Supporting Information

Probing the effect of P-doping in polymeric carbon nitride on CO_2 photocatalytic reduction

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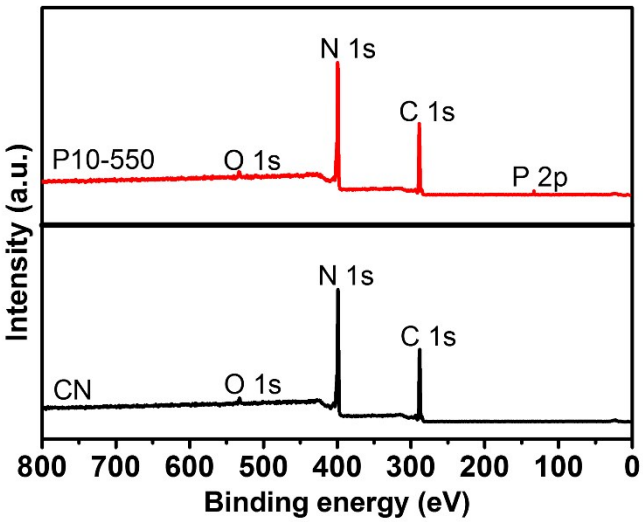

Fig. S1 XPS survey spectra of CN and P10-550.

Table S1 Elemental properties of CN and P10-550 (Fresh and Used) from XPS analysis.

Sample	C (atom%)	N(atom%)	O(atom%)	P(atom%)
CN	42.82	55.69	1.49	----------
P10-550	42.77	54.81	2.05	0.37
P10-550 Used	41.37	54.79	3.54	0.3

Table S2 Nitrogen adsorption-desorption data of CN and P10-550

samples	S_{BET}($m^2\ g^{-1}$)	Pore volume ($cm^3\ g^{-1}$)	Pore size (nm)
CN	41.5	0.32	31.2
P10-550	35.5	0.27	28.8

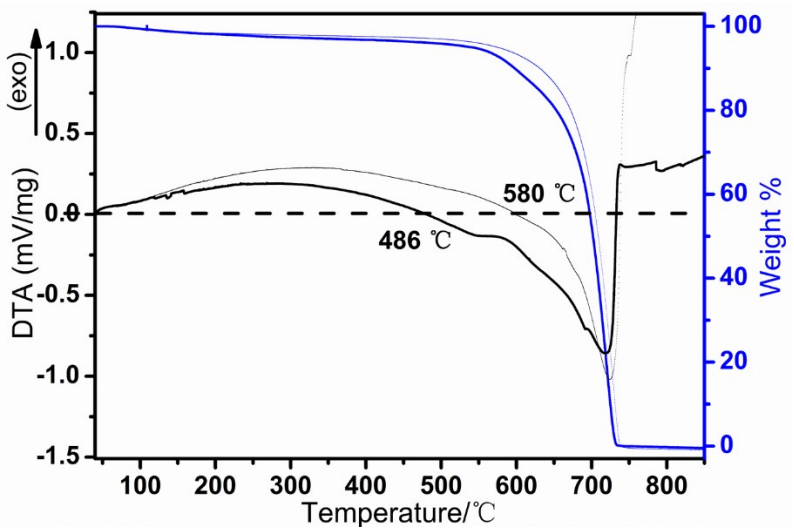

Fig. S2 TG-DTA curves of CN (dot line) and P10-550 (solid line) in air/N_2 (80/20).

Table S3 CO_2-TPD results of CN and P10-550

Catalyst	Desorption temperature (°C)	Desorption capacity (μmol·g^{-1})	Desorption temperature (°C)	Desorption capacity (μmol)	Total desorption Capacity (μmol)
CN	96	72.2	----------	----------	72.2
P10-550	92	27.0	314	234.7	261.7

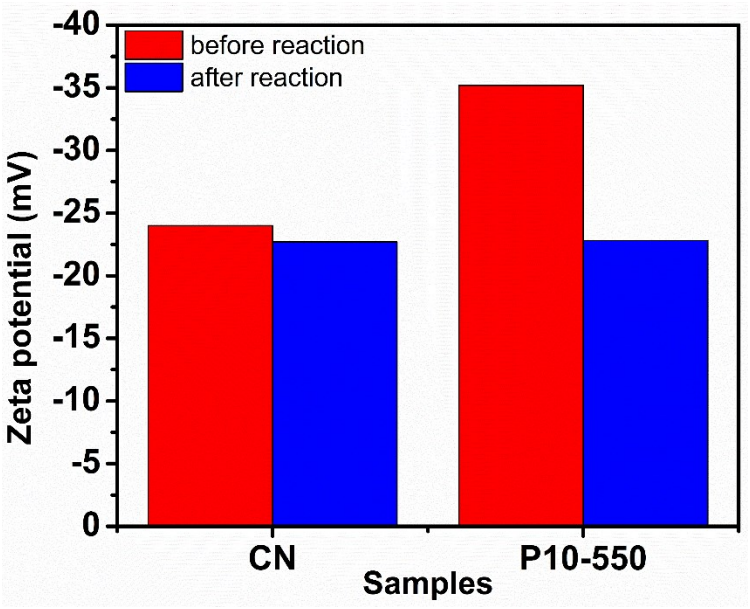

Fig. S3 Zeta potentials of CN and P10-550 before and after CO_2 photocatalytic reduction of 20 h.

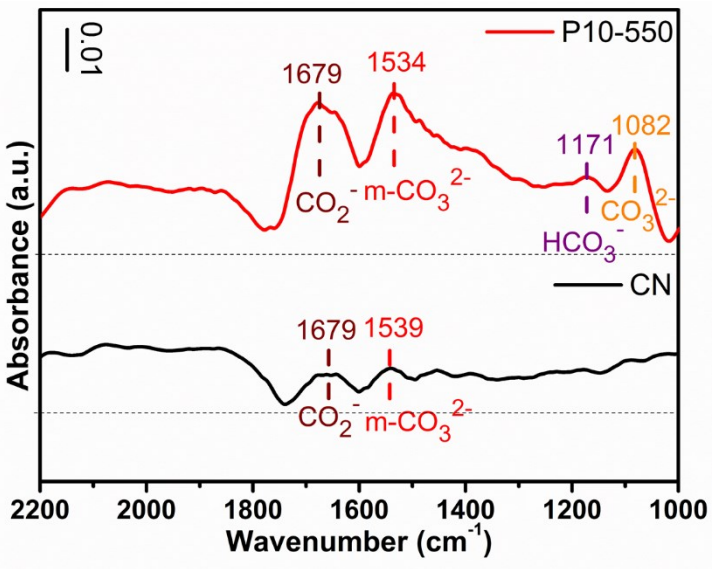

Fig. S4 *In-situ* FTIR spectra of CN and P10-550 at the presence of CO_2 and H_2O in dark (2200 ~1000 cm^{-1}) (The spectrum collected in N_2 as background).

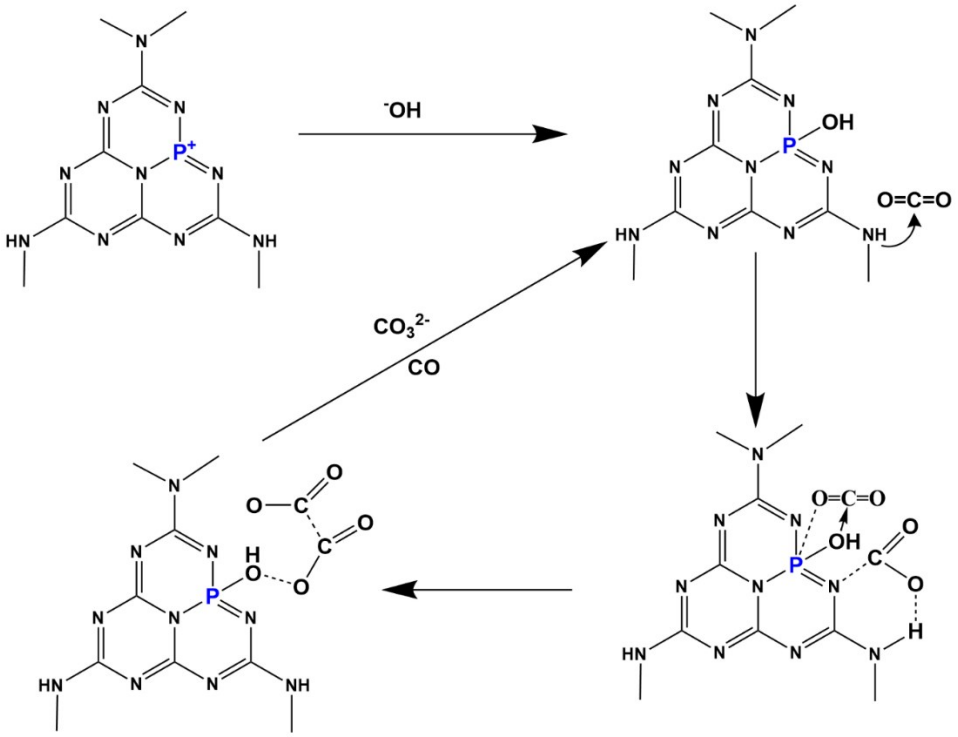

Fig. S5 A possible CO_2 reduction process on the P-doped CN photocatalyst.

Table S4 Time-resolved PL spectra data of CN and P10-550

sample	τ_{1}(ns)	a_1(%)	τ_{2}(ns)	a_2(%)	τ_{ave}(ns)
CN	2.58	41.7	34.8	58.3	33.2
P10-550	2.81	43.7	42.0	56.3	40.1

The decay curves can be fitted by the following two-exponential equation[1]:

$$I_t = I_0 + \sum_{i=1}^{n=2} A_i \exp\left(\frac{-t}{\tau_i}\right)$$

where I_0 is a baseline correction, and A_i and τ_i are the pre-exponential factors and excited-state luminescence decay time associated with the *i*th component, respectively. The average decay time (τ_{ave}) can be calculated by the following equation:

$$\tau_{ave} = \frac{\left(A_1\tau_1^2 + A_2\tau_2^2\right)}{\left(A_1\tau_1 + A_2\tau_2\right)}$$

[1] Liu M, Wageh S, Al-Ghamdi AA, Xia P, Cheng B, Zhang L, et al. Quenching induced hierarchical 3D porous g-C_3N_4 with enhanced photocatalytic CO_2 reduction activity. Chemical Communications. 2019;55(93):14023-6.