SUPPORTING INFORMATION

Spray Absorption and Electrochemical Reduction of Nitrogen Oxides from Flue Gas

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S1. The front view of the chamber.

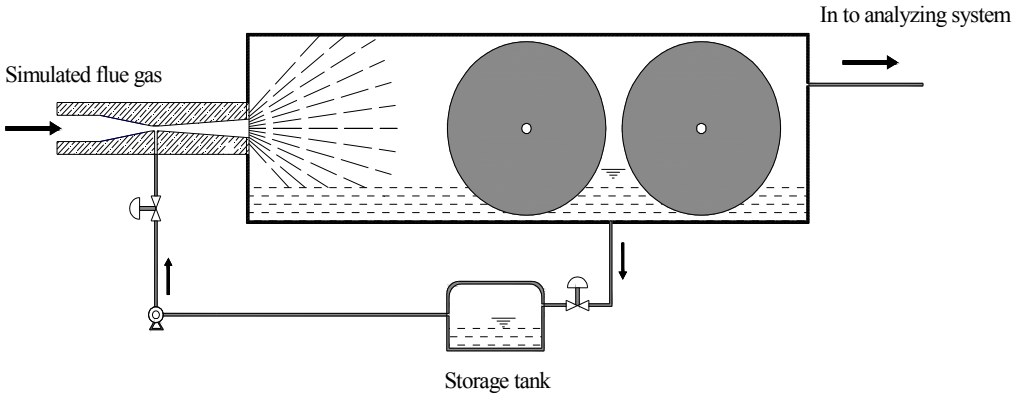

Figure S1. The front view of the chamber.

S2. F-F' section draw of the chamber.

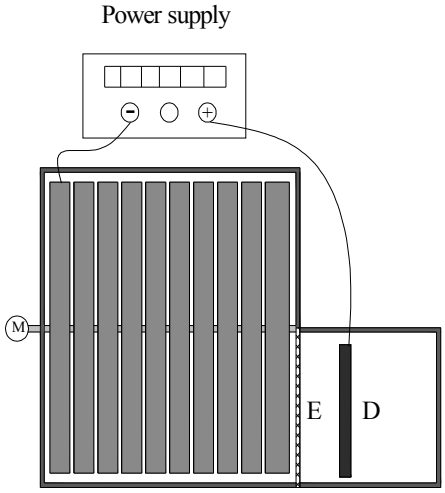

Figure S2. F-F' section draw of the chamber.

S3. Ion chromatogram of the electrolyte with time.

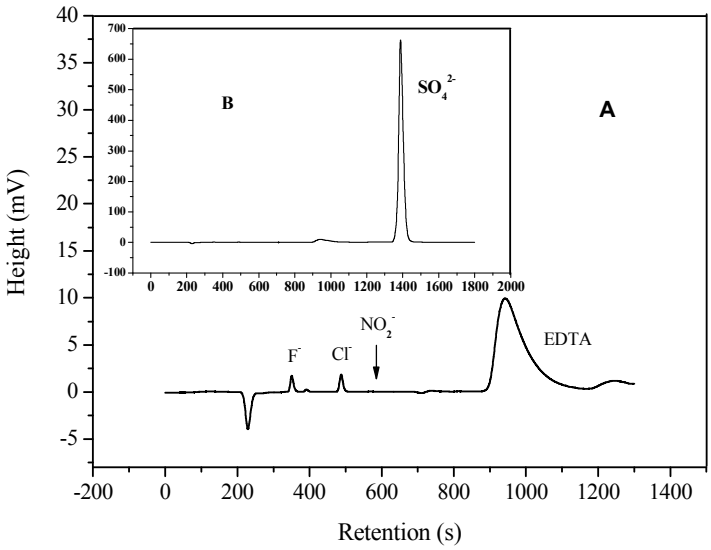

Figure S3. The ion chromatogram (A: the ion chromatogram before retention 1300s; B: all ion chromatogram).

S4. FTIR spectrum of in the outlet flue gas.

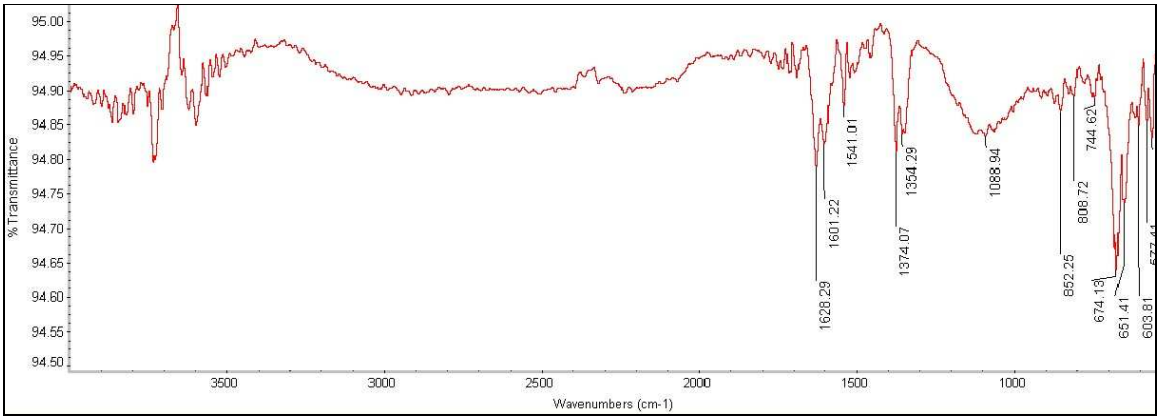

Figure S4. FTIR spectrum.

S5. Effect of electrolysis temperature on NO removal.

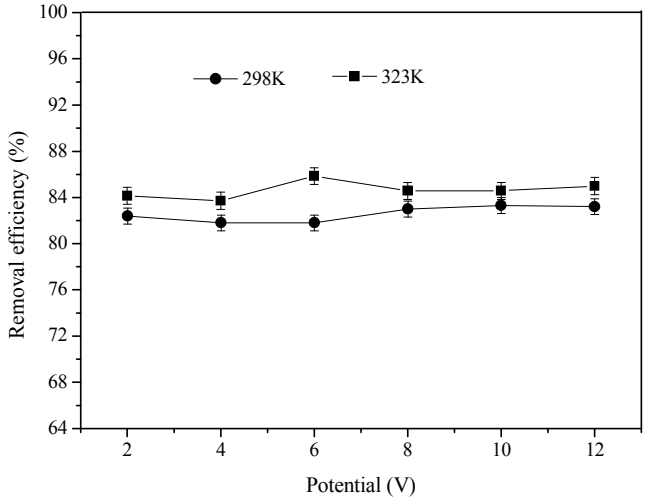

Figure S5. Effect of electrolysis temperature on NO removal (NO=850 mg·m^{-3}, Fe(Ⅱ)(EDTA)=60 mM, pH=5.5, L/G=3, O_2=5%, voltage from 2 to 12V).

Electrolysis temperature had certain effect on NO removal efficiency. As shown in figure below, the NO removal efficiency increased from approximately 82% at 298 K to 84% at 323 K. However, based on our experience, the reduction time decreased significantly at 323K. In addition, with the consideration of the fact that temperature of the flue gas from FGD (Flue Gas Desulfurization) was approximately 323K, 323K was used through our experiments in this study.

S6. Current density.

Given the voltage of 5V, the current was 0.5A. And the electrode surface area of the cathode was 47.49cm^2. The current density, therefore, was calculated as 10.6mA/cm^2.

S7. Current rate.

The current rate was calculated as below:

For experimental conditions of 30 min electrolysis time and 0.5 A current, the total amount of electron was:

$$n = \frac{I \times t}{F}$$
$$= \frac{0.5 \times 1800}{96485.3383}$$
$$= 9.3 \times 10^{-3}\ \text{mol}$$

Where I was the current with unit of A. t was the time of electrolysis with unit of Sec. and F was Faraday constant with unit $C \cdot mol^{-1}$.

200mL mixture solution from the Fe(II)(EDTA) spray and NO_x absorption region was used to investigate the current rate. Before electrolysis, concentrations of NO_3^-, NO_2^- and Fe(Ⅱ)(EDTA)(NO) in the mixture solution were 1.19×10^{-3} mol, 2.17×10^{-3} mol and 1.4×10^{-3} mol respectively. After electrolysis, their concentrations were 0.97×10^{-3} mol, 0.43×10^{-3} mol and 1.2×10^{-3} mol respectively. The total amount of electrons used in reduction reaction was:

$$n_1 + n_2 + n_3$$

$$= (1.19\times10^{-3} - 0.97\times10^{-3})\times5 + (2.17\times10^{-3} - 0.43\times10^{-3})\times3 + (1.4\times10^{-3} - 1.2\times10^{-3})\times2$$

$$= 6.72\times10^{-3}\,\text{mol}$$

Where n_1, n_2 and n_3 were the amount of electrons that reduced NO_3^-, NO_2^- and NO to N_2 respectively.

Therefore, the current rate was:

$$\frac{n_1 + n_2 + n_3}{n}$$

$$= \frac{6.72\times10^{-3}}{9.3\times10^{-3}}\times100\%$$

$$= 72.3\%\,.$$

S8. Effect of Fe(Ⅱ)(EDTA) concentration on NO removal.

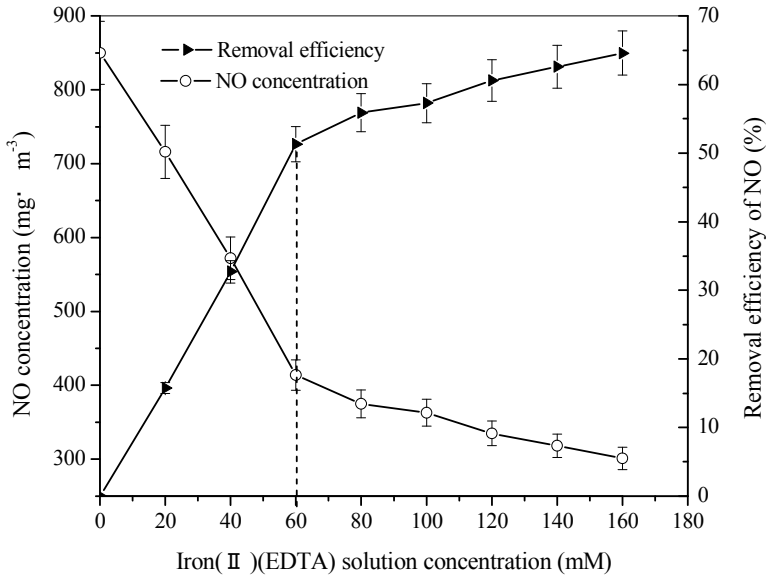

Figure S8. Effect of Fe(Ⅱ)(EDTA) concentration on NO removal (NO=850 mg • m^{-3}, L/G=3, O_2=5%, T=323K and no voltage).

S9. Effect of pH on NO removal.

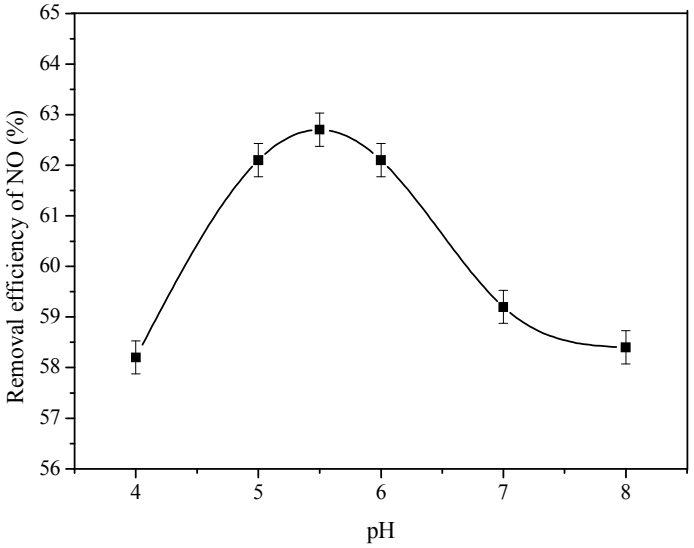

Figure S9. Effect of pH on NO removal (NO=850 mg • m^{-3}, Fe(Ⅱ)(EDTA)=60 mM, L/G=3, O_2=5%, T=323K and no voltage).

S10. Effect of voltages on NO removal.

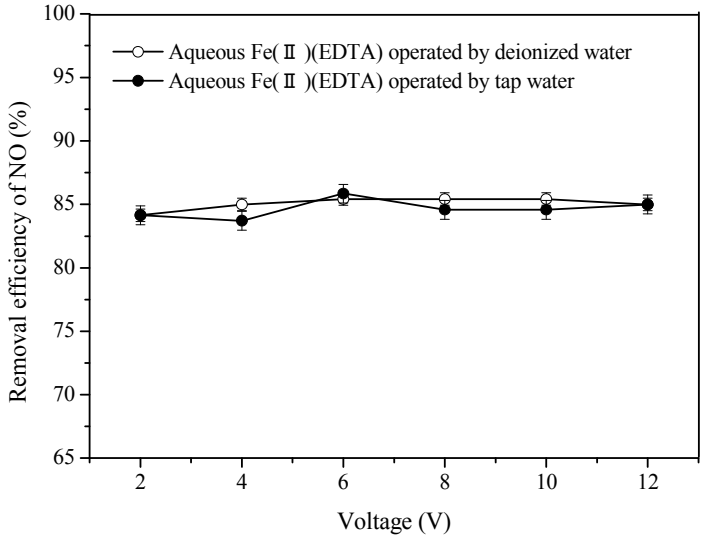

Figure S10. Effect of voltages on NO removal (NO=850 mg •m^{-3}, Fe(Ⅱ)(EDTA)=60 mM, pH=5.5, L/G=3, O_2=5%, T=323K).

S11. Effect of liquid-gas ratio on NO removal.

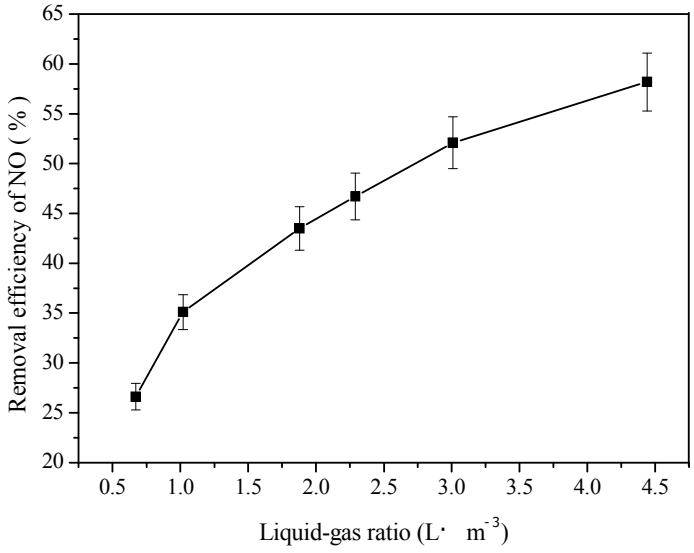

Figure S11. Effect of liquid-gas ratio on NO removal (NO=850 mg • m^{-3}, Fe(Ⅱ)(EDTA)=60 mM, pH=5.5, O_2=5%, T=323K and no voltage).

S12. Effect of rotating speed on NO removal.

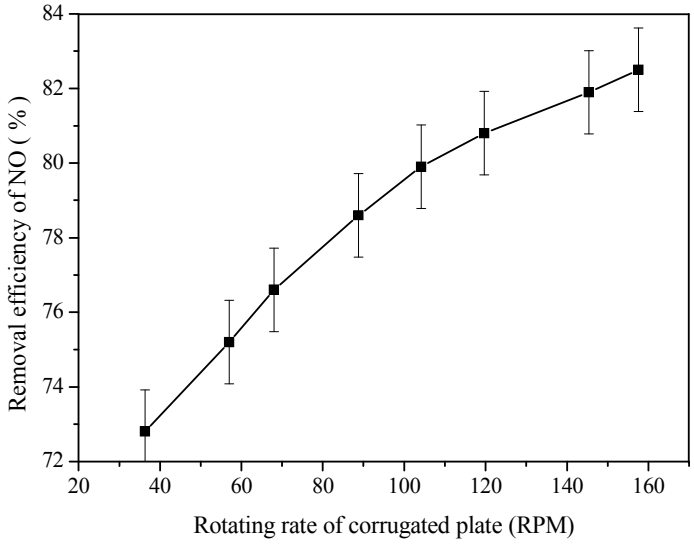

Figure S12. Effect of rotating speed on NO removal (NO=850 mg • m^{-3}, Fe(Ⅱ)(EDTA)=60 mM, pH=5.5, L/G=4, O_2=5%, T=323K and no voltage).

S13. Effect of NO concentration in inlet flue gas on NO removal.

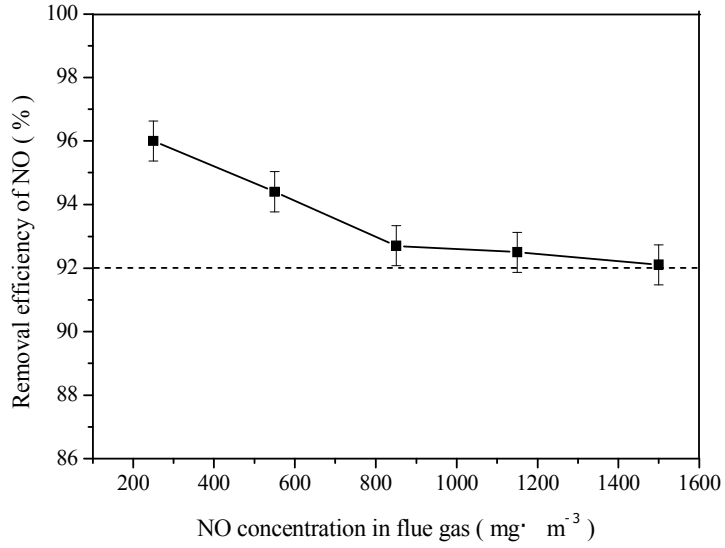

Figure S13. Effect of NO concentration in inlet flue gas on NO removal (Fe(Ⅱ)(EDTA)=60 mM, pH=5.5, L/G=4, Rotating speed=157 rpm, Voltage=6 V, O_2=5%, T=323K).

S14. Effect of SO_2 concentration on NO removal.

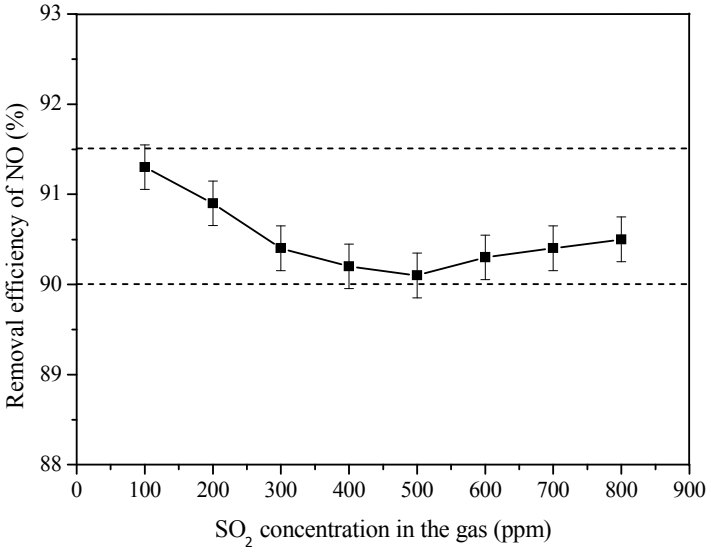

Figure S14. Effect of SO_2 concentration in inlet flue gas on NO removal (NO=850 mg • m^{-3}, Fe(Ⅱ)(EDTA)=60 mM, pH=5.5, L/G=4, Rotating speed=157 rpm, Voltage=6 V, O_2=5%, T=323K).