Supplementary Information

Three-dimensional Cu Nanobelt Cathode for Highly Efficient Electrocatalytic Nitrate Reduction

Xiaodan Wang, Mengqi Zhu, Guoshen Zeng, Xun Liu, Chihhsiang Fang, Chuanhao Li*

School of Environmental Science and Engineering and Guangdong Provincial Key Laboratory of Environmental Pollution Control and Remediation Technology, Sun Yat-sen University, Guangzhou 510006, China

E-mail:lichuanh3@mail.sysu.edu.cn

Content:

Calculation of energy utilization efficiency

The energy utilization efficiency was calculated using the following equations:

$$\eta = \frac{\left(Q\left(NO_2^-\text{-}N\right)_t + Q\left(N_2\text{-}N\right)_t + Q\left(NH_4^+\text{-}N\right)_t\right)}{Q_t} \times 100\% \quad (1)$$

$$Q_t = \frac{\int Idt}{1000} \quad (2)$$

$$Q\left(NO_2^-\text{-}N\right)_t = 2 \times \left[\frac{C\left(NO_2^-\text{-}N\right)_t \times V}{M_N}\right] \times F \quad (3)$$

$$Q\left(N_2\text{-}N\right)_t = 5 \times \left[\frac{\left(C\left(NO_3^-\text{-}N\right)_0 - C\left(NO_3^-\text{-}N\right)_t - C\left(NO_2^-\text{-}N\right)_t - C\left(NH_4^+\text{-}N\right)_t\right)}{M_N} \times V\right] \times F \quad (4)$$

$$Q\left(NH_4^+\text{-}N\right)_t = 8 \times \left[\frac{C\left(NH_4^+\text{-}N\right)_t \times V}{M_N}\right] \times F \quad (5)$$

where η (%) is the electro energy utilization efficiency, Q_t (C) is the total electric quantity that provide at time t (s); I (mA) is the current; $Q(NO_2^-\text{-}N)_t$, $Q(N_2\text{-}N)_t$ and $Q(NH_4^+\text{-}N)_t$(C) are the electric quantities that cost during NO_3^--N reduction to NO_2^--N, N_2-N and NH_4^+-N at time t; V is the volume of solution (0.05 L), M_N is the molar mass of N (14000 mg mol^{-1}) and F is the Faraday's constant (96487 C mol^{-1}).

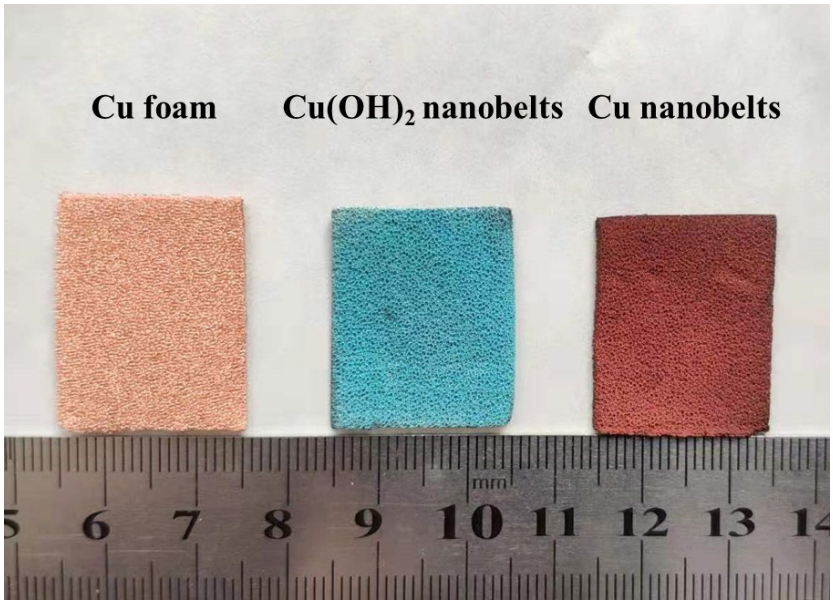


Figure S1 Photographs of the Cu foam electrode, $Cu(OH)_2$ nanobelt electrode and 3D Cu nanobelt electrode.

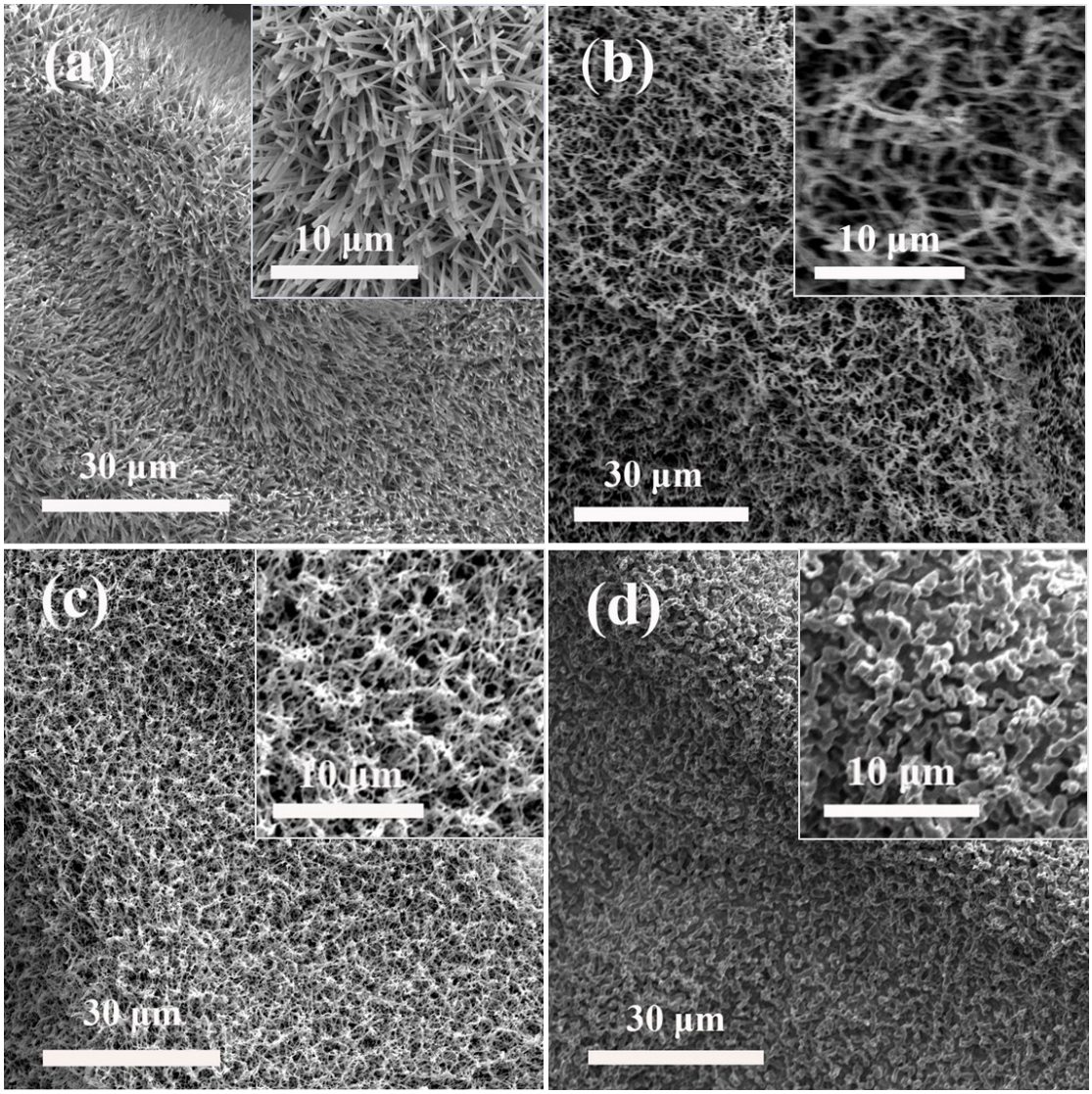


Figure S2 (a) SEM images of the surface of $Cu(OH)_2$ nanobelts. SEM images of the surface of 3D Cu nanobelts obtained at different temperature (b) 300 °C, (c) 400 °C and (d) 500 °C.

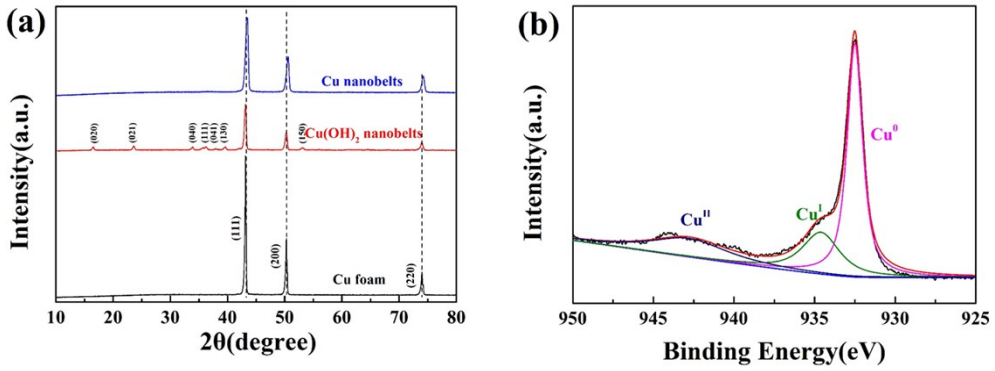


Figure S3 (a) XRD patterns of the Cu foam, $Cu(OH)_2$ nanobelt and 3D Cu nanobelt electrodes. (b) XPS spectra of the 3D Cu nanobelts.

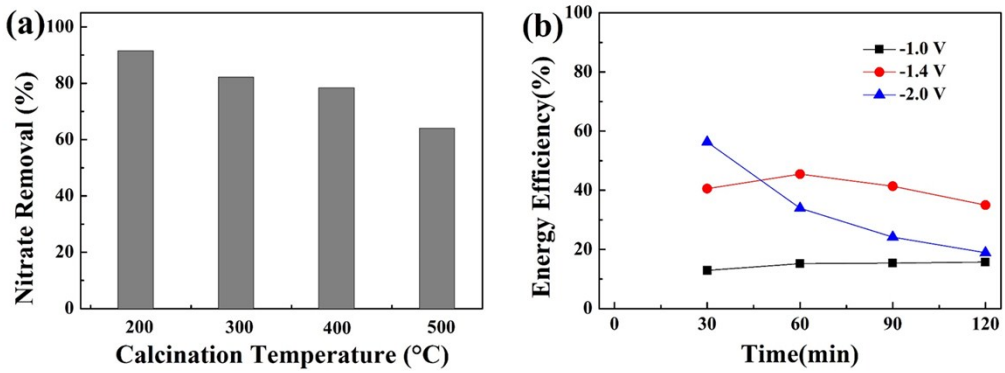


Figure S4 (a) Effect of calcination temperature on NO_3^--N removal efficiency. (3D Cu nanobelts cathode, 50 mL solution with 30 mg L^{-1} NO_3^--N, 0.5 h treatment). (b) The effect of applied potential on energy utilization efficiency.

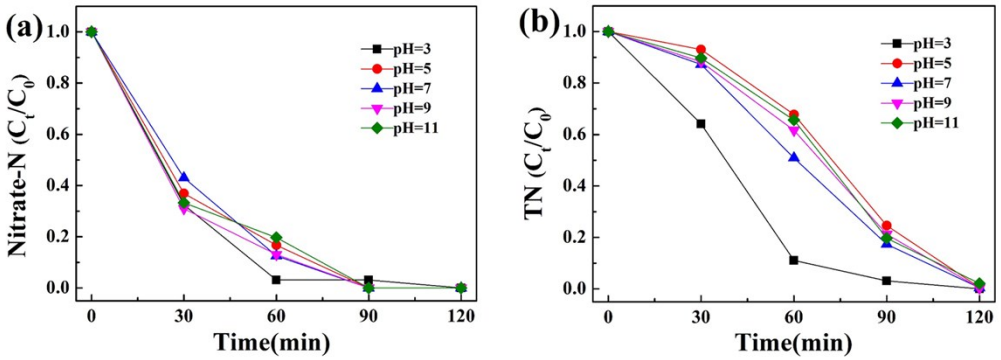


Figure S5 (a) Effect of initial pH on nitrate reduction and (b) TN removal. (30 mg/L NO_3^--N, -1.4 V vs Ag/AgCl, 0.07 M NaCl, 0.05 M Na_2SO_4).

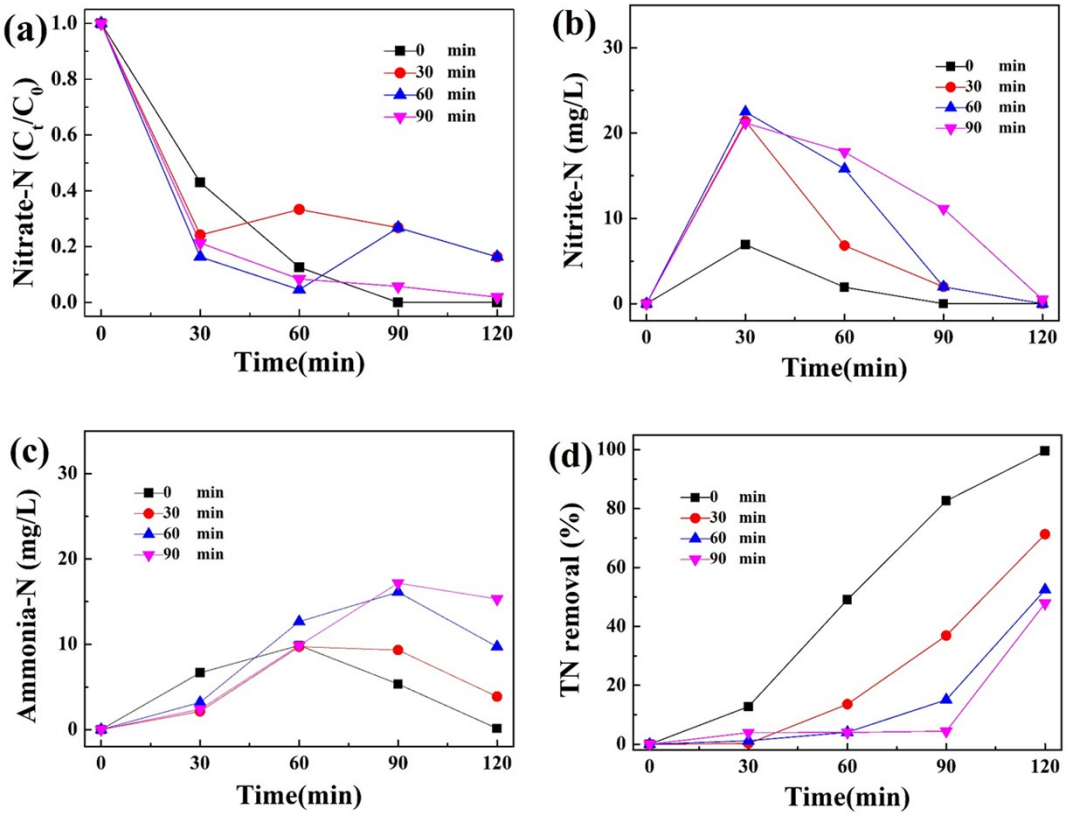
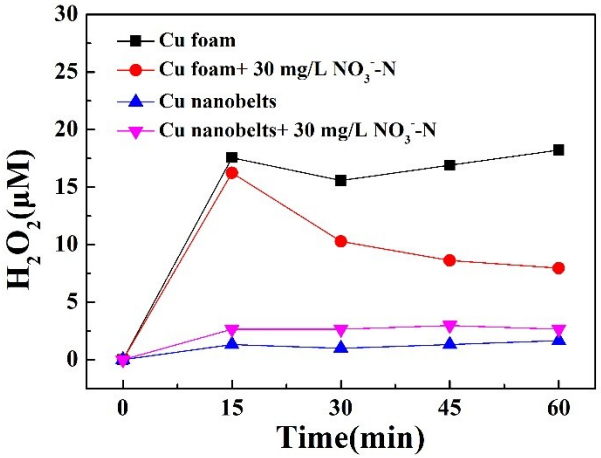


Figure S6 Effect of Cl^- adding time on (a) nitrate removal, (b) nitrite generation, (c) ammonia generation and (d) TN removal.



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71 **Figure S7** The H_2O_2 generated by Cu foam and 3D Cu nanobelts in the absence and

72 presence of nitrate (30 mg/L NO_3^--N, -1.4 V vs Ag/AgCl, 0.05 M Na_2SO_4).

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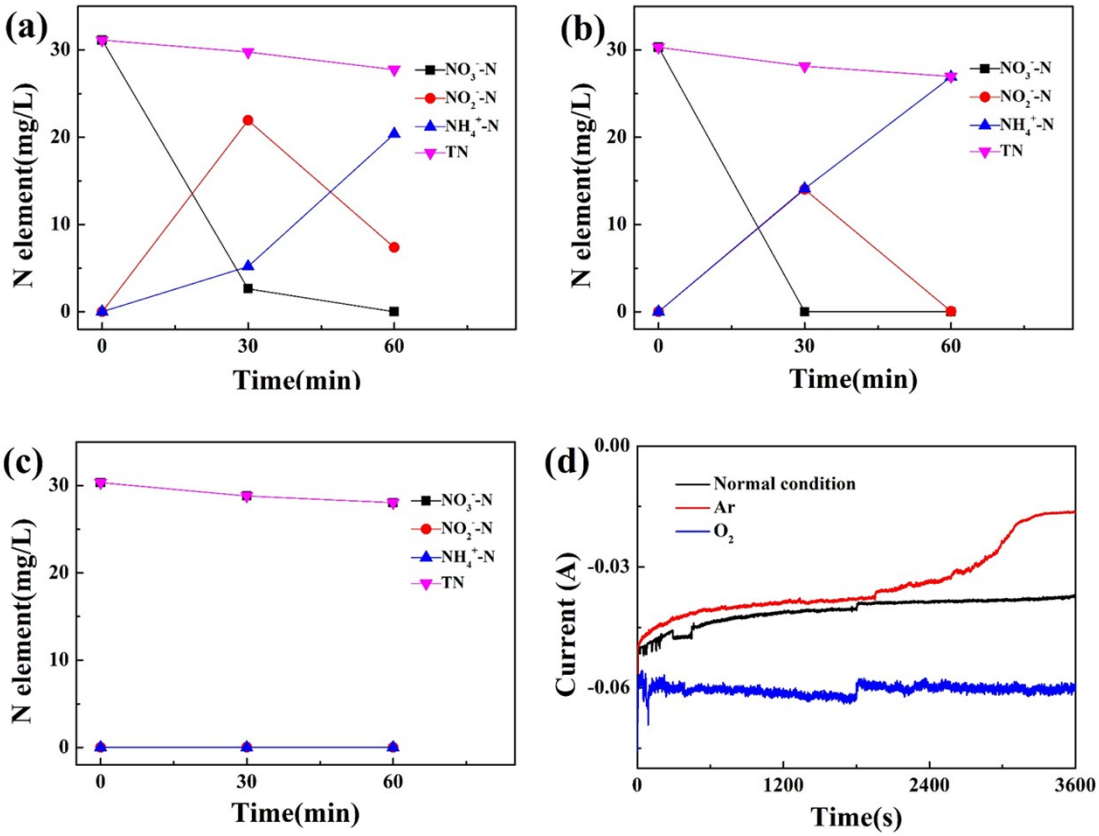

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75 **Figure S8** Effect of dissolved oxygen on nitrate removal

76 (a) regular condition, (b) Ar-saturated condition, (c) O_2-saturated condition and (d) the

77 corresponding current-time curve.

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