Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

A ferromagnetic nanocrystallines containing copper as an efficient catalyst for photoinduced water oxidation

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The preparing of Fe_2O_3 nanoparticles[1] and CuO nanoparticles[2]

Fe_2O_3 nanoparticles with size of 60 nm (Figure S8) and CuO nanoparticles were prepared according to published method.

Synthesis of $[Ru(bpy)_3]Cl_2 \cdot 6H_2O$

Commercial $RuCl_3 \cdot xH_2O$ is dried in an oven at 120 ^oC for 3 h. It is then finely ground in a mortar and returned to the oven for a further 1h prior to use. It is convenient to store the "dried" $RuCl_3$ at this temperature. "Dried" $RuCl_3$ (0.4 g, 1.93 mmol), 2, 2'-bipyridine (0.9 g, 5.76 mmol) and water (40 mL) are placed in a 100 mL flask fitted with a reflux condenser. Then sodium hypophosphite solution (2 mL) is added and the mixture heated at the boil for 30 min. During reflux, the initial green solution changes to brown and finally orange. It is filtered to remove traces of undissolved material and potassium chloride (12.6 g) added to the filtrate to precipitate the crude product. The solution and solid are then heated at the boil to give a deep red solution, which on cooling to room temperature yields beautiful, red plate-like crystals. These are filtered off, and air-dried. The yield is 0.9 g (63%). The product could be recrystallized from boiling water (~2.8 $mL \cdot g^{-1}$) and then air dried.

Text of XPS analyses

The samples prepared for XPS analyses were processed according to the following procedure: first, catalyst powders were added on to an Al foil and pressed under high pressure to be a thin film and the thickness of the catalyst films was hundreds of nanometers. Then, the resulted samples were used for XPS tests.

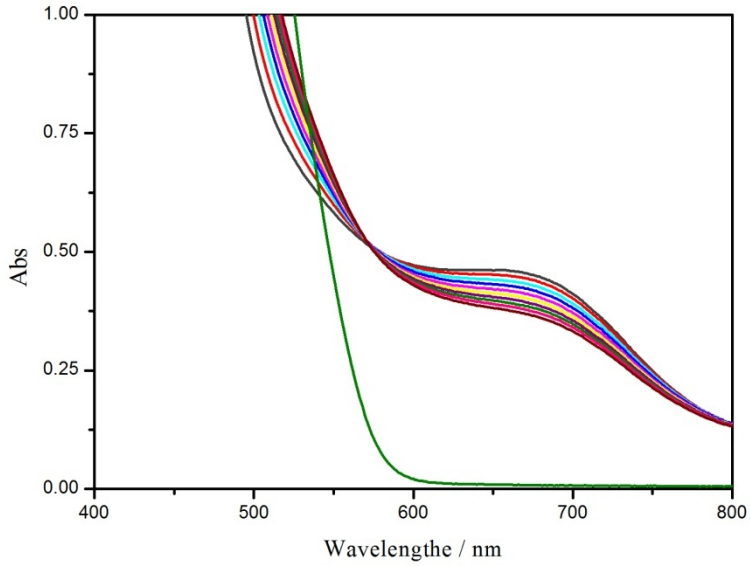

Figure S1. UV-vis spectral changes during the photocatalytic water oxidation with pH 8.0 buffer. The bottom green line shows the absorption of an aqueous borate buffer solution (pH = 8.0, 80 mM) containing $[Ru(bpy)_3]Cl_2$ (1.0 mM), $Na_2S_2O_8$ (5.0 mM) and $CuFe_2O_4$ (0.5gL^{-1}). Other lines show the UV-vis spectral changes of the green reaction solution obtained by irradiating the initial reaction solution about 30 s.

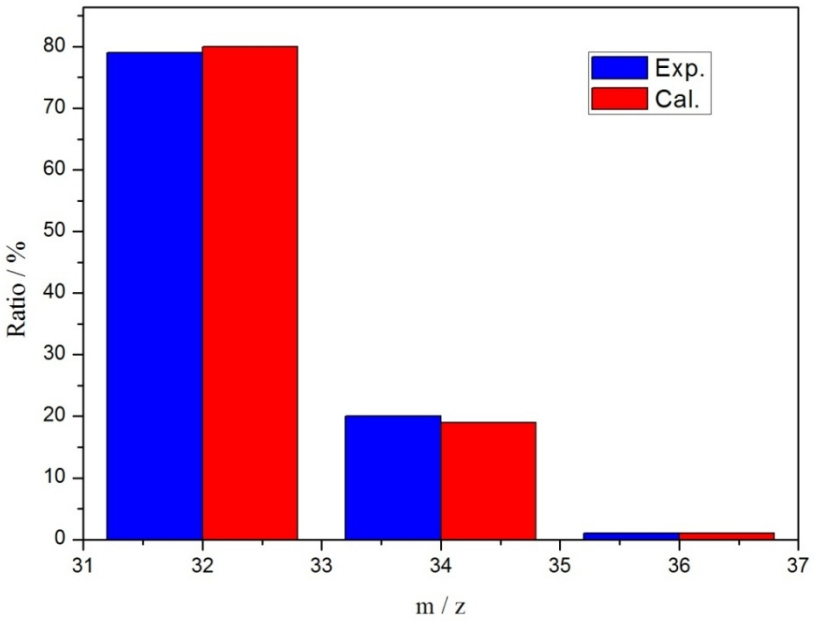

Figure S2. Observed and theoretical relative abundances of ^{18}O-labeled and unlabeled oxygen evolved during the photocatalytic oxidation of a buffer solution (4.5 mL) prepared with $H_2{}^{18}O$-enriched water (10.8% $H_2{}^{18}O$) containing $CuFe_2O_4$ (0.5 gL^{-1}) , $[Ru(bpy)_3]Cl_2$ (1.0 mM) and $Na_2S_2O_8$ (5.0 mM) (bule, observed mass intensity; red, calculated values assuming that evolved O_2 results exclusively from water).

Figure S3. The picture of collecting $CuFe_2O_4$ by a magnet.

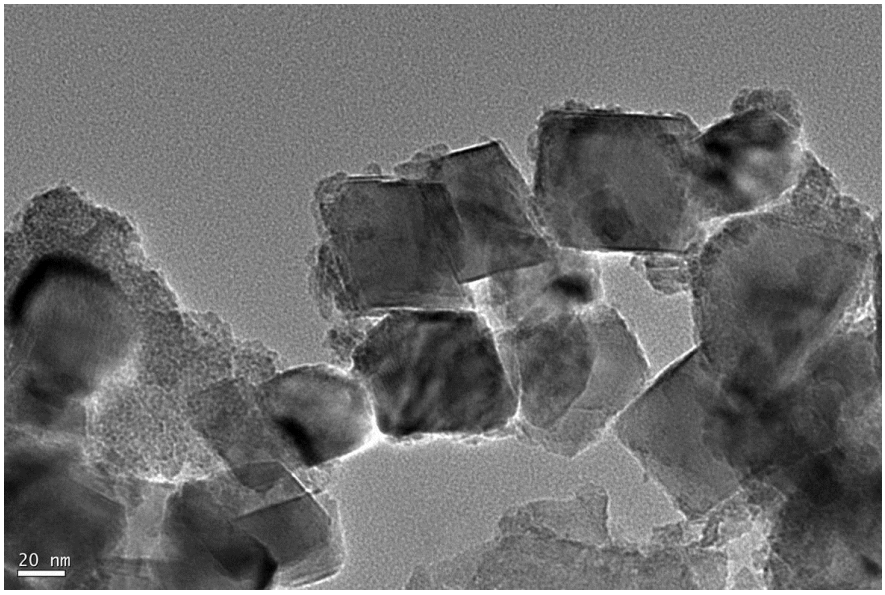

Figure S4. TEM of fresh $CuFe_2O_4$

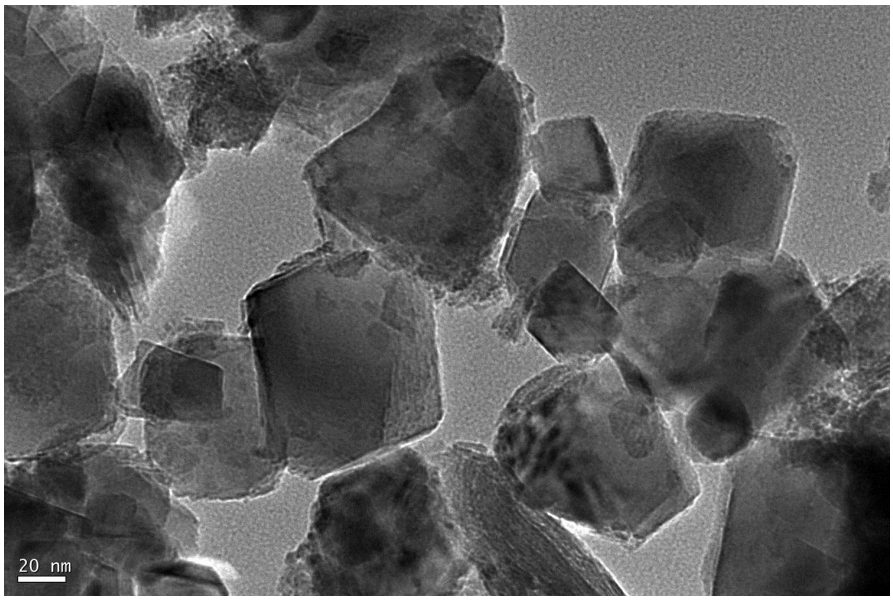

Figure S5. TEM of recovered $CuFe_2O_4$

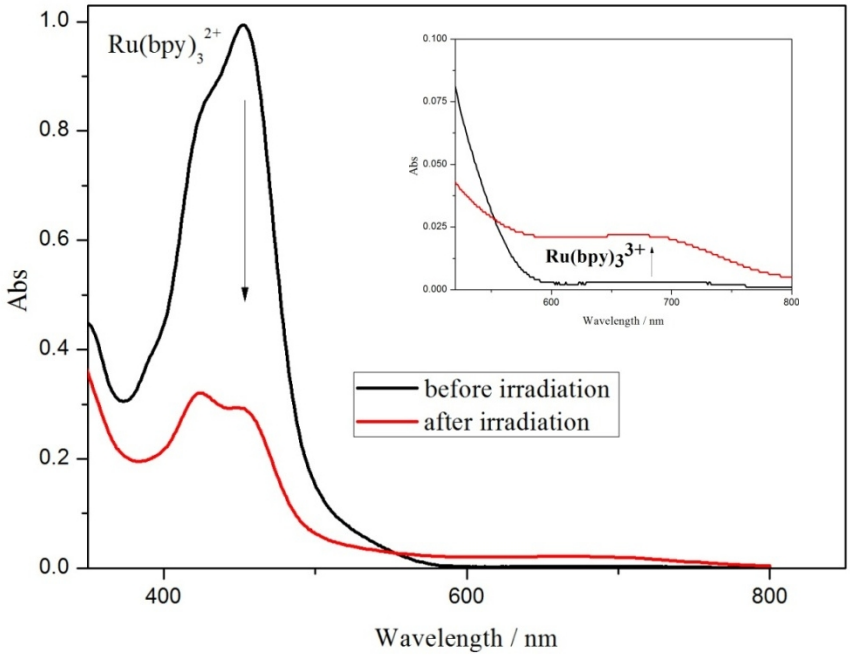

Figure S6. The absorbance spectra of $[Ru(bpy)_3]Cl_2$ solution (1.0 mM) containing $Na_2S_2O_8$ (5.0 mM) in an 80 mM NaBi (pH 8.0) buffer (black) before and (red) after visible light irradiation (> 420 nm). The absorption peaks at approximately 453 nm and 670 nm correspond to $Ru(bpy)_3^{2+}$ and $Ru(bpy)_3^{3+}$, respectively. After visible light irradiation, the absorption peak corresponding to $Ru(bpy)_3^{3+}$ increased because of photo-induced oxidation of $Ru(bpy)_3^{2+}$ whereas the absorption peak of $Ru(bpy)_3^{2+}$ decreased.

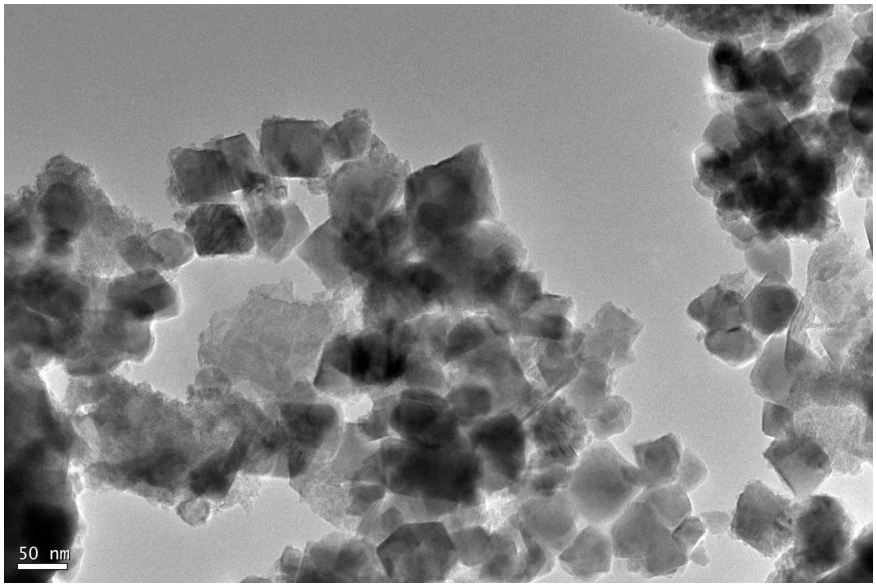

Figure S7. TEM of fresh $CuFe_2O_4$

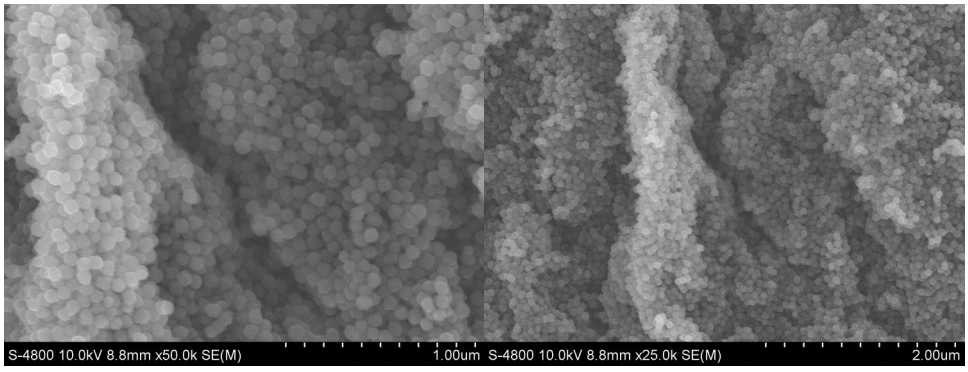

Figure S8. SEM images of Fe_2O_3 nanoparticles.

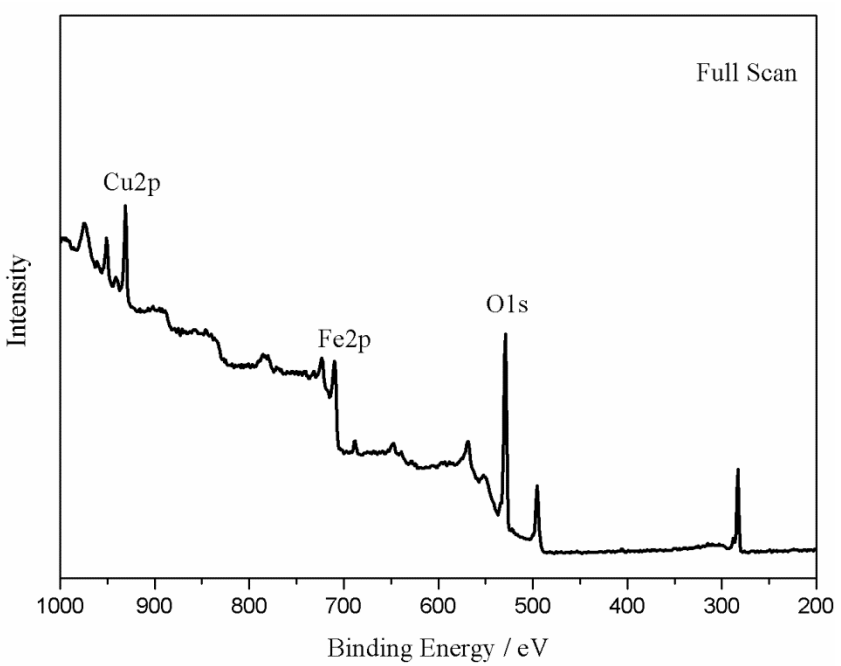

Figure S9. X-ray photoelectron spectrum of $CuFe_2O_4$ showing the all elements region peaks of $CuFe_2O_4$.

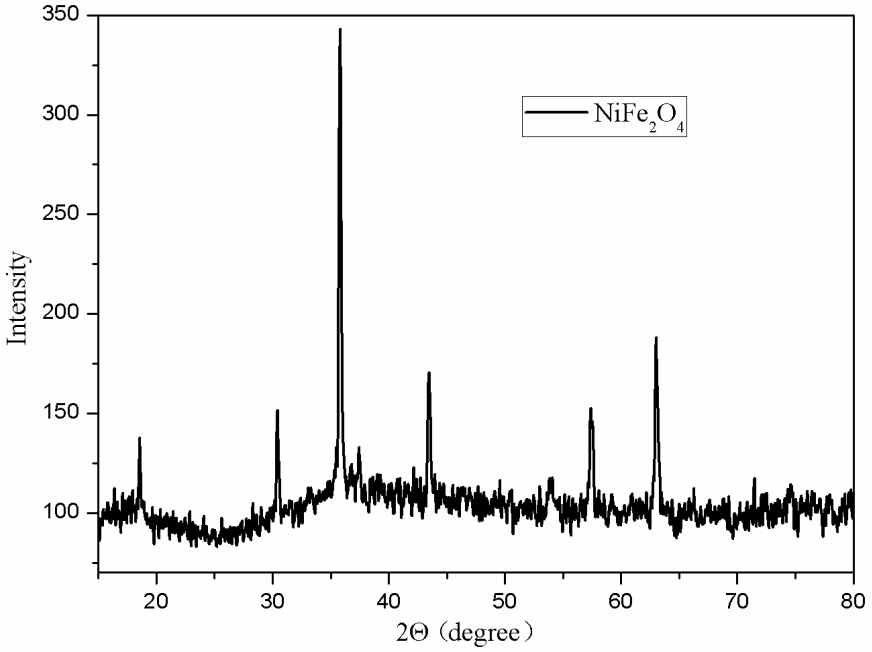

Figure S10.XRD of $NiFe_2O_4$

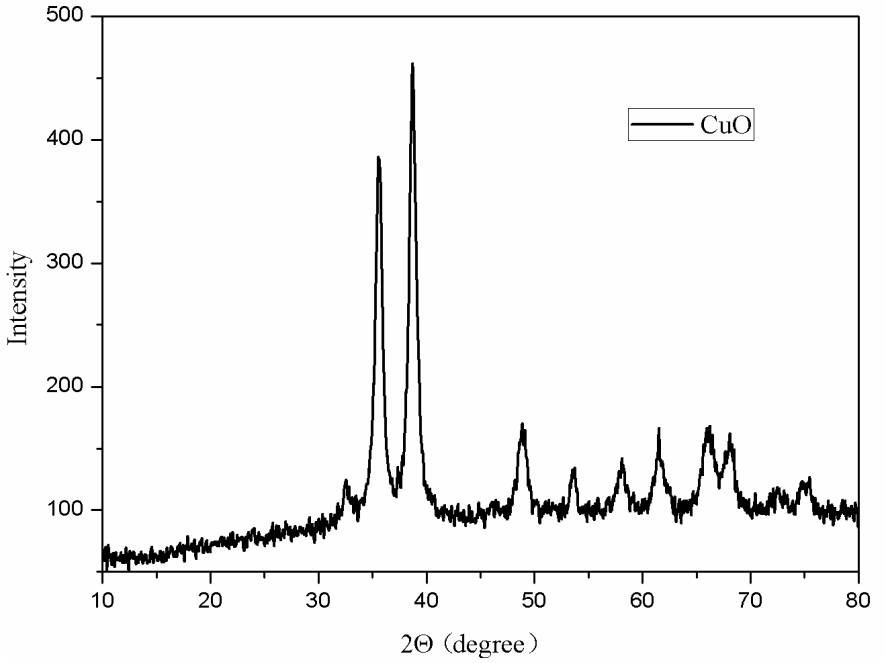

Figure S11.XRD of CuO

1. T. Raming, A. Winnubst, C. M. van Kats and A. Philipse, *J. Colloid Interface Sci.*, 2002, **249**, 346-350.
2. J. Zhu, D. Li, H. Chen, X. Yang, L. Lu and X. Wang, *Mater.Lett.*, 2004, **58**, 3324-3327.