Supplementary Information

$SrFe_xNi_{1-x}O_{3-\delta}$ perovskites coated on Ti anodes and their electrocatalytic properties for cleaning nitrogenous wastewater

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1. Measurement of total nitrogen (TN) concentration

1.1. Principle

The TN concentration were determined by alkaline potassium persulfate digestion UV spectrophotometric method (HJ 636-2012), featured with non-toxic chemicals, compared with other determination methods of ammonia nitrogen, such as salicylic acid spectrophotometry, Nessler's reagent spectrophotometry, and distillation-neutralization titration. In this method, $K_2S_2O_8$ served as a strong oxidant to convert the nitrogenous contaminants into nitrates (digestion conditions: 130 ℃, 90 min). Deionized water was used as the reference solution and UV absorbances (A_{220} and A_{275}) of water samples at 220 nm and 275 nm were obtained by the UV-visible spectrophotometer, respectively. Moreover, corrected absorbance (A_{cor}) was calculated according to formula (S1), and the TN concentration was directly proportional to A_{cor}.

With respect to the $(NH_4)_2SO_4$ solution for simulated nitrogenous wastewater, the TN concentration represented the concentration of NH_4^+. TN concentration in the treated nitrogenous wastewater should satisfy the discharge standard of pollutants for municipal wastewater treatment plant in China (GB 18918-2002, Class I-A Standard, TN concentration ≤ 15 mg/L).

1.2. Detection limit and measurement range

Detection limit: 0.54 mg L^{-1}; Measurement range: 0-150 mg L^{-1}.

1.3. Measurement steps:

(1) Preparation of alkaline potassium persulfate solution: 2.00 g $K_2S_2O_8$ and 0.75 g NaOH were exactly dissolved in 500 mL deionized water, reserved in polyethylene bottles (dark room, 25 ± 5 ℃). The alkaline potassium persulfate solution could be steadily used for 2 weeks.

(2) The standard $(NH_4)_2SO_4$ solutions with various TN concentrations were prepared, aiming to obtain the relationship between UV absorbance and TN concentration.

(3) 1.0 mL standard $(NH_4)_2SO_4$ solution with various TN concentrations and 3.0 mL alkaline potassium persulfate solution were mixed and added into the comparison tube, which was strictly sealed and oscillated for 5 min.

(4) All the mixed solutions in comparison tubes were digested at 130 ℃ for 90 min.

(5) After digestion, each solution was cooled into the room temperature, and then diluted with 40 mL deionized water. The UV absorbances (A_{220} and A_{275}) of diluent solutions at 220 nm and 275 nm were obtained by the UV-visible spectrophotometer

(SP-752, Shanghai Spectrum Corp.) with deionized water as the reference solution. Moreover, the corrected absorbance (A_{cor}) was calculated according to formula (S1) and UV absorbances of various TN concentrations were listed in **Table S1**.

$$A_{cor} = A_{220} - 2 \times A_{275} \quad \text{(S1)}$$

Table S1. UV Absorbances of various TN concentrations for standard work curve.

TN concentration (mg L^{-1})	A_{220}	A_{275}	A_{cor}
0	0.264	0.002	0.260
30	0.326	0.002	0.322
60	0.378	0.002	0.374
90	0.431	0.002	0.427
120	0.486	0.002	0.482
150	0.549	0.002	0.545

The standard work curve of TN concentration was depicted in **Figure S1** and the linear correlation coefficient (R^2) was 0.9988, which reveals the intensive linear relationship between absorbance and TN concentration.

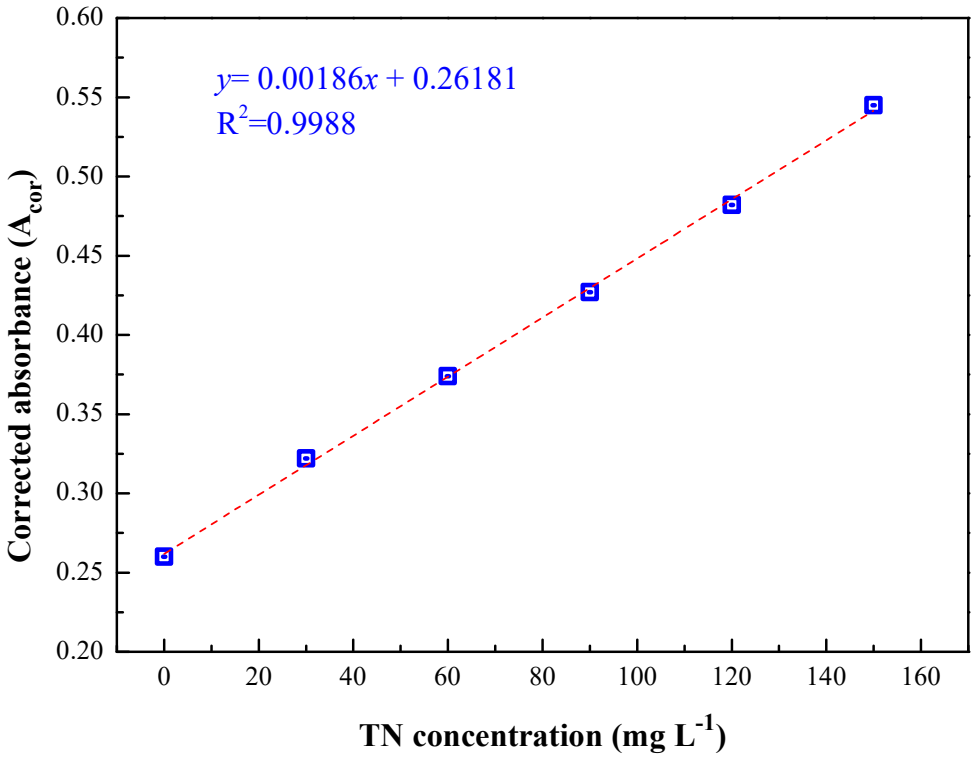

Figure S1. Standard work curve of TN concentration.

2. Optimum operation conditions of ECR with the $SrFe_xNi_{1-x}O_{3-\delta}$/Ti anode

Various amounts of $SrFe_xNi_{1-x}O_{3-\delta}$ (x = 0, 0.1, 0.2, 0.3, 0.4 and 0.5) were coated on the anode, and conductivity of ECR was tested under the constant current density of 15.69 mA cm^{-2} and electrocatalytic time of 30 min (**Figure S2**). The optimum amount of $SrFe_xNi_{1-x}O_{3-\delta}$ coated on anode is considered to be 0.09804 g cm^{-2}, which results in a better

conductivity of ECR.

Under the $SrFe_xNi_{1-x}O_{3-\delta}$ amount of 0.09804 g cm^{-2} coated on the anode and electrocatalytic time of 30 min, the effect of current density of ECR with $SrFe_xNi_{1-x}O_{3-\delta}$/Ti anodes ($x$ = 0, 0.1, 0.2, 0.3, 0.4 and 0.5) in cleaning nitrogenous wastewater is illustrated in **Figure S3**. The optimum electrocatalytic current density is chosen as 11.76 mA cm^{-2}, under which the ECR has a superior TN removal ratio. Higher current density (over 11.76 mA cm^{-2}) of ECR can not dramatically boost the TN removal ratio at cost of power consumption.

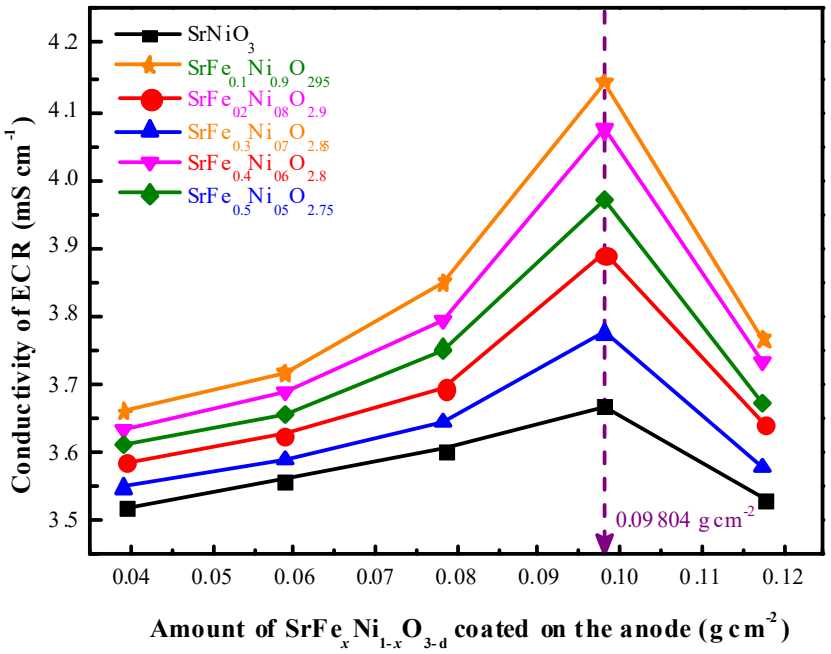

Figure S2. Effect of amount of $SrFe_xNi_{1-x}O_{3-\delta}$ coated on the anode for the conductivity of ECR.

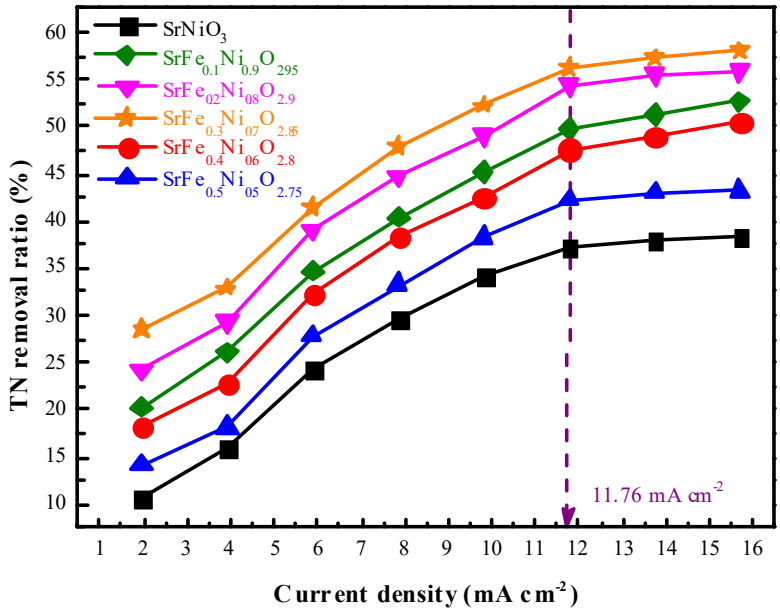

Figure S3. Effect of amount of $SrFe_xNi_{1-x}O_{3-\delta}$ coated on the anode for TN removal ratio.