CoP Decorated 2D/2D Red Phosphorus/B Doped g-C_3N_4 Type II Heterojunction for Boosted Pure Water Splitting Activity via Two-Electron Pathway

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The leak ratios of Co and P atoms (wt%)

ICP-MS and ion chromatography were used to detect the concentration of Co^{2+} and PO_4^{3-} in the solution after the reaction to confirm the stability of CoP/RP/BCN. The concentration of Co^{2+} and PO_4^{3-} were 19.1 μg L^{-1} and 0.99 mg L^{-1} by ICP-MS and ion chromatography analysis, respectively. The leak ratios of Co and P atoms (wt%) are calculated as as follows:

$$R_P = \frac{C_{PO_4^{3-}} \times V_{H_2O}}{M \times W_P} = \frac{0.99 \times 0.03}{6 \times 49.81\%} \times 100\% = 0.99\% \quad R_{Co} = \frac{C_{Co^{2+}} \times V_{H_2O}}{M \times W_{Co}} = \frac{0.019 \times 0.03}{6 \times 0.64\%} \times 100\% = 1.48\%$$

where R is the leak ratio. C is the concentration of Co^{2+} or PO_4^{3-} in the solution after the reaction. V is the volume of the reaction solution. M is the mass of catalyst. W is the concentration of Co or P in CoP/RP/BCN.

Table S1 The radiative fluorescence lifetimes and their relative percentages of photo-excited charge carriers in the different samples.

Sample	τ_1 (ns)	A_1	τ_2 (ns)	A_2	τ_3 (ns)	A_3	τ_{Ave} (ns)
CN	0.61	1696.87	2.46	535.08	11.56	29.144	2.89
BCN	0.55	1545.56	2.46	604.51	12.99	27.79	3.26
RP/BCN	0.50	3294.12	2.60	813.35	10.39	99.89	3.57
CoP/RP/BCN	1.06	5751.70	4.85	695.11	34.59	29.85	5.58

Table S2 The effect of B, RP, and CoP on sample photocatalytic activity.

Group	Sample	Hydrogen evolution rate /μmol h^{-1} g^{-1}	Multiple
1	BCN[a]	1.3	1.6
	CN[b]	0.8	
	COP/RP/BCN[a]	166.2	3.8
	COP/RP/CN[b]	44.0	
2	RP/BCN[a]	5.4	1.6
	BCN[b]	1.3	
	COP/RP/BCN[a]	166.2	50.4
	COP/BCN[b]	3.3	
3	COP/BCN[a]	3.3	2.5
	BCN[b]	1.3	
	COP/RP/BCN[a]	166.2	30.8
	RP/CN[b]	5.4	

a, the numerator of multiple; b, the denominator of multiple

Table S3 The elemental contents of different samples based on the ICP-MS analysis

Sample	**B (wt%)**	**P (wt%)**	**Co (wt%)**
$CoP_3/RP_8/B_{0.5}CN$	0.40	33.81	0.26
$CoP_3/RP_8/B_1CN$	0.64	49.81	0.64
$CoP_3/RP_8/B_{1.5}CN$	1.10	58.77	0.95

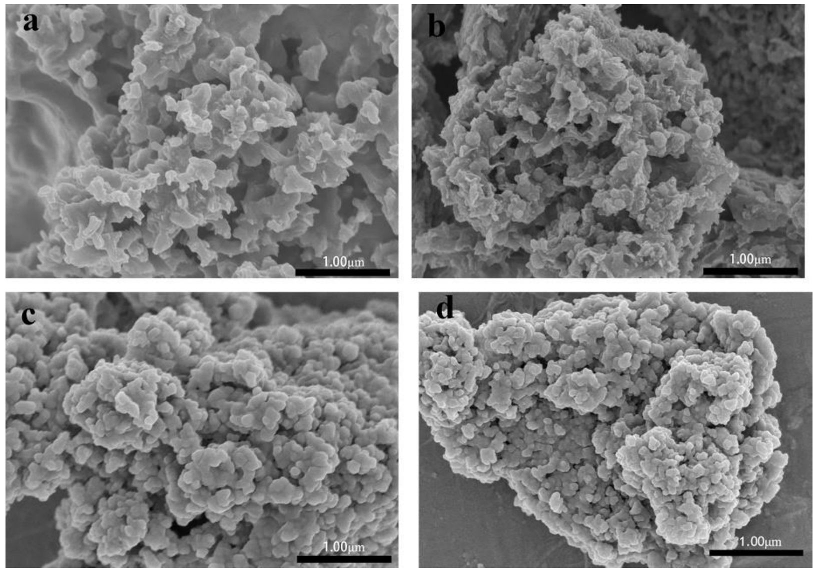

Fig. S1 SEM images of (a) CN, (b) BCN, (c) RP/BCN, and (d) CoP/RP/BCN.

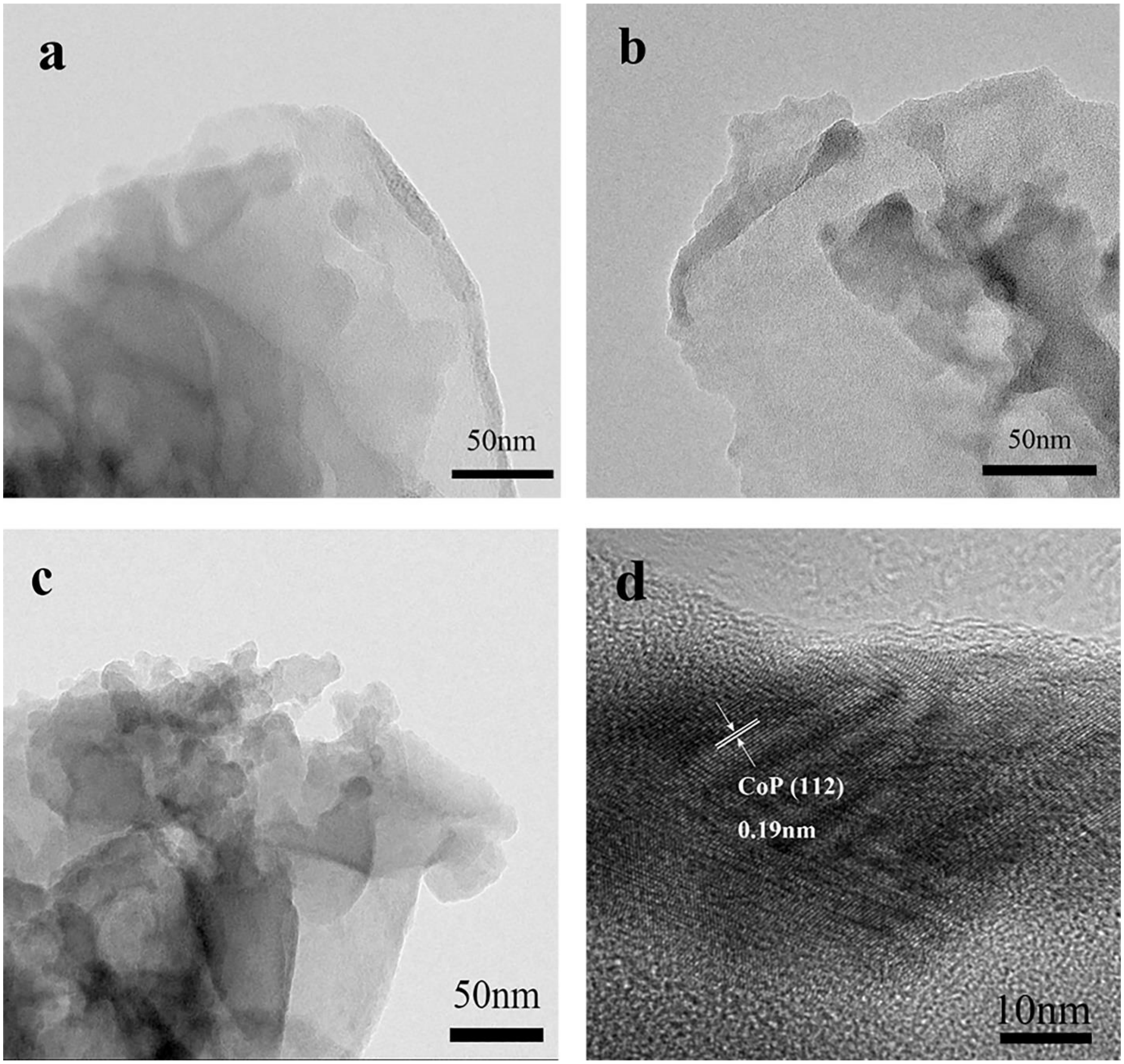

Fig. S2 TEM images of (a) CN, (b) BCN, and (c) CoP/RP/BCN. (d) HRTEM image of CoP/RP/BCN.

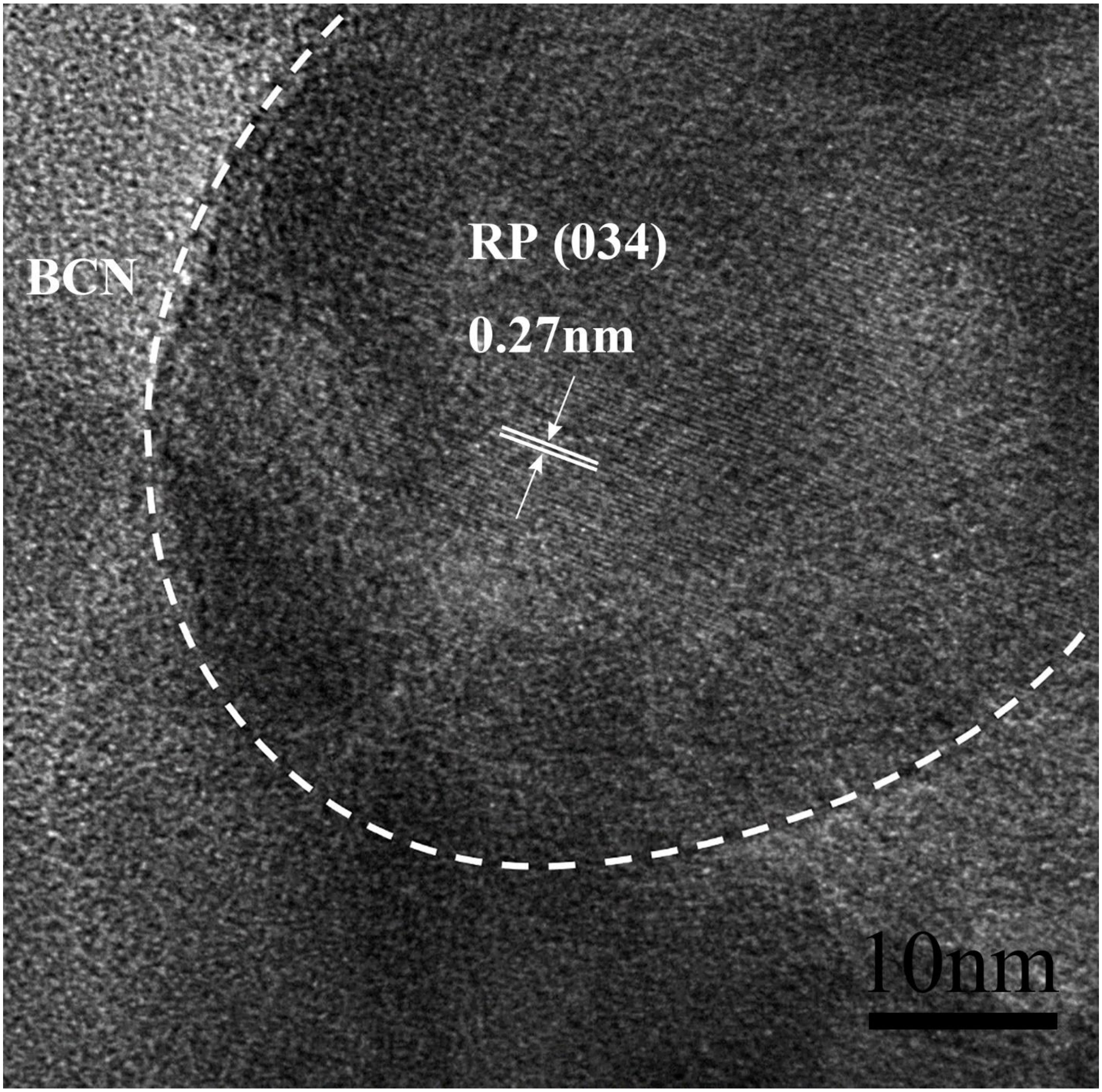

Fig. S3 HRTEM image of CoP/RP/BCN.

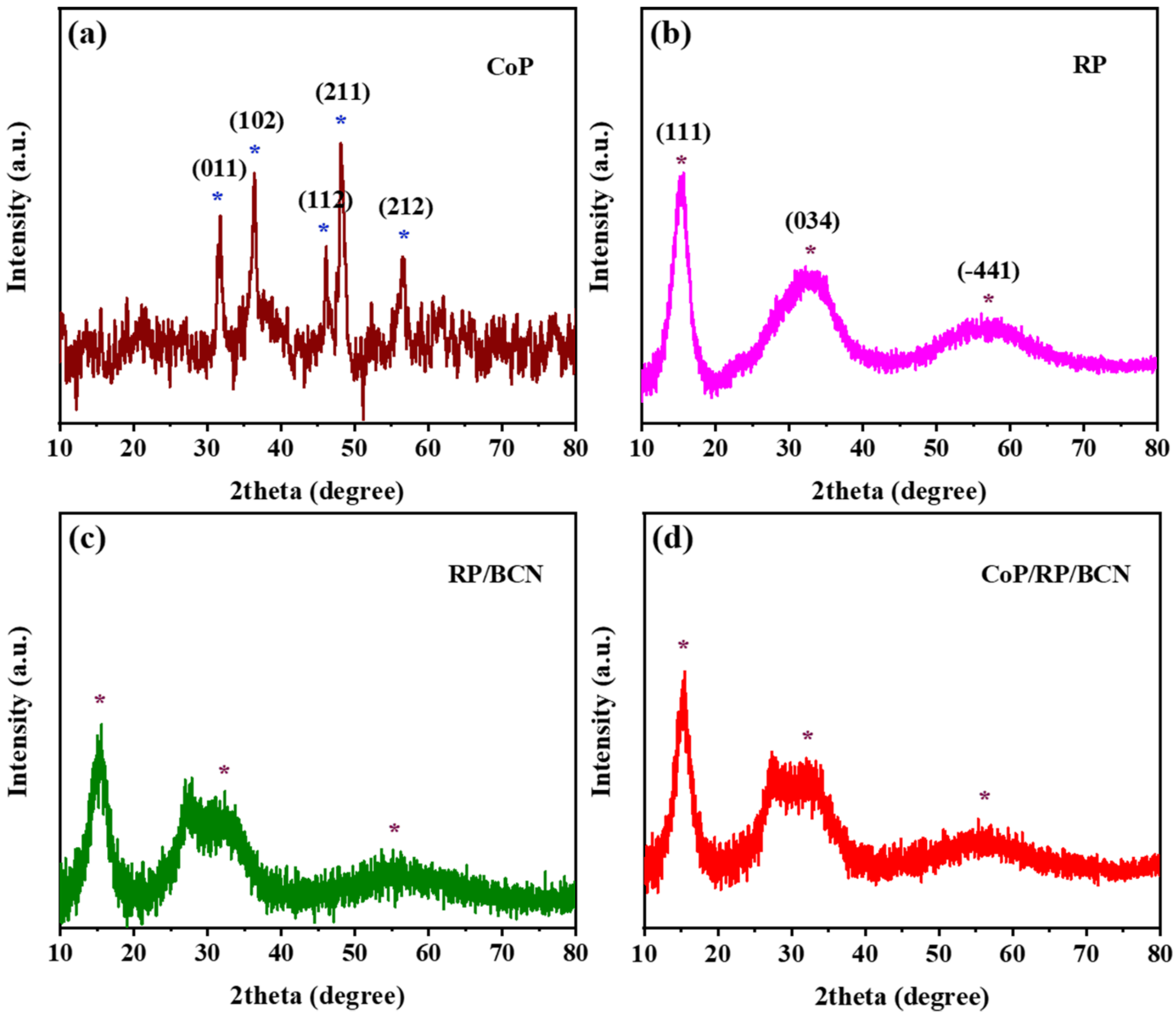

Fig. S4 XRD patterns of CoP, RP, RP/BCN, and CoP/RP/BCN.

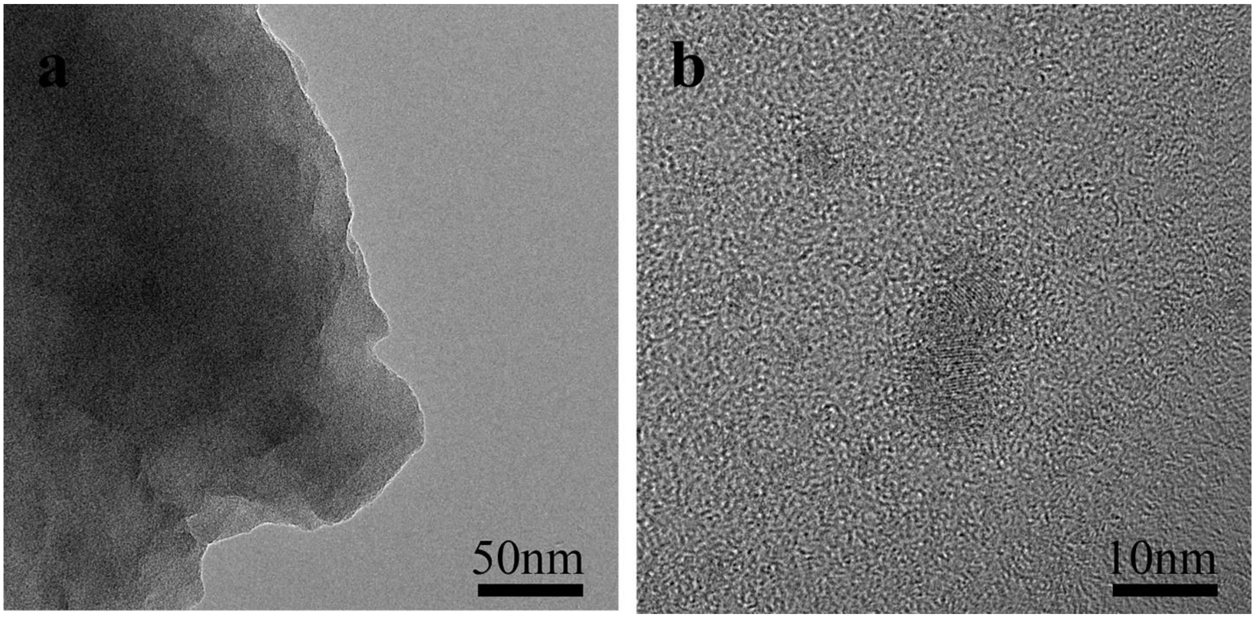

Fig. S5 TEM images of (a) RP and (b) CoP.

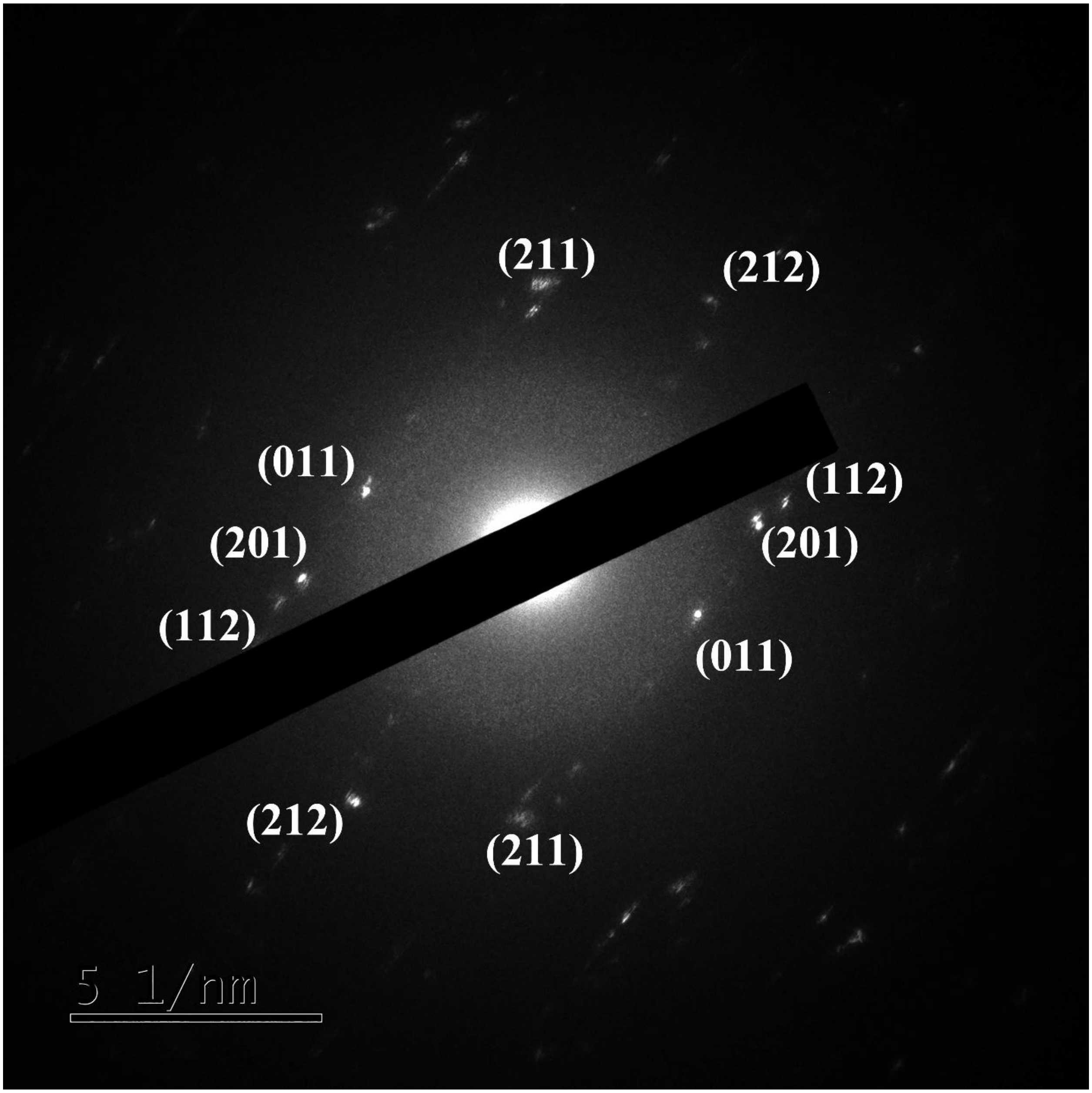

Fig. S6 SADE pattern of CoP loaded on the CoP/RP/BCN.

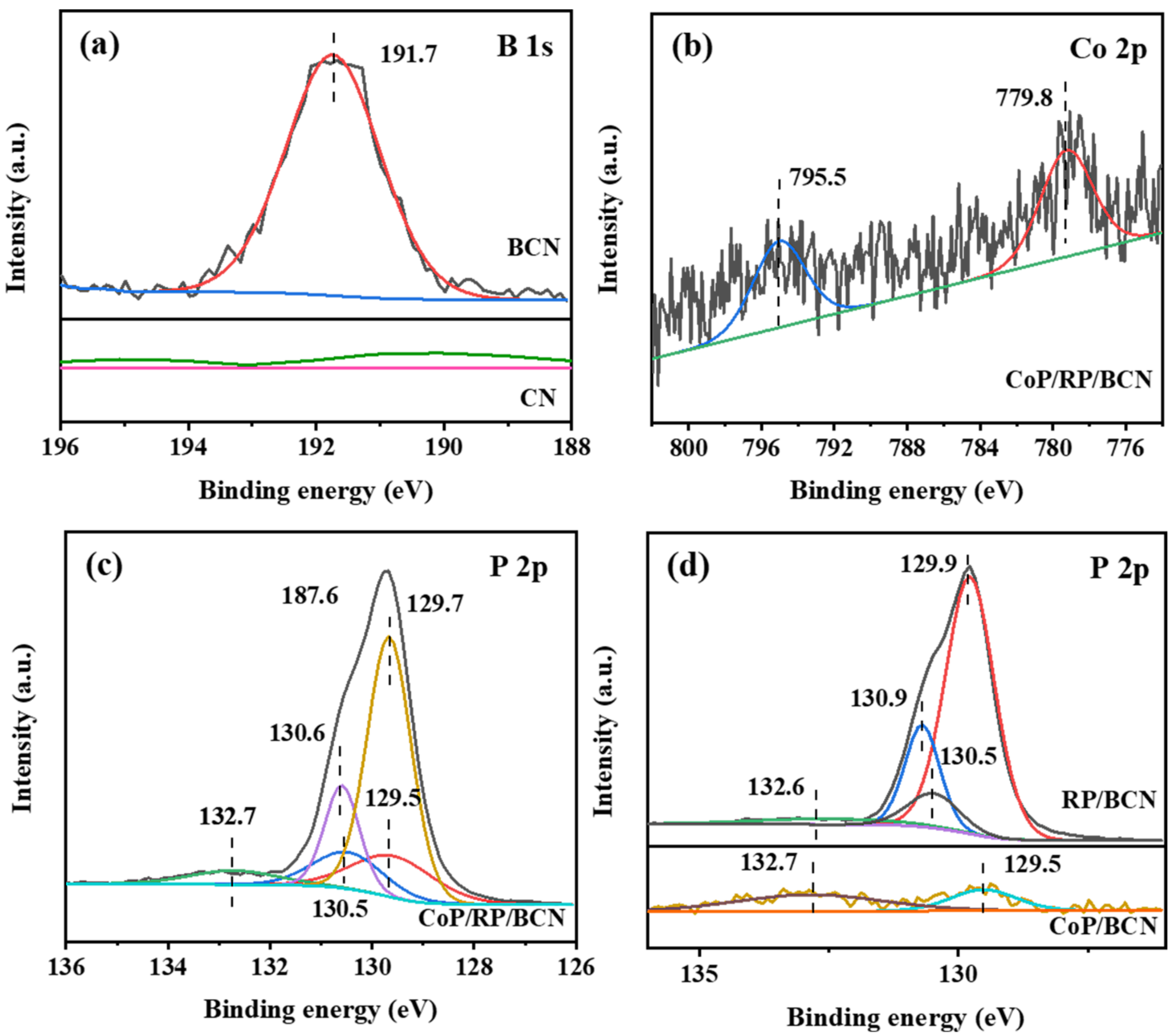

Fig. S7 The XPS spectra of (a) B 1s for CN and BCN, (b) Co 2p for CoP/RP/BCN, P 2p for (c) CoP/RP/BCN and (d) RP/BCN and CoP/BCN.

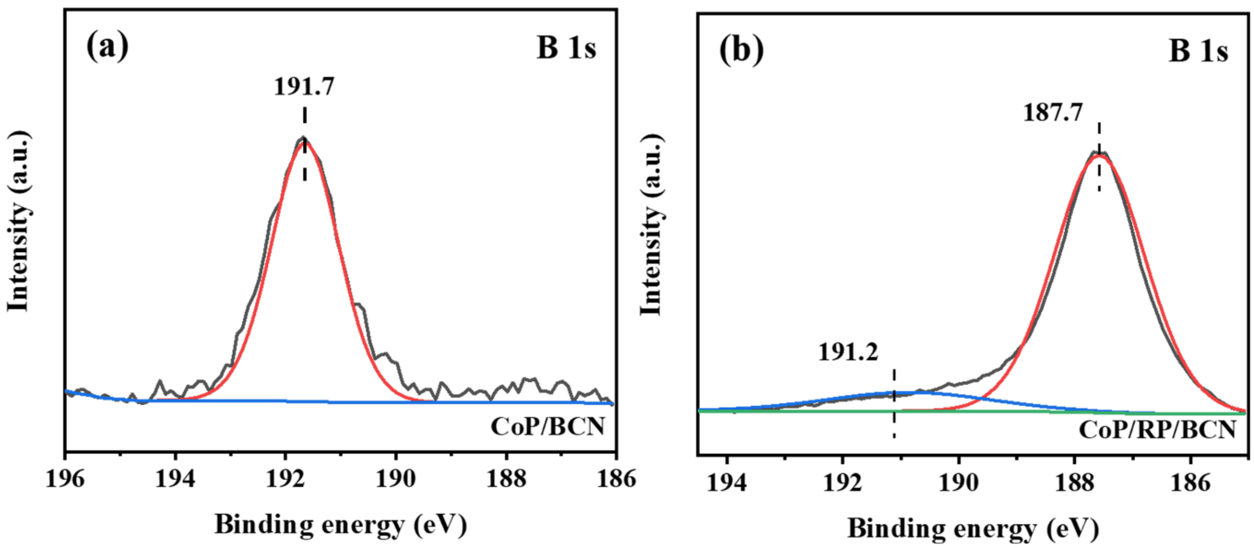

Fig. S8 The XPS spectra of B 1s for (a) CoP/ BCN and (b) CoP/RP/BCN

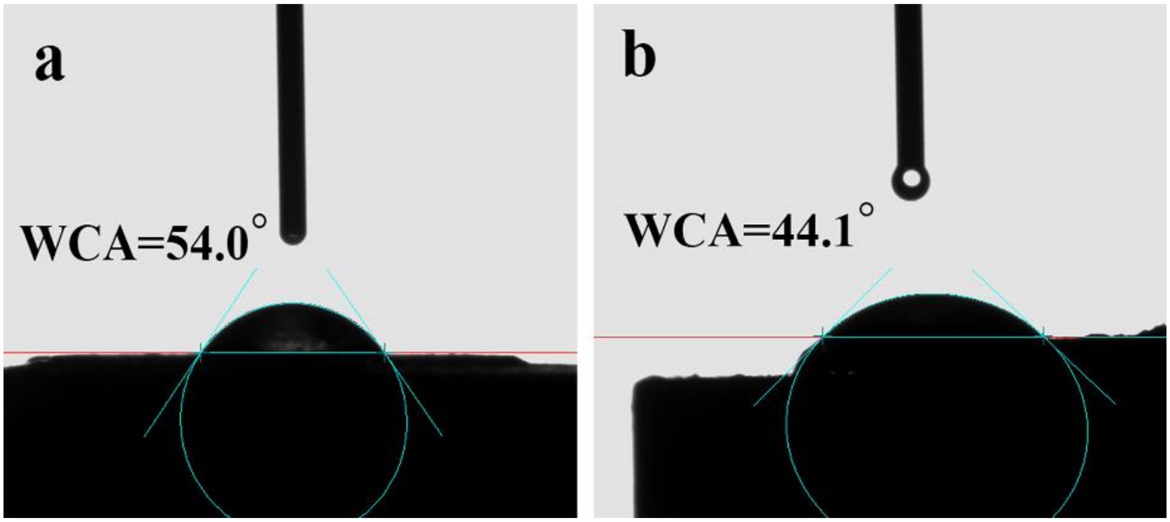

Fig. S9 The water contact angles of (a) RP/BCN and (b) CoP/RP/BCN.

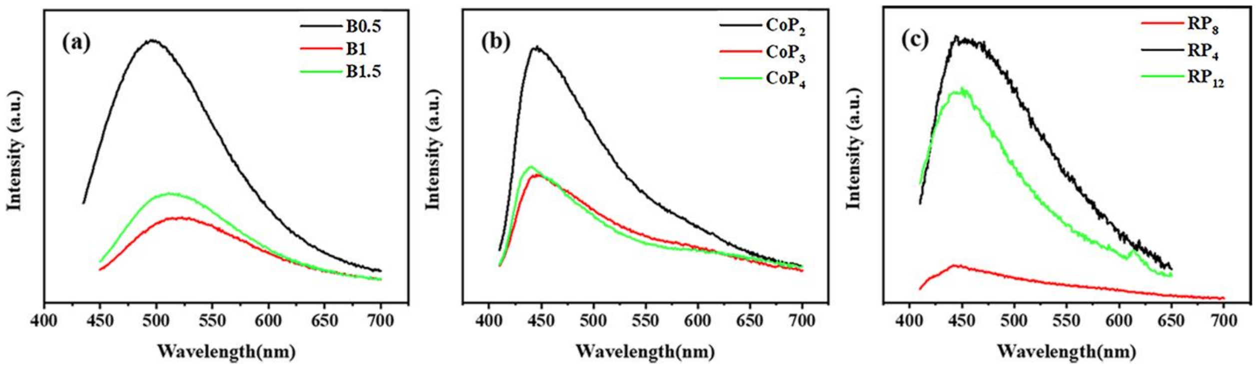

Fig. S10 PL spectra of (a) B_xCN, (b) $CoP_x/RP_8/CN$, and (c) $CoP_3/RP_x/B_1CN$.

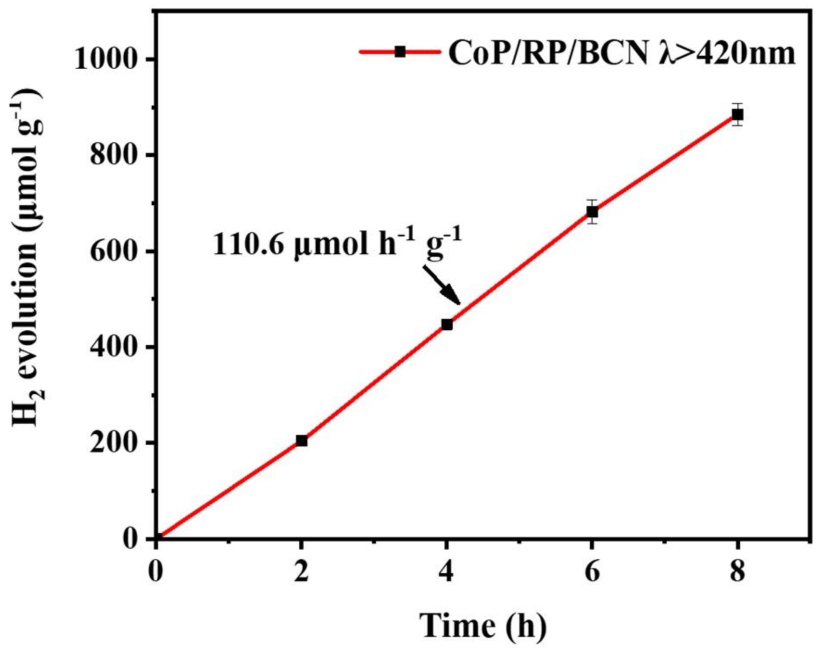

Fig. S11 Photocatalytic H_2 evolution rates of CoP/RP/BCN under light irradiation (λ > 420 nm).

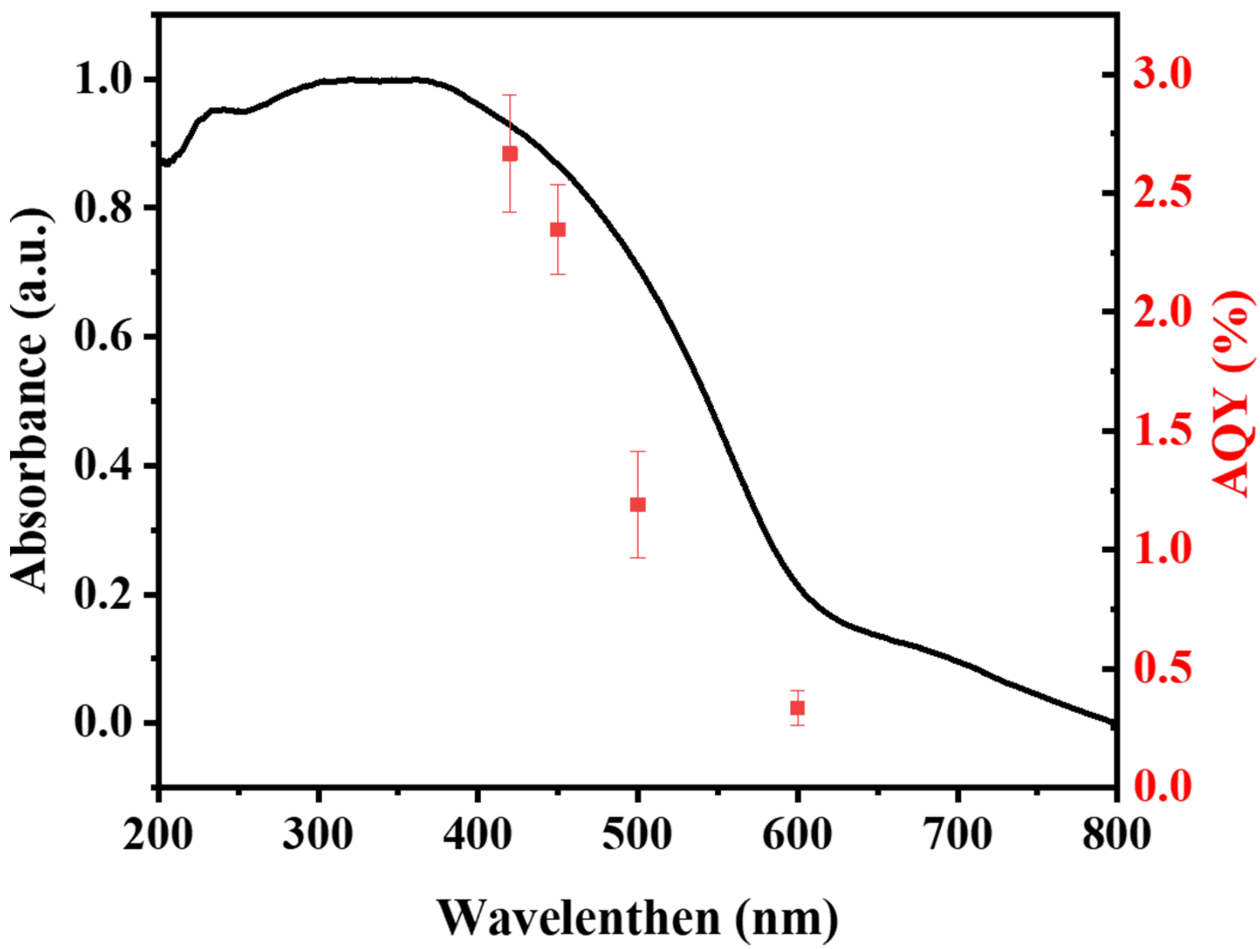

Fig. S12 Wavelength-dependent AQYs for CoP/RP/BCN at different wavelengths.

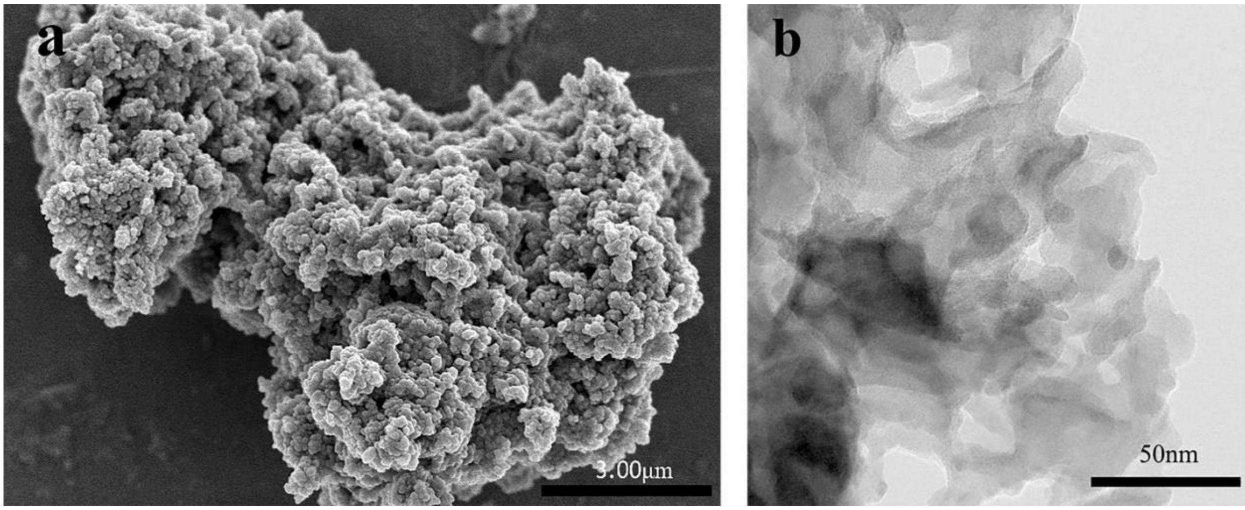

Fig. S13 (a) SEM and (b) TEM images of CoP/RP/BCN after cycling hydrogen generation under visible light irradiation (λ>420nm).

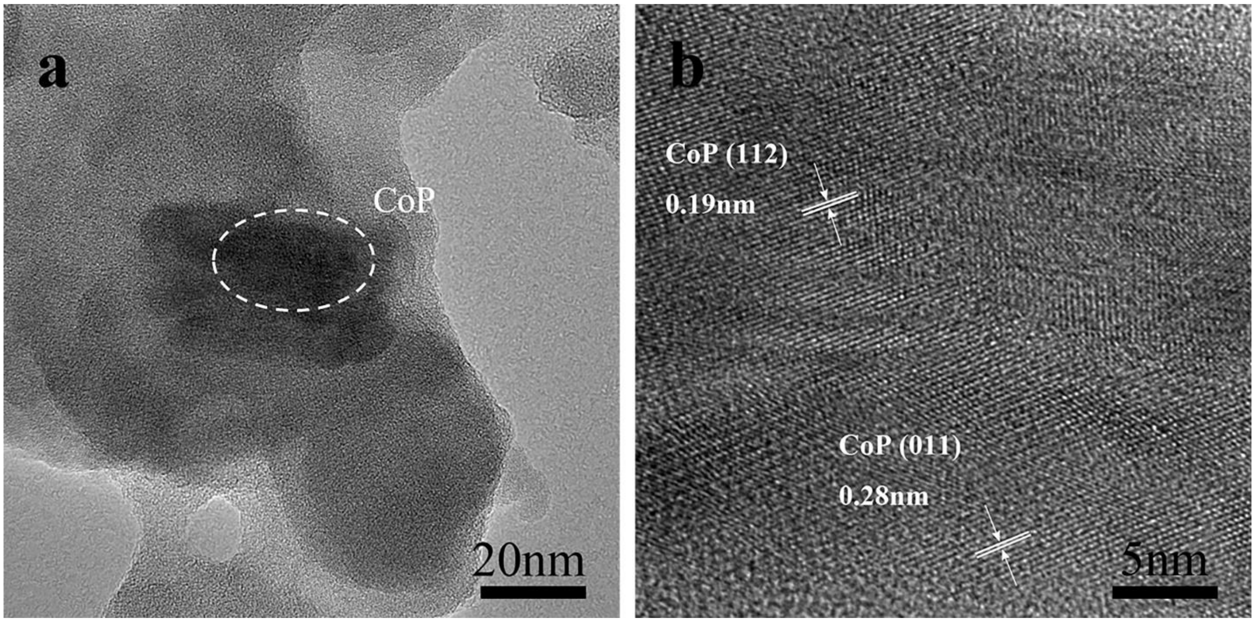

Fig. S14 The HRTEM image of CoP for CoP/RP/BCN after cycling hydrogen generation under visible light irradiation (λ>420nm).

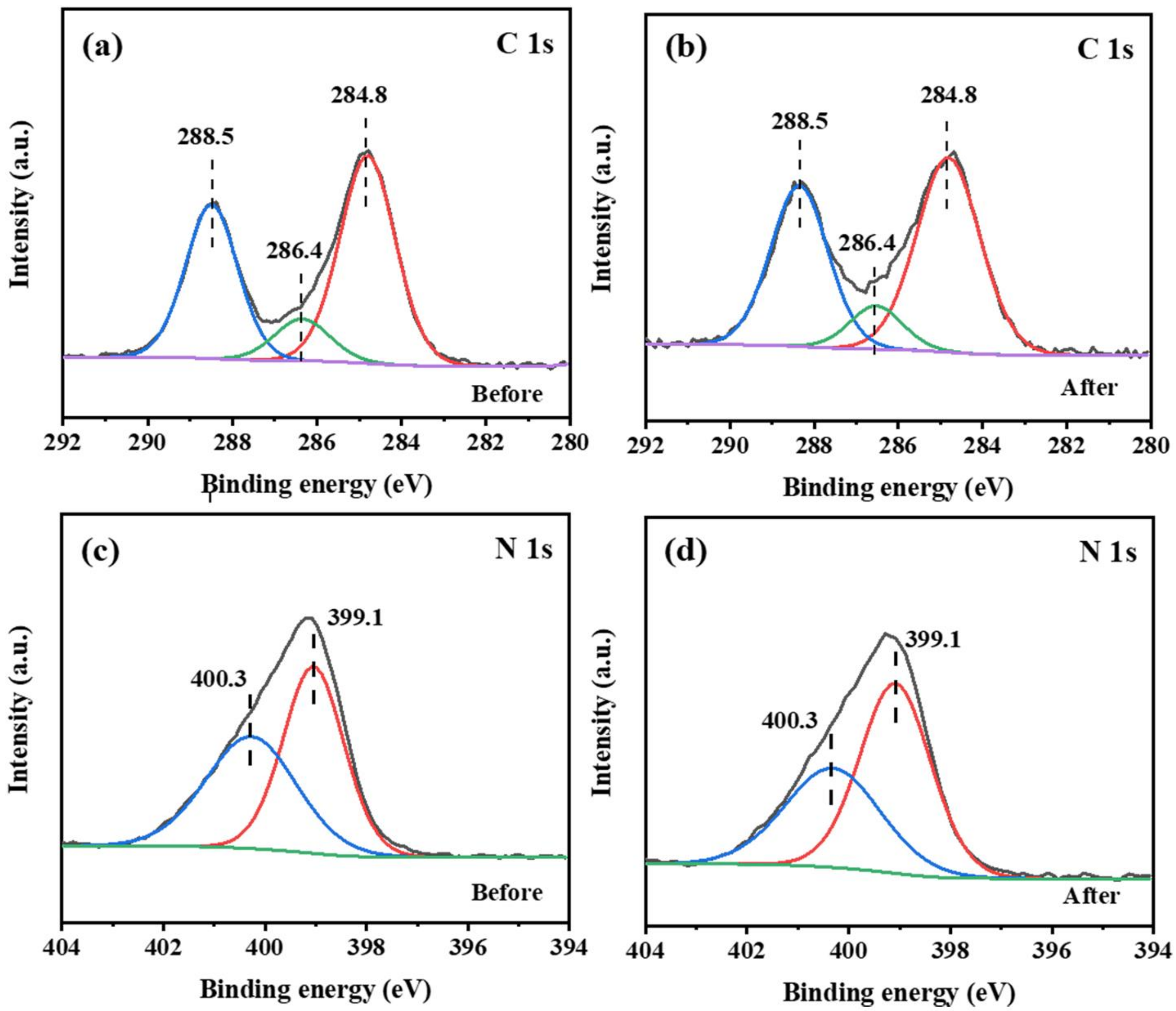

Fig. S15 The XPS spectra of (a, b) C 1s and (c, d) N 1s for sonicated CoP/RP/BCN after cycling hydrogen generation under visible light irradiation (λ>420nm) compared with that of before.

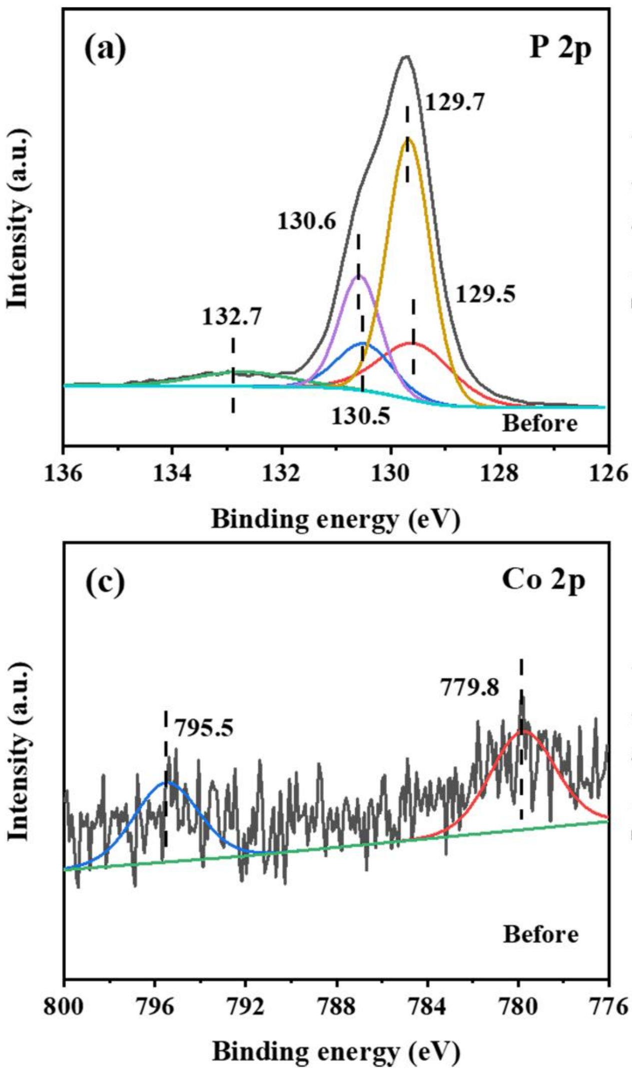

Fig. S16 The XPS spectra of (a, b) P 2p and (c, d) Co 2p for sonicated CoP/RP/BCN after cycling hydrogen generation under visible light irradiation (λ>420nm) compared with that of before.

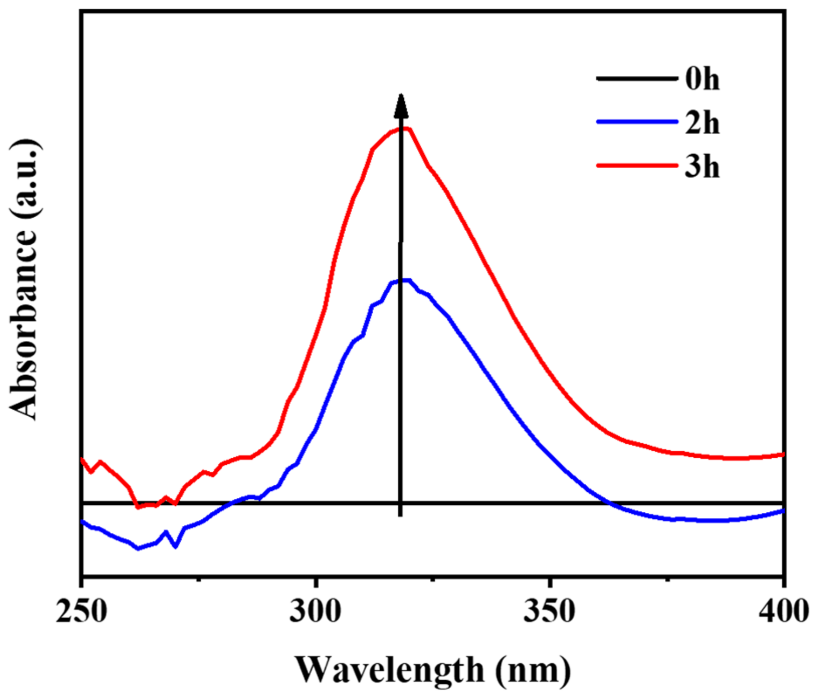

Fig. S17 UV–vis absorption spectra of CoP/RP/BCN system with light irradiation by iodometry.

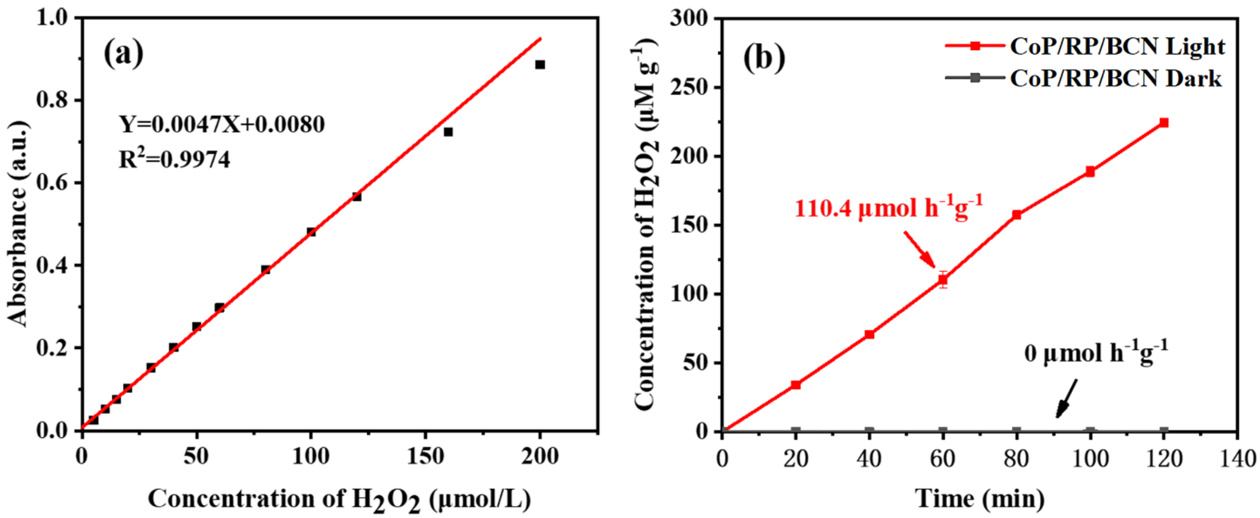

Fig. S18 (a) Standard curve of different concentration of H_2O_2 by iodometry. (b) Photocatalytic H_2O_2 evolution rates of CoP/RP/BCN under light irradiation (λ > 420 nm) and dark.