Supporting information for

Highly dispersed Cu_2O quantum dot (about 2 nm) constructed by simple functional group anchoring strategy: Boosts 72 times photocatalytic water splitting ability

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Characterization

The morphology, sizes of the obtained photocatalysts and the energy dispersive spectrometry (EDS) data were measured using a Hitachi S-4800 scanning electron microscopy (SEM) at 5 kV. The high-resolution transmission electron microscopy (HRTEM) images and elemental mapping images of the as-synthesized materials were recorded on a JEOL JEM-2010F transmission electron microscope at 200 kV. X-ray diffraction (XRD) was performed on a Bruker D8 X-ray diffractometer with a Cu-Kα radiation in the 2θ range of 10-80°. Fourier transform infrared spectra (FT-IR) were recorded on a Bruker VERTEX 70 IR spectrometer using KBr pellets. The X-ray photoelectron spectroscopy (XPS) was measured on a Thermo Fisher Scientific

ESCALAB 250Xi photoelectron spectrometer. Ultraviolet-visible (UV-vis) absorption spectra of the as-obtained photocatalysts were measured using a Hitachi U-3010 spectrophotometer during 250-800 nm at room temperature. An electron spin resonance spectrometer (Evisa JES-FA300) was used to obtain the electron paramagnetic resonance (EPR) spectroscopy. CHI 760E electrochemical instrument was used to perform the Mott-Schottky curves with a three-electrode quartz cells (Counter electrode: Pt wire; Reference electrode: Ag/AgCl; Working electrode: photocatalysts coated ITO glass). The 300 W Xe lamp of Beijing China Education Aulight Co., Ltd. was used as the light source. A Vis REF standard visibility mirror was used with a light source wavelength of 350-780 nm. The photoluminescence spectra (PL) were obtained on a Hitachi F-4500 fluorescence spectrophotometer (excitation wavelength: 250 nm). Gas chromatograph (GC 7920, conductivity detector (TCD), N_2 carrier gas).

Photocatalytic hydrogen evolution measurement

Photocatalytic hydrogen evolution (PHE) experiments were carried out on an online photocatalytic hydrogen evolution system (CEL-SPH2NP, Beijing China Education Aulight Co., Ltd.). The quartz reaction kettle is used as a container, and the closed gas circulation system and gas extraction system are connected at the interface by coating vacuum grease. 0.1 g of photocatalyst was dispersed in 100 mL of aqueous solution containing 25 mL of methanol and dispersed uniformly under sonication. methanol was chosen as the cavity sacrificial agent and a 300W Xe lamp was used as the light source. Before the reaction, the reactor is degassed several times to remove air from the reactor. Volatile hydrogen was determined by online gas chromatography (GC 7920, conductance detector (TCD), N_2 carrier gas), and the precipitated gas was analyzed and detected every 1 h.

Photocatalytic stability test

Three times (15h) photocatalytic hydrogen evolution experiments were carried out on the photocatalytic hydrogen evolution system, including a 5-hour cycle. After the end of one cycle, the reactor was taken down and stood for a period of time, and then vacuumized again to continue the next cycle hydrogen production experiment.

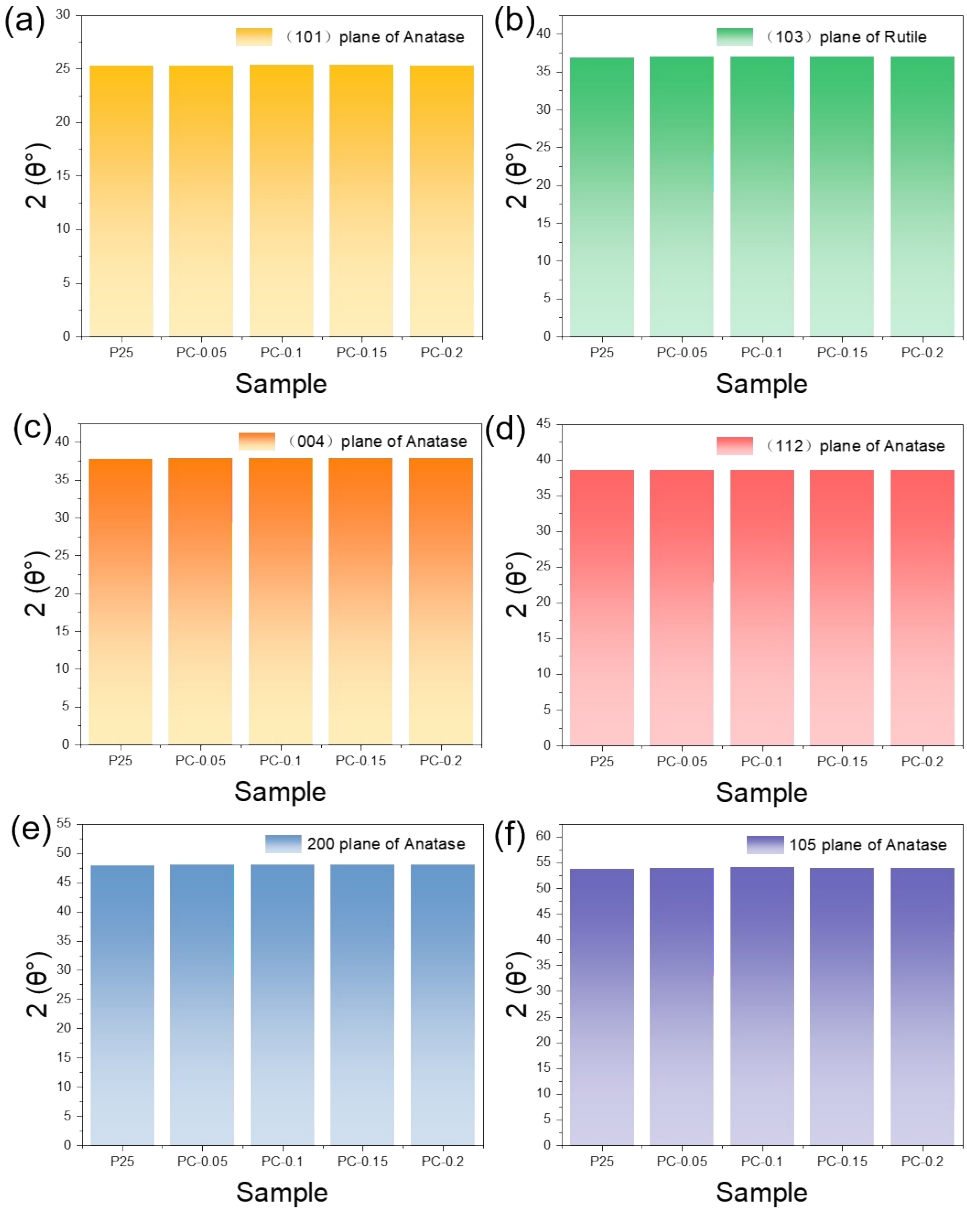

Fig. S1. The peak position of each sample in XRD: a. (101) plane of anatase; b. (103) plane of Rutile; c. (112) plane of anatase; d. (004) plane of anatase

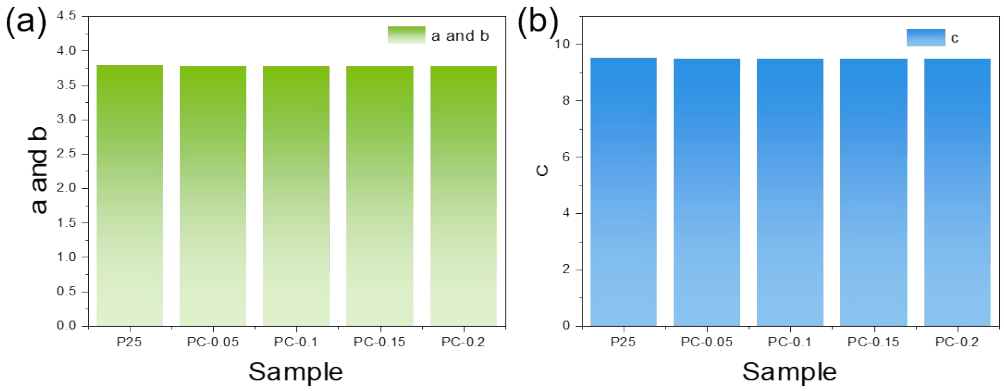

Fig. S2. The calculated lattice constant of each sample from XRD.

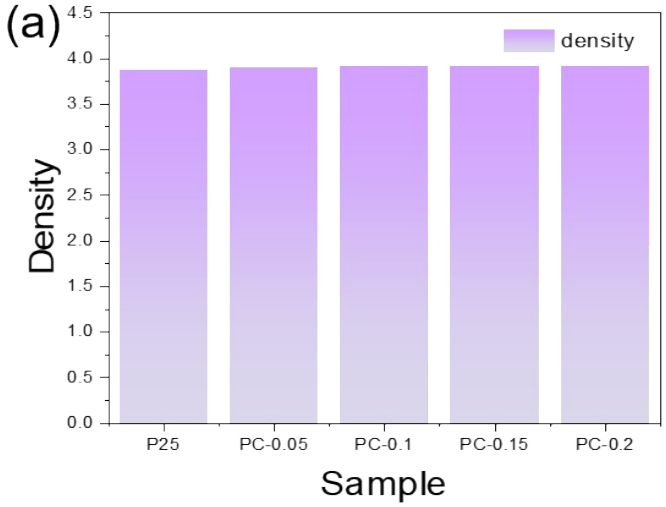

Fig. S3. The calculated lattice density of each sample from XRD.

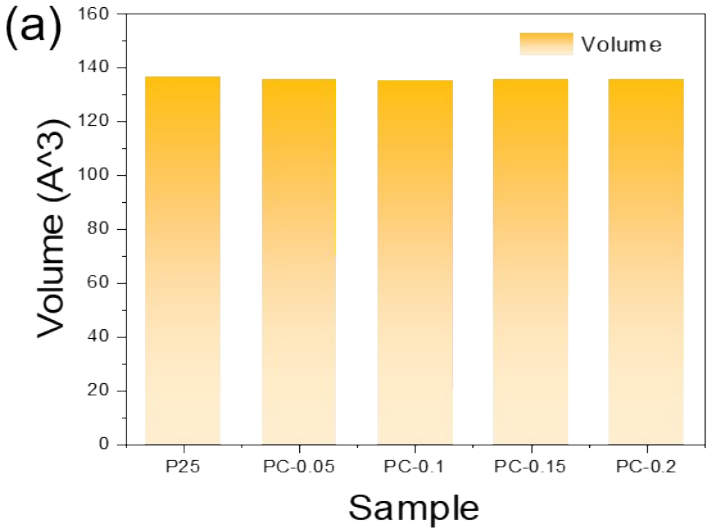

Fig. S4. The calculated lattice volume of each sample from XRD.

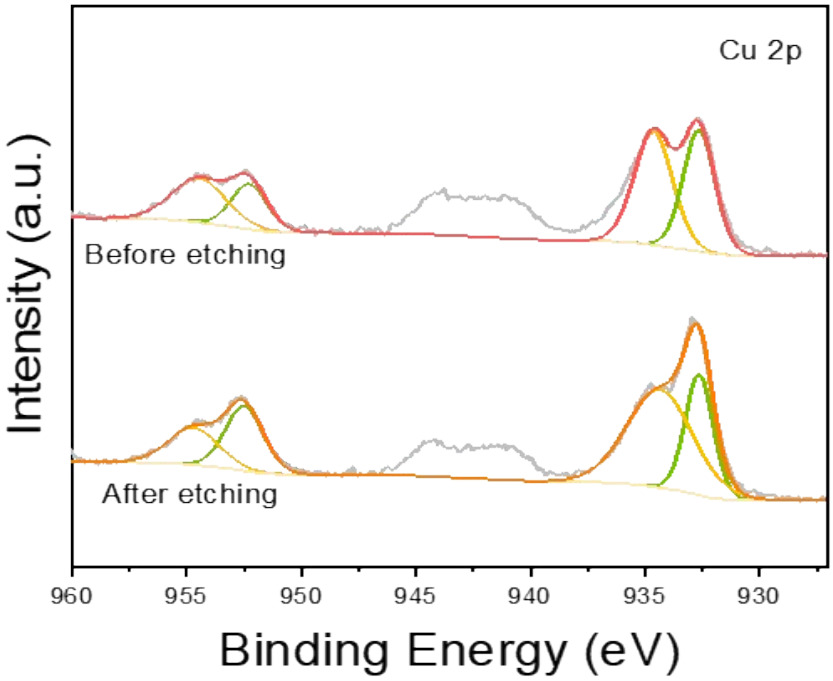

Fig. S5. Comparison of high-resolution XPS spectra of Cu before and after etching.

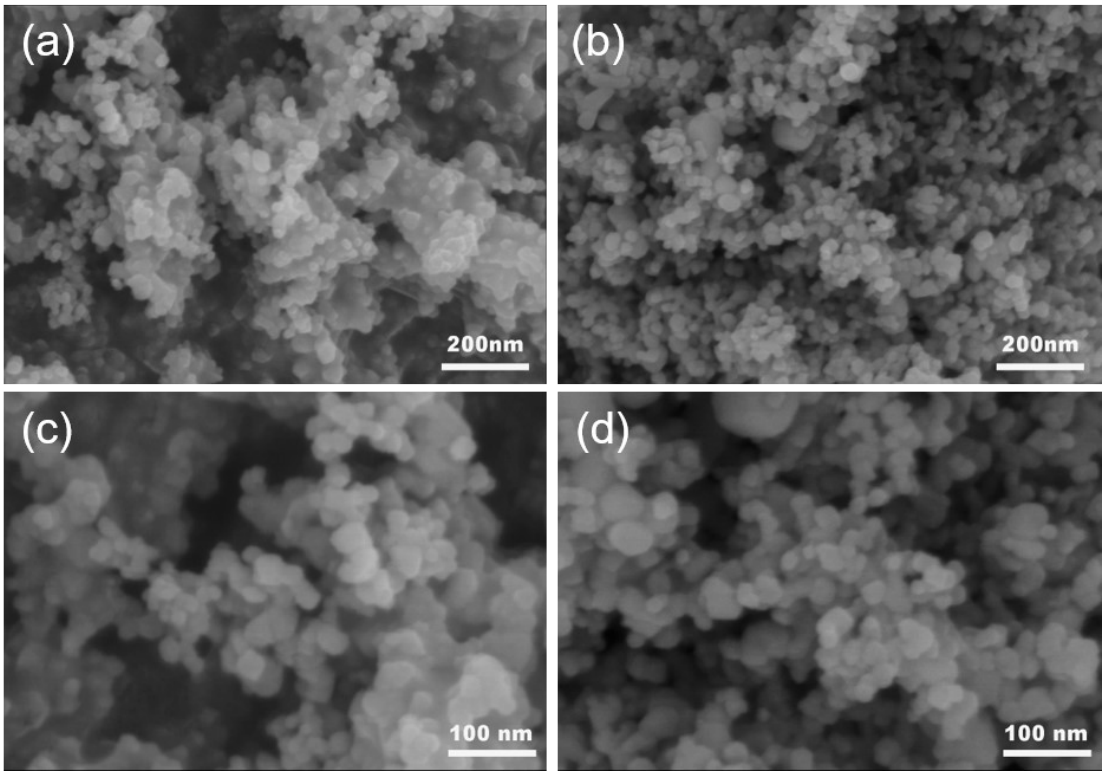

Fig. S6. SEM images of P25 10w (a),20w (c) and PC-0.1 10w (b),20w (d)

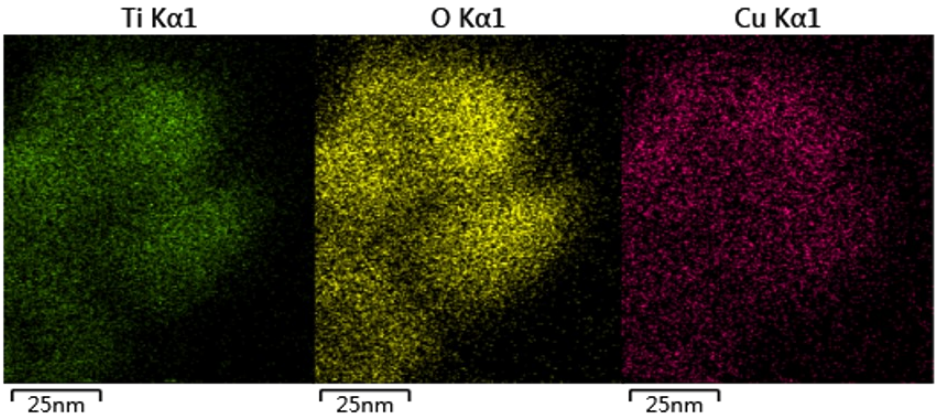

Fig. S7. Elemental mapping of PC-0.1 for Ti, O, Cu.

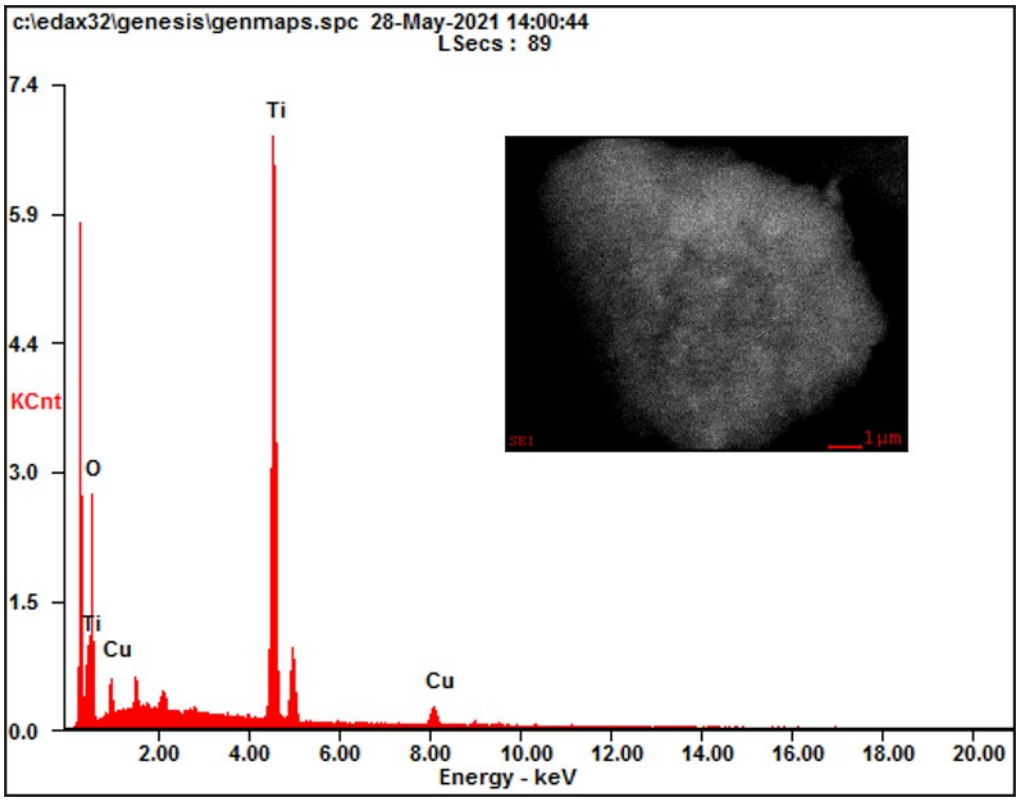

Fig. S8. Element contents of PC-0.1

Table S1. Element contents of PC-0.1

Element	Wt%	At%
OK	44.41	71.08
TiK	49.53	26.48
CuK	06.06	02.44
Matrix	Correction	ZAF

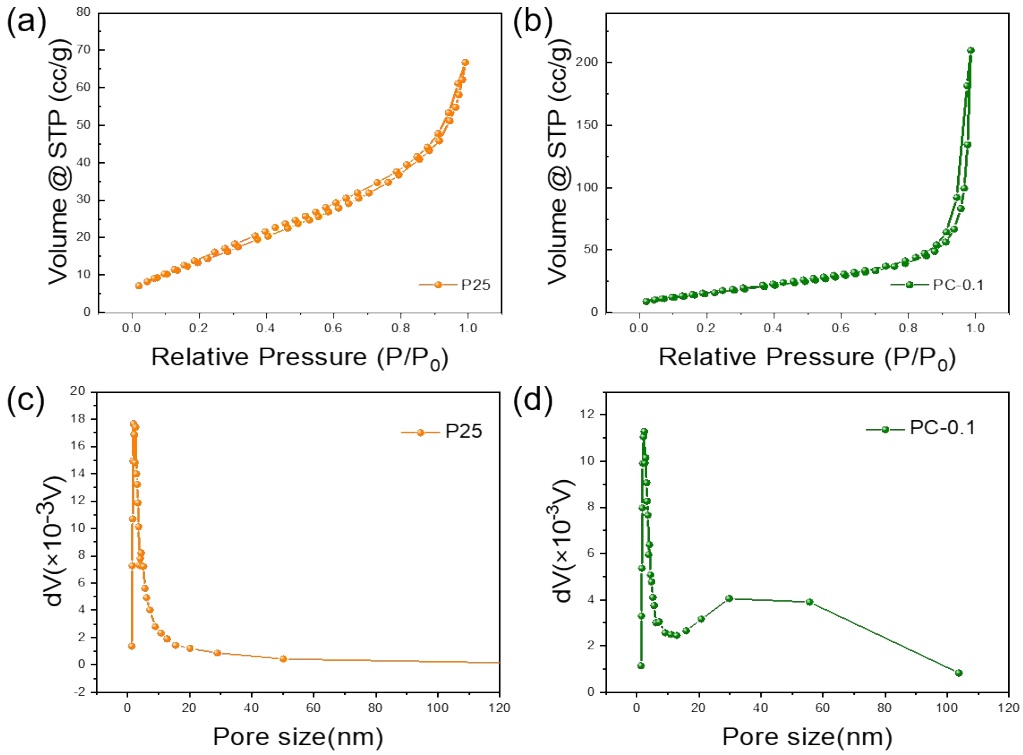

Fig. S9. pore size distributions of P25 (a) and PC-0.1 (b),N_2 adsorption–desorption isotherms of P25 (c) and PC-0.1 (d).

Table S2. The surface area,pore volume and pore diameter of P25 and P-ANL-3

Sample	Surface Area (m^2/g)	Pore Volume (cc/g)	Pore Diameter (nm)
P25	82.395	0.114	1.194
PC-0.1	70.140	0.330	2.574

Table S3. Comparisons of the photocatalytic H_2 evolution of the catalysts prepared in the present work with the recently reported TiO_2-based catalysts.

Photocatalyst	Light Source	H_2 evolution rate/(μmol·g^{-1}·h^{-1})	Reference
This Work	300 W Xe lamp	14911	-
TiO_2/rGO	3 W-LED (365 nm, 80 mW cm^{-2})	103.82	[1]
Cu-TiO_2	UV (450 W Hg)	8470	[2]
Ni/TiO_2	UV (450 W Hg)	3390	[3]
Pt/TiO_2	AM 1.5 G solar simulator	11200	[4]
Cu/TiO_2	UV (450 W Hg)	8470	[3]
Cu/S-TiO_2	500 W Xe lamp with UV cut off filter	7500	[5]
Pt/Ga-TiO_2	150 W Xe lamp	5722	[6]
Rh/Nb-TiO_2	300 W Xe lamp	7850	[7]
TiO_2-His	Xe lamp	216.3	[8]

References

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