Electronic Supplementary Material (ESI) for Reaction Chemistry & Engineering.

Fabrication of Cu_2O-loaded TiO_2 nanotubes with heterojunctions via an electrochemical method: Enhanced photocatalytic activity

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Figure S1 shows the energy-dispersive X-ray spectroscopy (EDS) of pristine TiO_2 NTs, and Cu_2O-TiO_2 NTs obtained at Cu deposition voltages of 1V, 2V, 3V, 4V, and 5V. As shown in Fig. S1 and Table 1, pristine TiO_2 NTs were composed of three elements: Ti, O, and C. The Ti:O atomic ratio was approximately 2:1, and C originated from external pollution. After the electrochemical deposition of Cu to form Cu_2O-TiO_2 NTs, the characteristic peak of Cu gradually intensified with the increase in the deposition voltage. The atomic percentage of Cu gradually increased from 1.75 to 4.85% with the increase in the deposition voltage from 1 to 5 V. No other elements were detected, which confirmed that the Cu_2O-TiO_2 NTs prepared by the electrochemical deposition process were of high purity and no other impurities were generated.

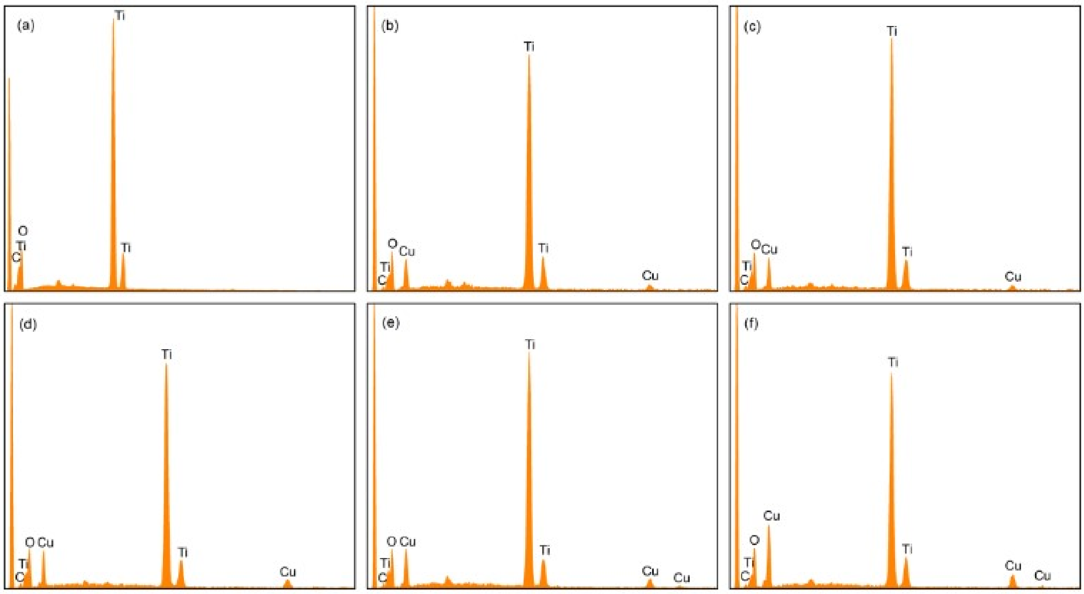

Fig. S1 EDS profiles of different samples: (a) pristine TiO_2 NTs, (b–f) Cu_2O-TiO_2 NTs obtained at Cu deposition voltages of 1V, 2V, 3V, 4V, and 5V, respectively

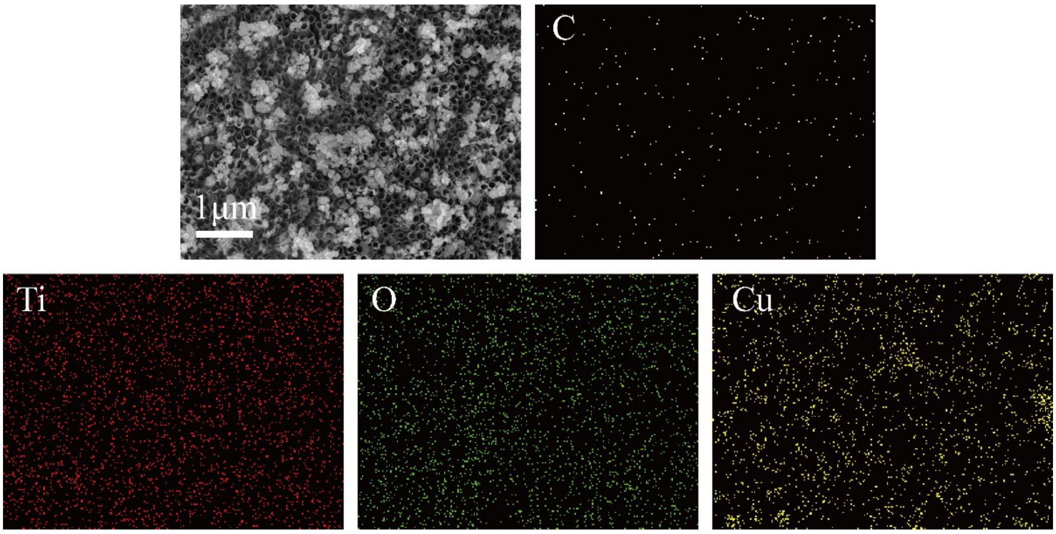

Fig. S2 EDS mapping of Cu_2O-TiO_2 NTs

Figure S2 shows the EDS mapping of the Cu_2O-TiO_2 NTs. As shown that the distribution of Cu, Ti, O, C is uniform, and there is no obvious aggregation phenomenon. The as-prepared Cu_2O nanopraticles loading TiO_2 NTs are homogeneous and crack-free. It can be conclude that after electrochemical deposition Cu element is also uniformly distributed on the surface of TiO_2 NTs.

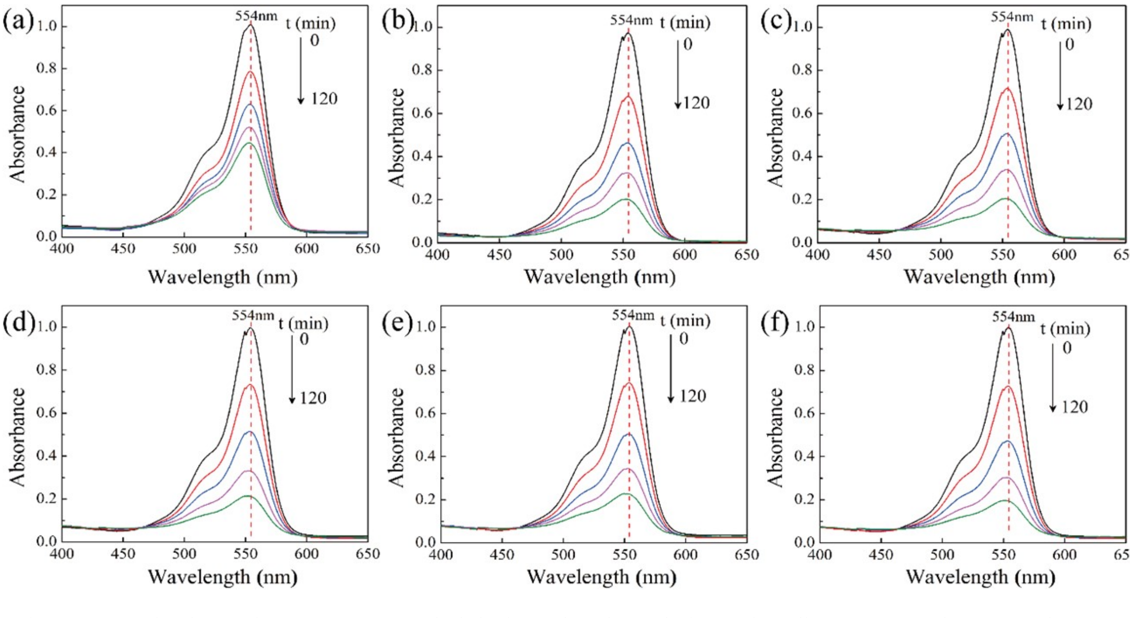

Fig. S3 UV-vis absorption spectra recorded during RhB degradation using different samples as catalysts: (a) pristine TiO_2 NTs, (b–f) Cu_2O-TiO_2 NTs obtained at Cu deposition voltages of 1V, 2V, 3V, 4V, and 5 V, respectively

Quantum efficiency (QE) is the ratio of the photochemical reaction rate to the absorbed photon flux in a specific wavelength range; And photon flux is the number of photons radiated by the light source and unit time interval, and is a function of wavelength λ.

The QE was calculated by the following formula:

$$QE = \frac{reaction\ rate}{q_p} = \frac{K\cdot n(H_2)}{IA\lambda/hc} \times 100\%$$

Among them, K is the number of transferred electrons (2 in this work), I is the optical power density, $1.5\cdot10^{-4}$ W·cm^{-2}; A is the area of light exposure, 1 cm^2; λ is $3.65\cdot10^{-11}$ m; h is the Planck's constant, $6.626\cdot10^{-34}$; and c is the speed of light, $3\cdot10^8$. The calculation result was shown in Fig. S4.

The maximum QE of ~ 22.08% is obtained at 3V Cu_2O-TiO_2 NTs， which is consistent with the maximum IPCE of ~ 22.08%.

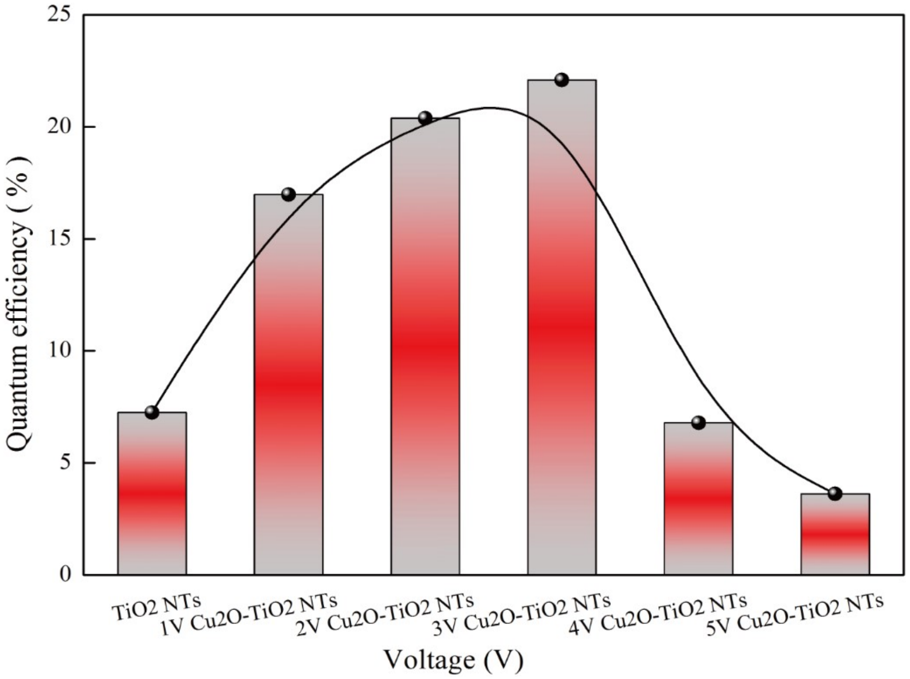

Fig. S4 Quantum efficiency of pristine TiO_2 NTs and Cu_2O-TiO_2 NT samples prepared using different Cu deposition voltages under UV illumination

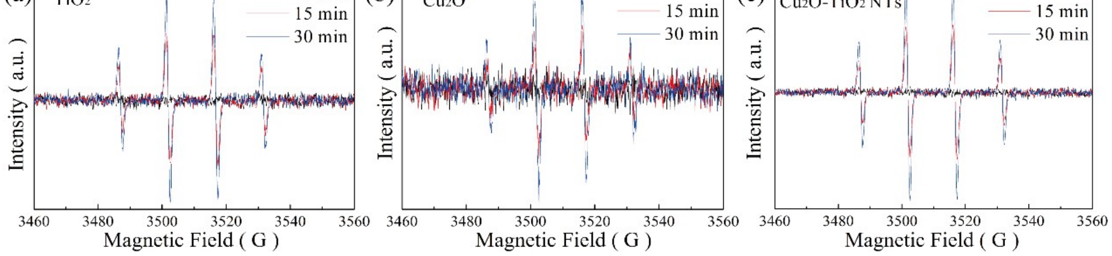

Fig. S5 EPR spectra under UV light irradiation: (a) pristine TiO_2 NTs, (b) Cu_2O and (c) 3V Cu_2O-TiO_2 NTs

Fig. S5 exhibits the electron paramagnetic resonance (EPR) spectra of pristine TiO_2 NTs, Cu_2O, and 3V Cu_2O-TiO_2 NTs with UV light irradiation at 0 min, 15 min and 30 min. At 0 min irradiation, none of the three samples showed characteristic peaks under the magnetic field. After 15 min and 30 min irridation, the intensities of the characteristic peaks significantly arise at different magnetic field intensity for all the samples, which meaning more hydroxyl radical (·OH) be obtained under UV irridation.