

Supporting Information

A highly active bimetallic oxides catalyst supported on γ -Al₂O₃/TiO₂ for catalytic wet peroxide oxidation of quinoline solution under microwave irradiation

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Number of Figures: 10

Text S1. The pretreatment of carries

Before the preparation, the carrier $\gamma\text{-Al}_2\text{O}_3/\text{TiO}_2$ (Tianjin Shuangchuan Chemical Factory, P. R. China, Φ 3 - 5 mm) was firstly crushed and then sieved into 20 – 40 mesh to obtain 1 – 2 mm size granules. Secondly, the support were repeatedly washed several times with deionized water to eliminate the inorganic ions in the surface of the carriers, dried for 12 h at 110 °C to constant weight in an oven, and calcined at 500 °C for 5 h to remove organic impurities in a muffle furnace.

Table S1 the content of O, Al, Ti, Cu and Ni in the support

The carries of $\gamma\text{-Al}_2\text{O}_3/\text{TiO}_2$ were prepared by sol-gel methods. The content of element is measured by EDX coupled with SEM. The results of the element are presented in Table S1.

Table S1 the content of O, Al, Ti, Cu and Ni in the support

Samples	O (wt.%)	Al (wt.%)	Ti (wt.%)
$\gamma\text{-Al}_2\text{O}_3/\text{TiO}_2$	31.56	63.18	5.26

Figure S1 display the effect of the Cu/Ni ratio on quinoline mineralization.

The molar ratio of $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$ and $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ (total $1.5 \text{ mol}\cdot\text{L}^{-1}$) are 1:1, 3:1, 5:1, and 7:1. The results are offered in Fig. S1. As the Cu/Ni ratio rises from 1:1 to 5:1 in the content of C4, there is a tendency to towards an increase of TOC abatement; however, there is a tendency to towards a decrease of TOC abatement when the Cu/Ni ratio rises to 7:1. Therefore, the best removal efficiency of TOC was attained with the molar ratio of 5:1 (total $1.5 \text{ mol}\cdot\text{L}^{-1}$).

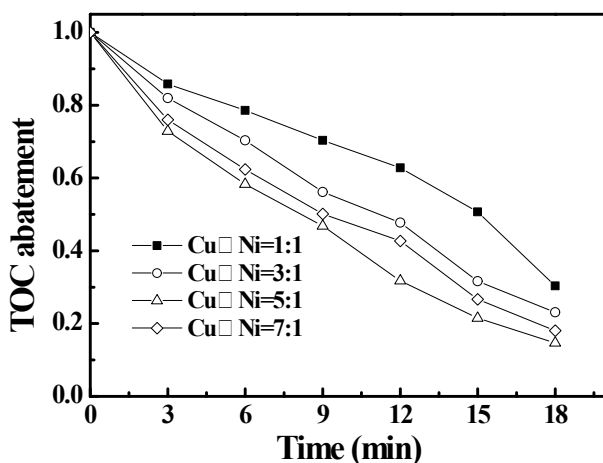


Fig.S1. Effect of the Cu/Ni ratio on quinoline mineralization (quinoline concentration: 100 mg/L, temperature: 333 K, MW: 500 W, H_2O_2 : H_2O_2 : 22.75 mmol/L, catalyst: 2 g/L)

Results and discussion

The characterization of C1 and C3

Figure S2 display the SEM images of C1.

The representative X-ray diffraction (XRD) pattern for C1 is shown in Figure S3.

Figure S4 presents the N₂ adsorption/desorption isotherms of C1.

Figure S5 the corresponding pore size distribution curve of C1.

According to the Brunauer–Deming–Deming–Teller (BDDT) classification, the isotherm pattern is type IV with type H3 hysteresis loops that is typical of mesoporous structure. The BET surface area, pore size and pore volume of this catalyst are respectively.

The representative X-ray diffraction (XRD) pattern for C3 is shown in Figure S6.

Figure S7 display the SEM images of C3.

Figure S8 presents the N₂ adsorption/desorption isotherms of C3.

Figure S9 the corresponding pore size distribution curve of C3.

According to the Brunauer–Deming–Deming–Teller (BDDT) classification, the isotherm pattern is type IV with type H3 hysteresis loops that is typical of mesoporous structure. The BET surface area, pore size and pore volume of this catalyst are respectively.

Figure S10. EDX spectra and components ratio (inset) of C4.

Table S2 Removal of quinoline and TOC under different conditions

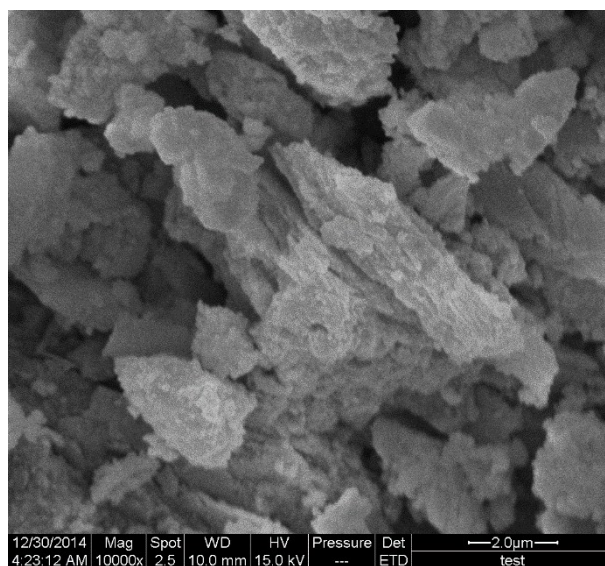


Figure S2. SEM image of C1.

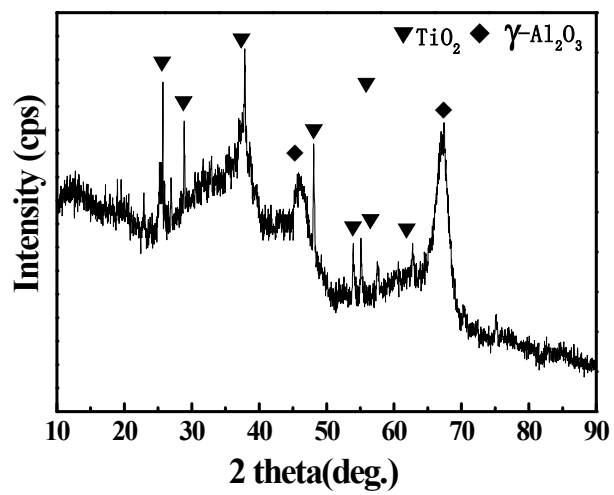


Figure S3. XRD pattern of C1.

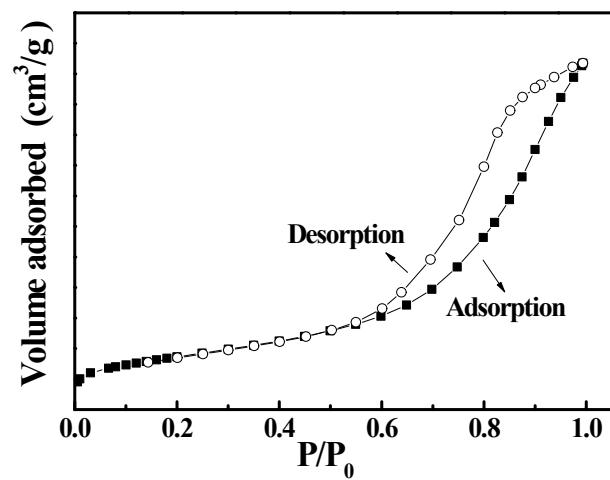


Figure S4 presents the N₂ adsorption/desorption isotherms of C1.

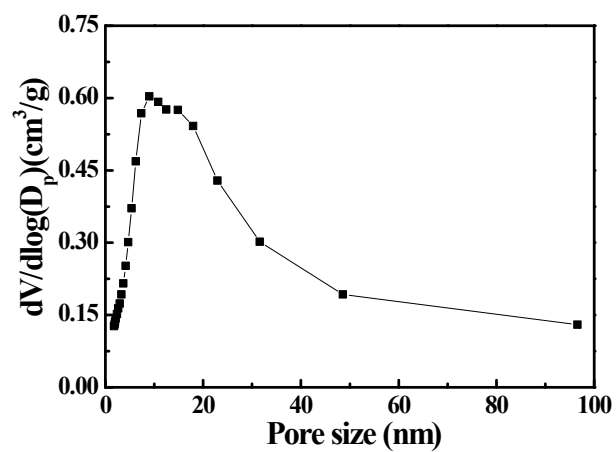


Figure S5 the corresponding pore size distribution curve of C1.

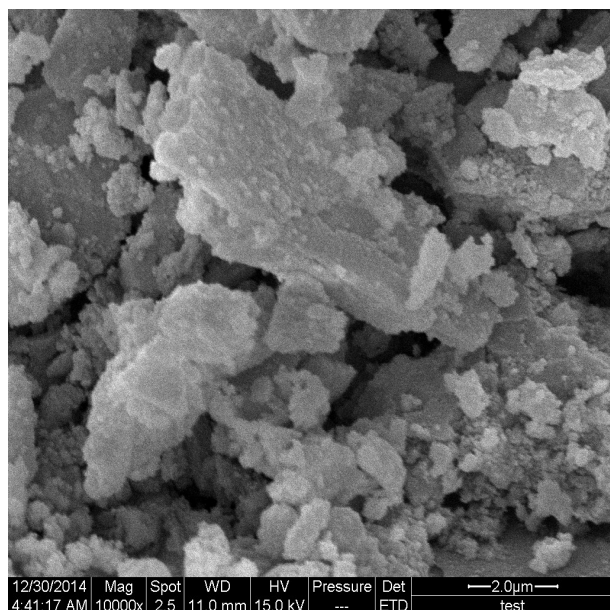


Figure S6. SEM image of C3.

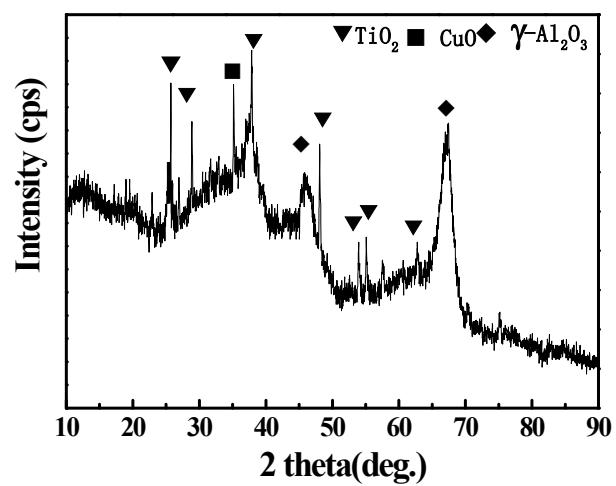


Figure S7. XRD pattern of C3.

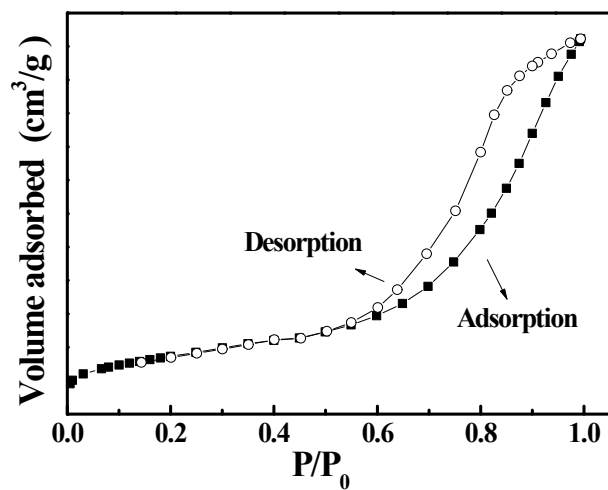


Figure S8 presents the N₂ adsorption/desorption isotherms of C3.

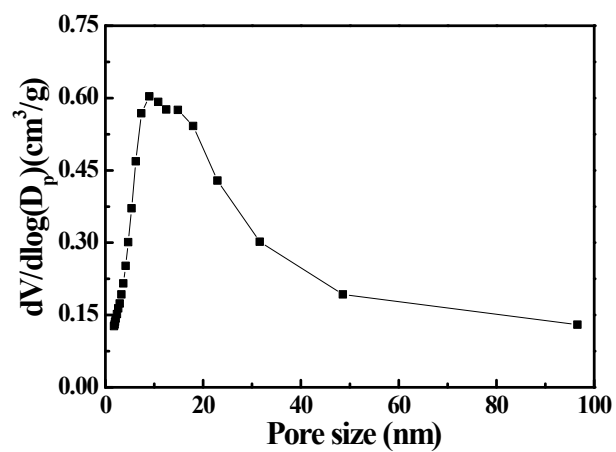


Figure S9 the corresponding pore size distribution curve of C3.

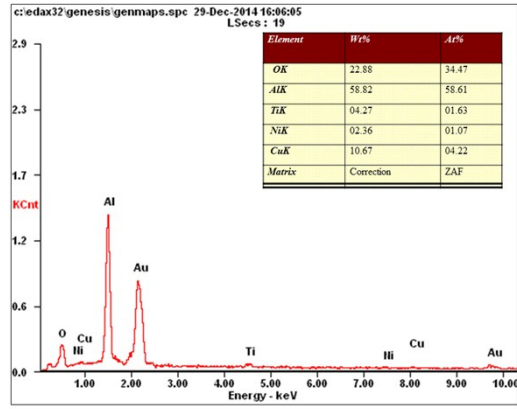


Figure S10. EDX spectra and components ratio (inset) of C4.

Table S2 Removal of quinoline and TOC under different conditions

A series of experiments was conducted under the employed conditions (MW = 500 W, pH 7, temperature = 333 K, and initial quinoline concentration = 100 mg/L) to estimate the catalytic activities of C4: (a) 4 g/L C4 without H₂O₂; (b) 22.75 mmol/L H₂O₂; (c) 4 g/L C1 and 22.75 mmol/L H₂O₂; (d) 4 g/L C2 and 22.75 mmol/L H₂O₂; (e) 4 g/L C3 and 22.75 mmol/L H₂O₂; (f) 0.67 g/L C2, 3.33 g/L C3 and 22.75 mmol/L H₂O₂; (g) 4 g/L C4 and 22.75 mmol/L H₂O₂, (h) 4 g/L C4 and 22.75 mmol/L H₂O₂ without MW. Other reaction conditions: a – g (reaction time 18 min), h (reaction time 60 min).

Different conditions	TOC removal (%)	Quinoline degradation (%)
a	8	10
b	1.27	1.94
c	15	26.73
d	47.77	75.21
e	61.67	100
f	68.77	100
g	81.13	100
h	49.23	100