Electronic Supplementary Information

Visible-light sensitive Cu(II)-TiO_2 with sustained anti-viral activity for efficient indoor environment remediation

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Table S1. ICP measurement of Cu(II)-TiO_2 (950-HCl) with different pH value.

Samples	Cu(II)-TiO_2 (950-HCl)					
Grafting pH value	2	4	7	10	12	14
Initial amount of Cu(II) (wt%)	0.1	0.1	0.1	0.1	0.1	0.1
Measured Cu(II) (wt%)	0.002	0.006	0.011	0.018	0.089	0.101

Table S2. ICP measurement of Cu(II)-TiO_2 (950-HCl-12) with different initial amount of Cu(II).

Samples	Cu(II)-TiO_2 (with acid treatment)			
Initial amount of Cu(II) (wt%)	0.05	0.1	0.25	0.5
Measured Cu(II) (wt%)	0.037	0.089	0.203	0.476

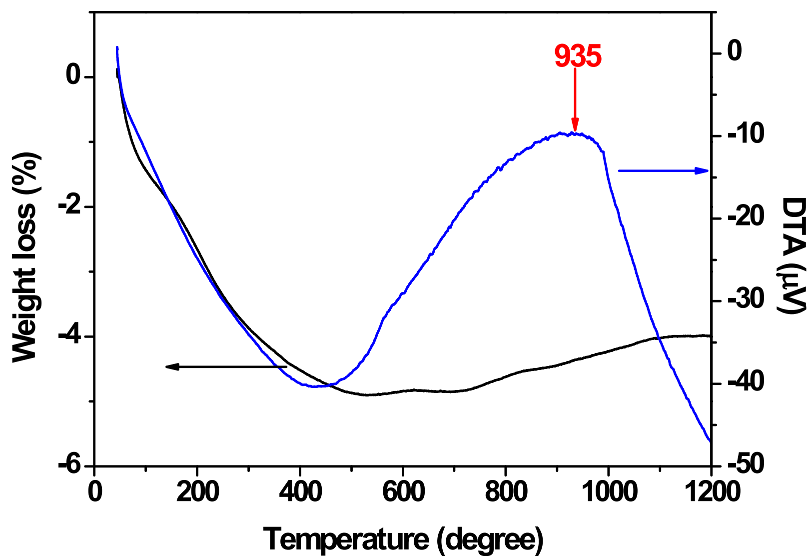

Figure S1. TG-DTA curves of TiO_2 powders.

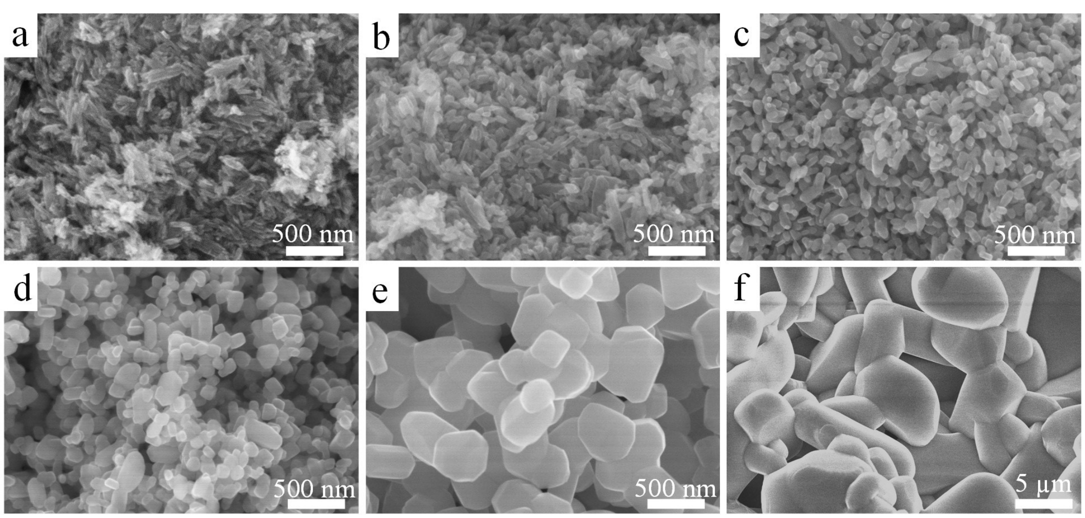

Figure S2. SEM images of TiO_2 samples obtained at different temperature.

Figure S3. Images of TiO_2 samples obtained at different temperatures.

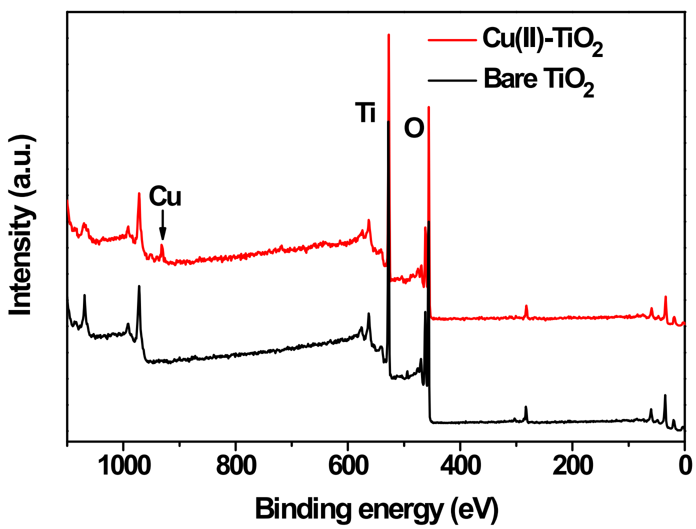

Figure S4. XPS spectra of bare and Cu(II) nanoclusters grafted TiO_2, which was annealed at 950 ºC for 3h.

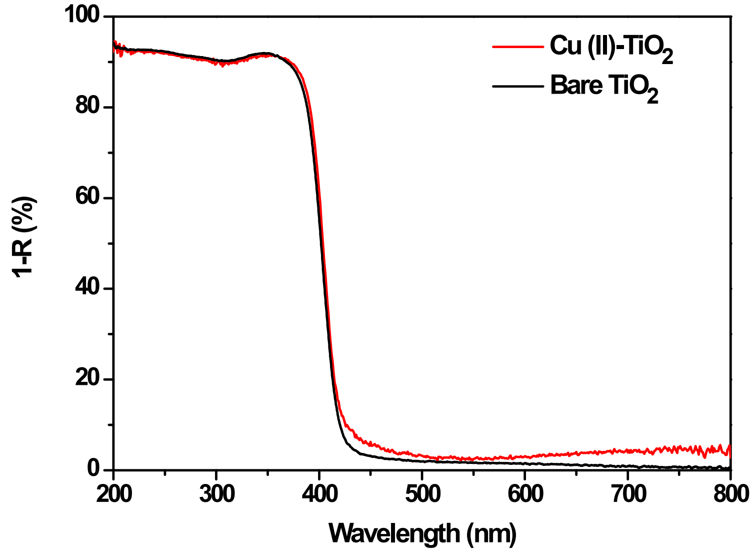

Figure S5. UV-Vis spectra of bare TiO_2 and Cu(II)-TiO_2, which was annealed at 950 ºC for 3h.

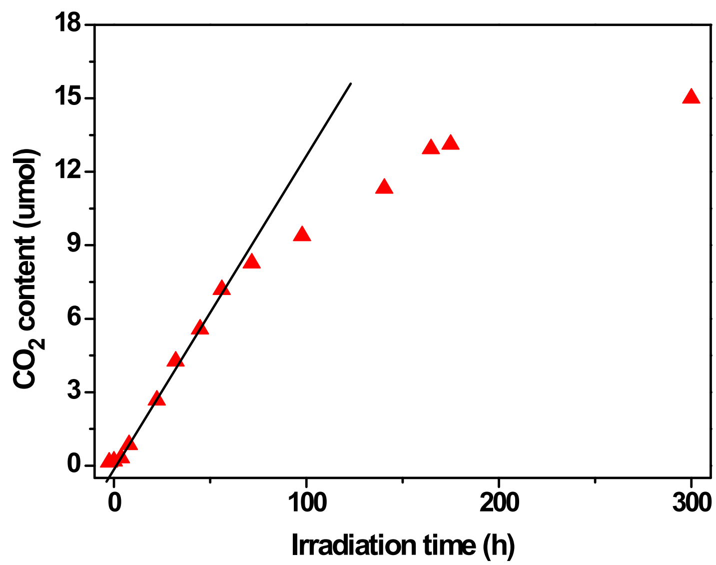

Figure S6. The CO_2 generation curve over Cu(II)-TiO_2 (950) sample under visible light irradiation. The CO_2 generation rate (R_{CO2}) was obtained from the slope of the CO_2 generation curve between the irradiation time of ca. 0 to 60 h.

The calculation of quantum efficiency (QE) was conducted using the same procedure reported in literature (*1*).

Take Cu(II)-TiO_2 (950) sample for example. Under the visible light irradiation, the wavelength of visible light is from 420 to 530 nm, and the light intensity is 1 mW/cm^2. The irradiating area is 5.5 cm^2. Therefore, the absorption rate of incident photons (R^a_p) was determined to be 9.78×10^{14} quanta·sec^{-1} using the following equation: $R^a_p = \int_{400}^{530} S \times \alpha \times I$ (*S* is the area of the sample, *α* is the light absorption and *I* is the light intensity at each wavelength). As for CO_2 generation, assuming that the reaction from IPA to CO_2 is proceeded: $C_3H_8O+5H_2O+18h^+ \rightarrow 3CO_2+18H^+$, that is, six photons are required to produce one CO_2 molecule. The CO_2 generation rate (R_{CO2}) was obtained from the slope of the CO_2 generation curve in Figure S6. As shown in Figure S10, R_{CO2} was determined to be 0.13 μmol·h^{-1}. Thus the QE for CO_2 generations were calculated using the following equation:

QE = 6×CO_2 generation rate/absorption rate of incident photon

=6×(1.3×10^{-1}×10^{-6}/3.6×10^3)mol·sec-1×

6.0×10^{23}quanta·mol^{-1}/9.78×10^{14}quanta·sec^{-1}

= 13.2×10^{-1} (13.2%).

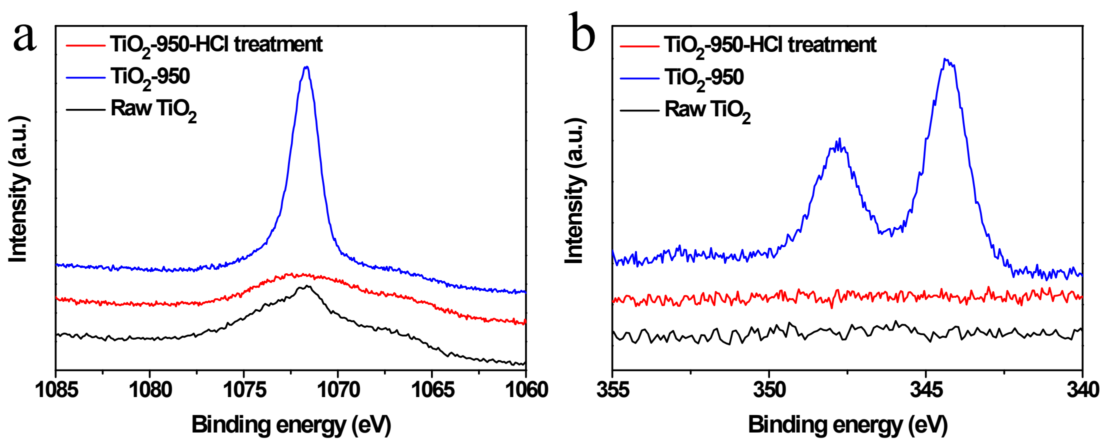

Figure S7. a) Na 1s and b) Ca 2p core-level spectra of raw TiO_2, 950 ºC annealed TiO_2 and HCl treated TiO_2 (950) samples.

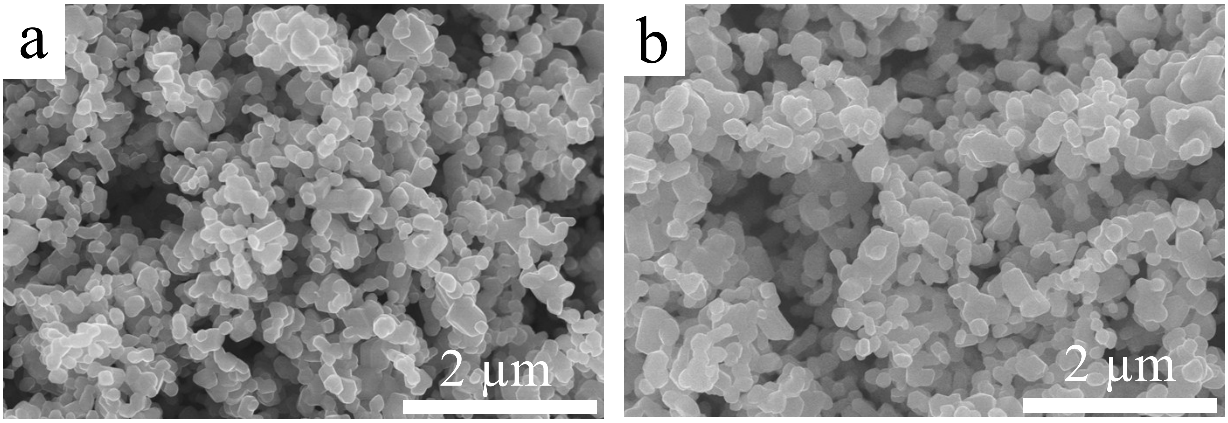

Figure S8. SEM images of TiO_2 (950) samples before and after acid treatment.

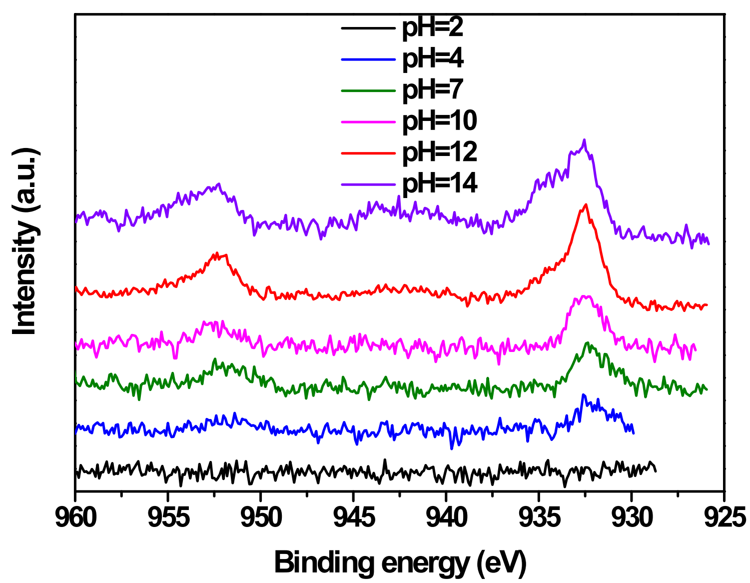

Figure S9. Cu 2p core-level spectra of Cu(II)-TiO_2 (950-HCl) samples obtained from different pH values.

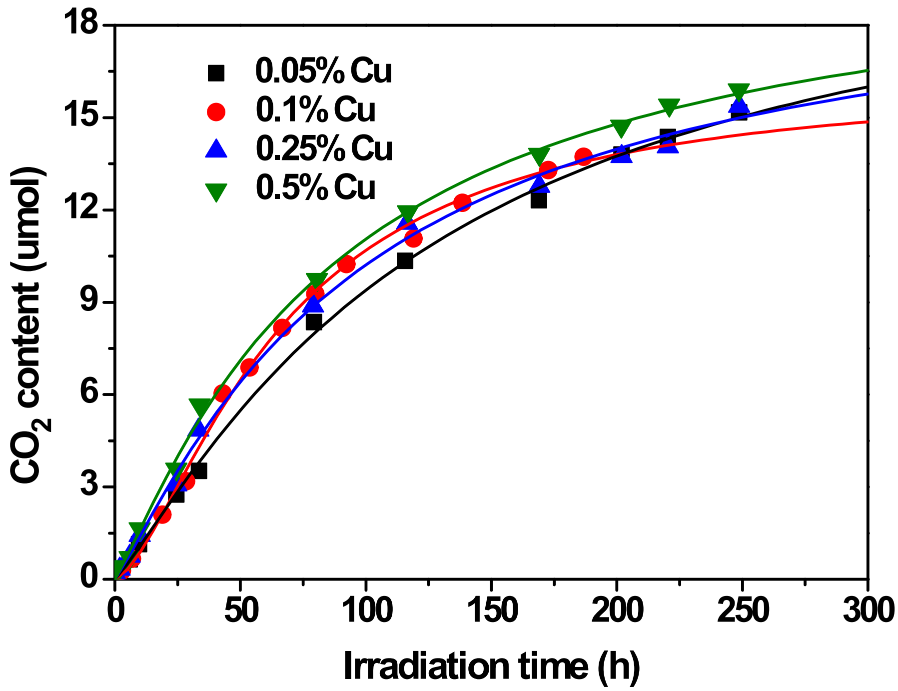

Figure S10. Comparative studies of CO_2 generation over Cu(II)-TiO_2 (950-HCl) with different initial amount of Cu(II) under the same conditions.

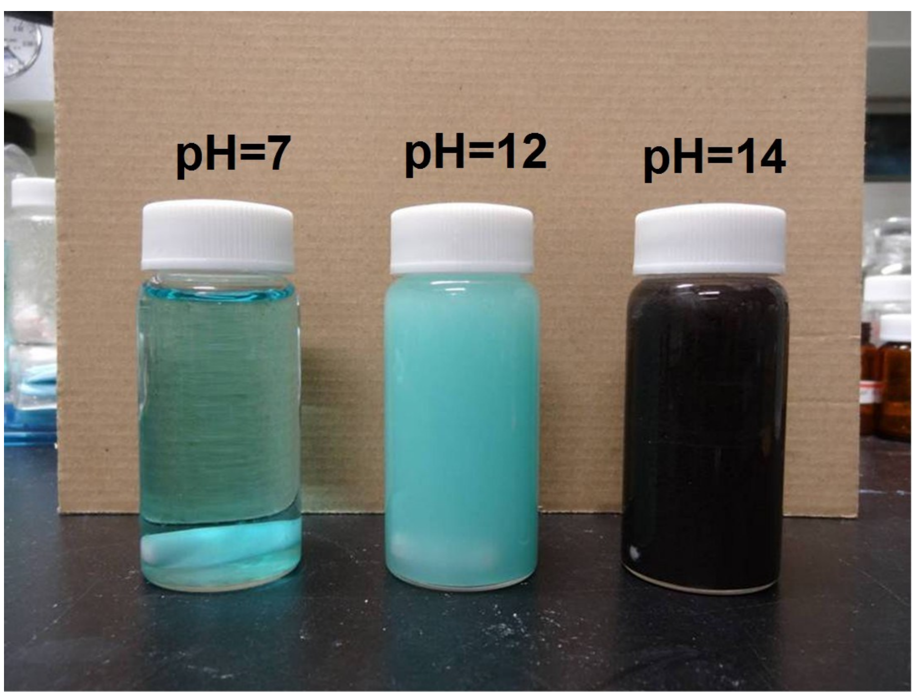

Figure S11. Photos for $CuCl_2$ hydrolyzed products at different pH value.

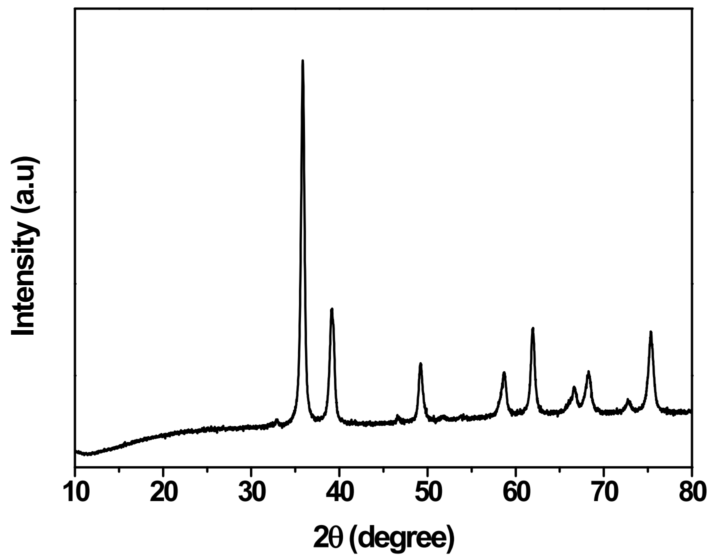

Figure S12. XRD pattern of $CuCl_2$ hydrolyzed products obtained at pH 14. The result shows that the products are crystallized CuO.

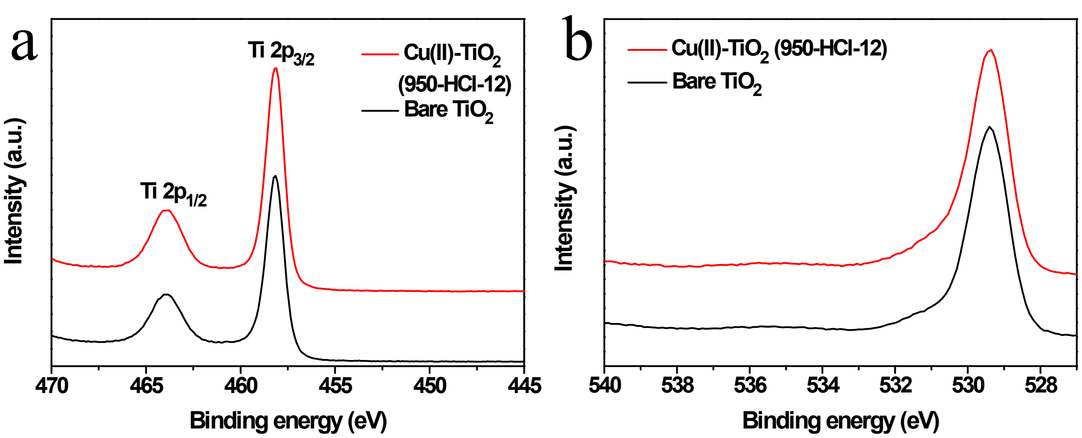

Figure S13. a) Ti 2p and b) Cu 2p core-level spectra of Cu(II)-TiO_2 (950-HCl-12).

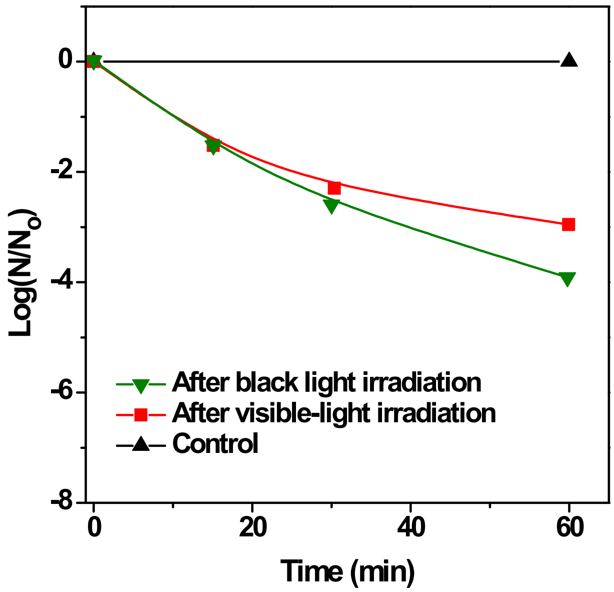

Figure S14. Inactivation of *Qβ* bacteriophage by Cu(II)-TiO_2 (950-HCl-12) under dark after black light and visible-light irradiation.

References

1 H. G. Yu, H. Irie, Y. Shimodaira, Y. Hosogi, Y. Kuroda, M. Miyauchi, K. Hashimoto, *J. Phys. Chem. C* 2010, **114**, 16481–16487.