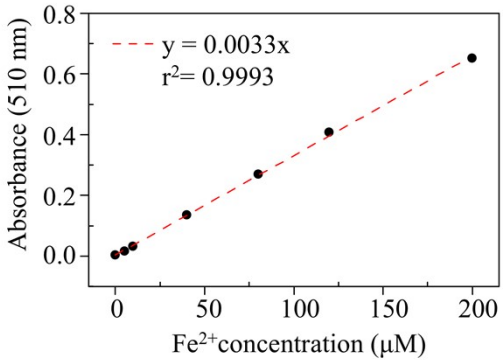


**Figure S9.** The calibration curve of $Fe^{2+}$ concentrations versus its absorbance at 510 nm after 1,10-Phenanthroline colorimetric reaction

# References

1. C. A. Cohn, *Geochemical Transactions*, 2005, **6**, 3.