Supplementary Information

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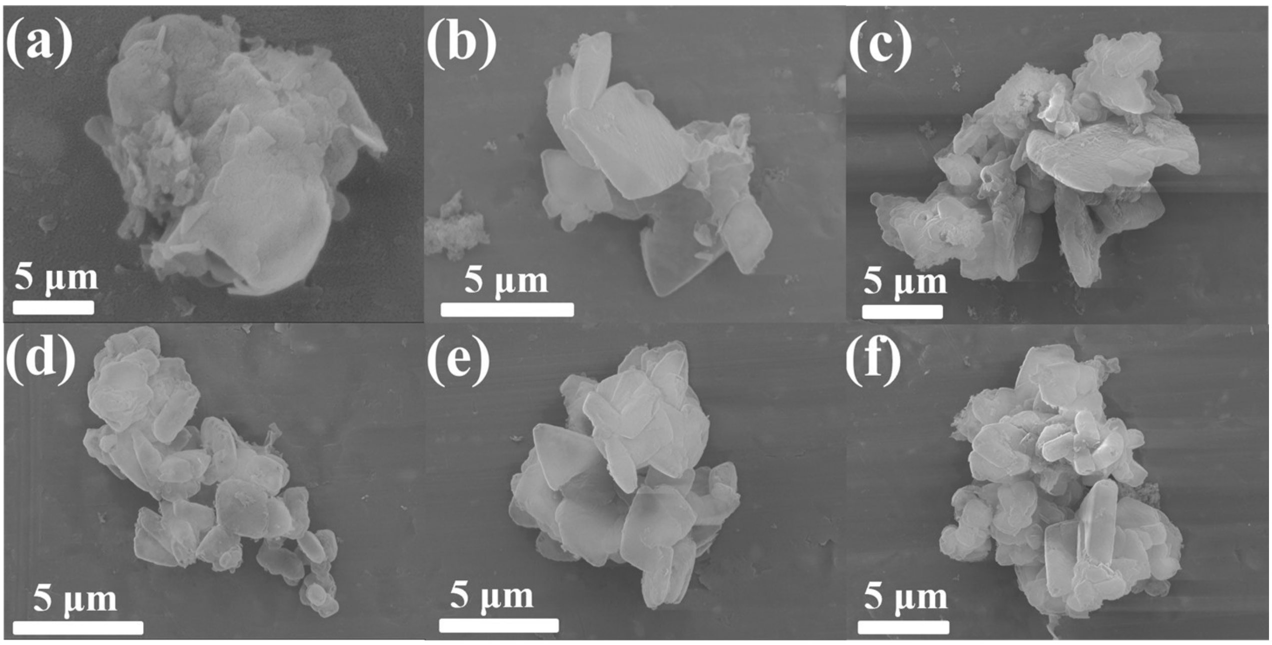

Fig. S1 FE-SEM images of (a) CN_{550}, (b) CN_{610}, (c) CN_{630}, (d) CN_{650}, (e) CN_{670}, and (f) CN_{690}.

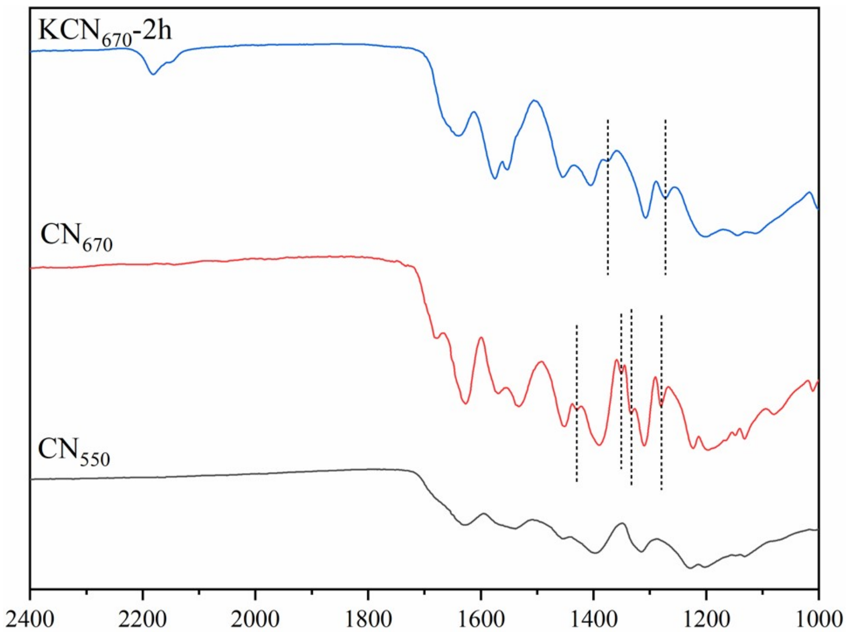

Fig. S2 FT-IR spectra of CN_{550}, CN_{670}, and KCN_{670}-y.

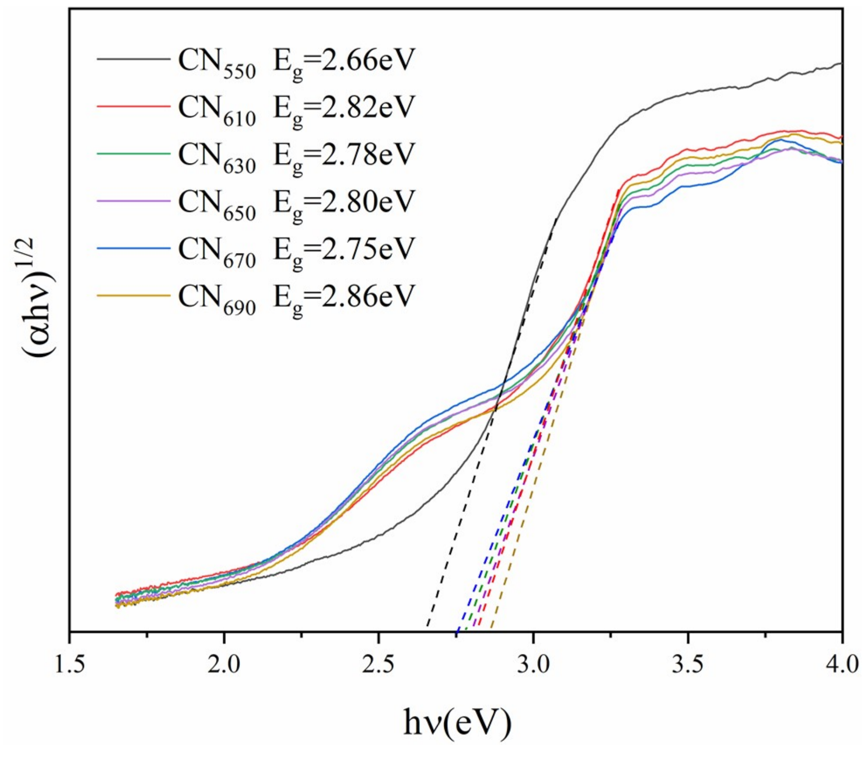

Fig. S3 Plots of transformed Kubelka-Munk function for CN_x samples.

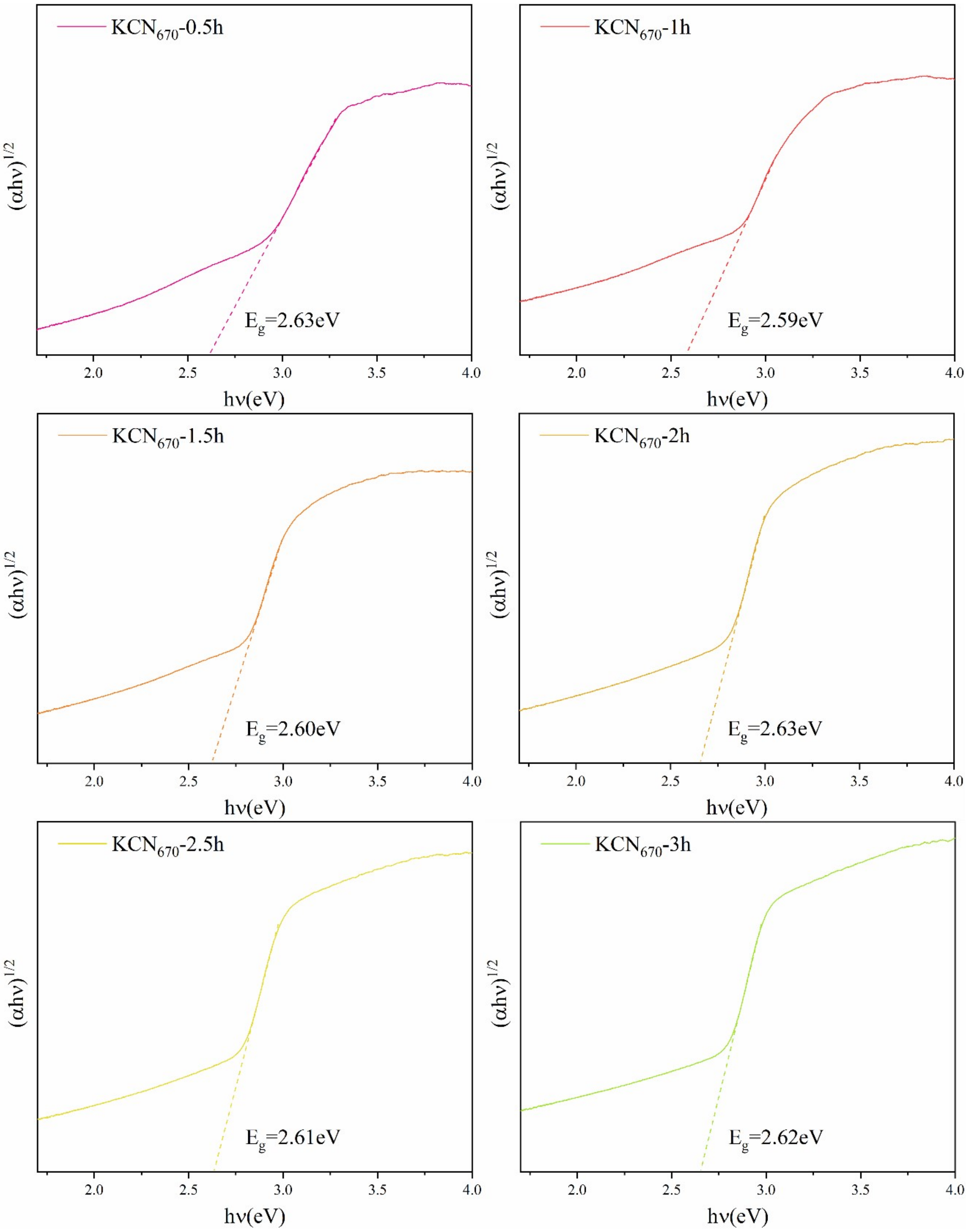

Fig. S4 Plots of transformed Kubelka-Munk function for KCN_{670}-y samples.

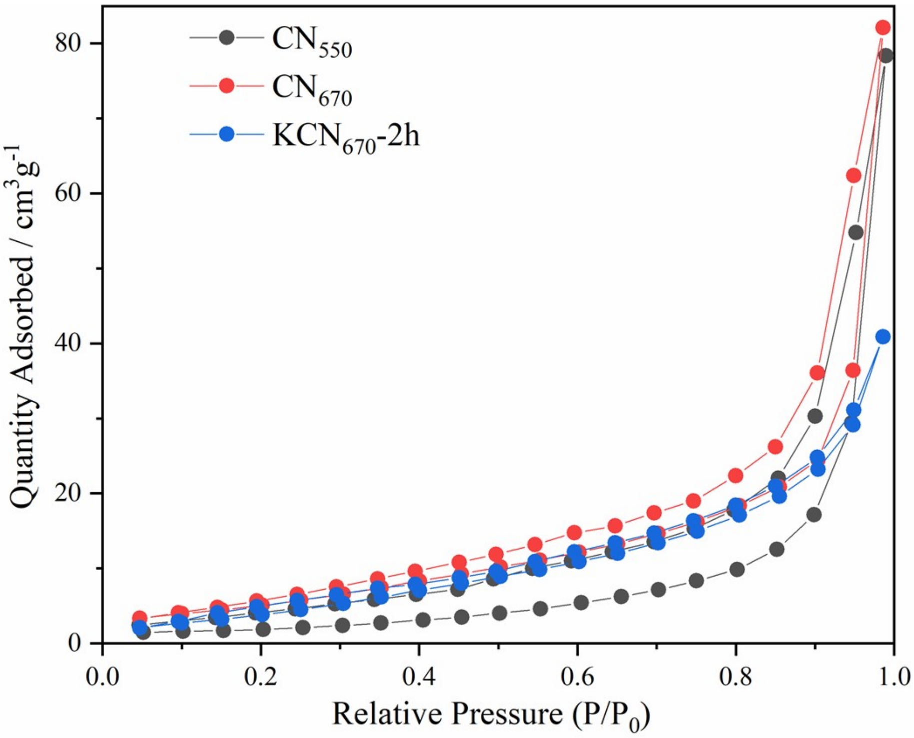

Fig. S5 N_2 adsorption-desorption isotherms of CN_{550}, CN_{670}, and KCN_{670}-2h

Table S1 The element contents in CN_{550}, CN_{670}, KCN_{670}-1h, KCN_{670}-2h and KCN_{670}-3h samples estimated by elemental analysis.

Elemental analysis	C(wt%)	N(wt%)	H(wt%)	C/N(mol ratio)
CN_{550}	34.5	61.1	2.21	0.658
CN_{670}	33.6	58.6	2.11	0.669
$LiCN_{670}$-1h	32.1	55.5	1.97	0.674
$LiCN_{670}$-2h	29.7	50.9	1.86	0.680
$LiCN_{670}$-3h	27.5	46.4	1.72	0.691
$NaCN_{670}$-1h	32.4	56.2	1.99	0.673
$NaCN_{670}$-2h	30.5	52.7	1.91	0.675
$NaCN_{670}$-3h	28.9	49.4	1.85	0.682
KCN_{670}-1h	33.2	57.2	1.90	0.678
KCN_{670}-2h	32.4	55.2	1.75	0.685
KCN_{670}-3h	28.8	47.8	1.65	0.703

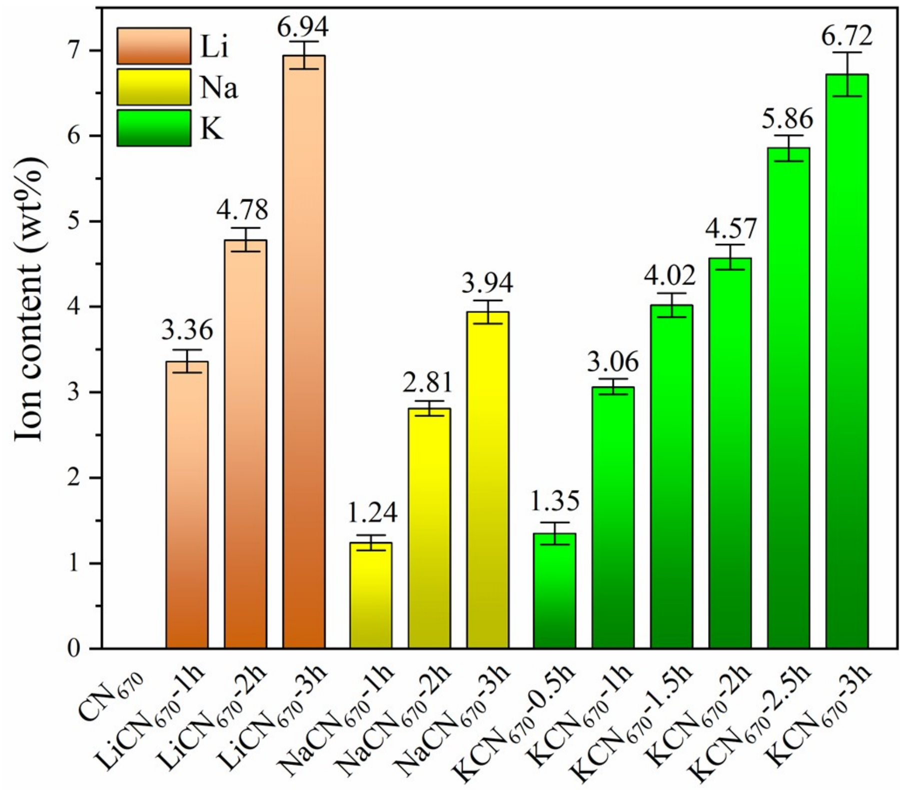

Fig.S6 The Li, Na, K element contents in CN_{670}, ACN_{670}-1h, ACN_{670}-2h, and ACN_{670}-3h samples (A=Li, Na, K) estimated by ICP.

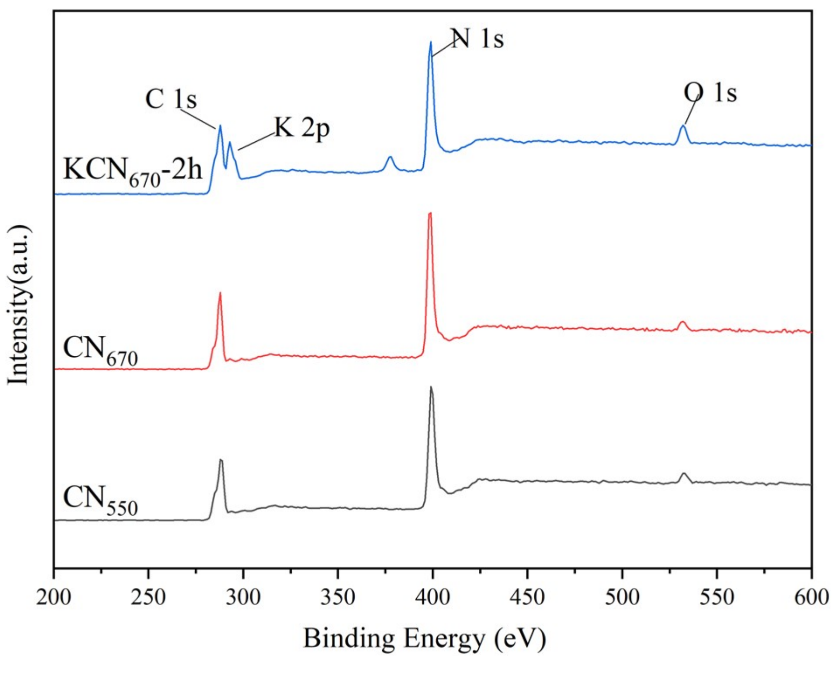

Fig. S7 XPS survey spectra of CN_{550}, CN_{670}, and KCN_{670}-2h.

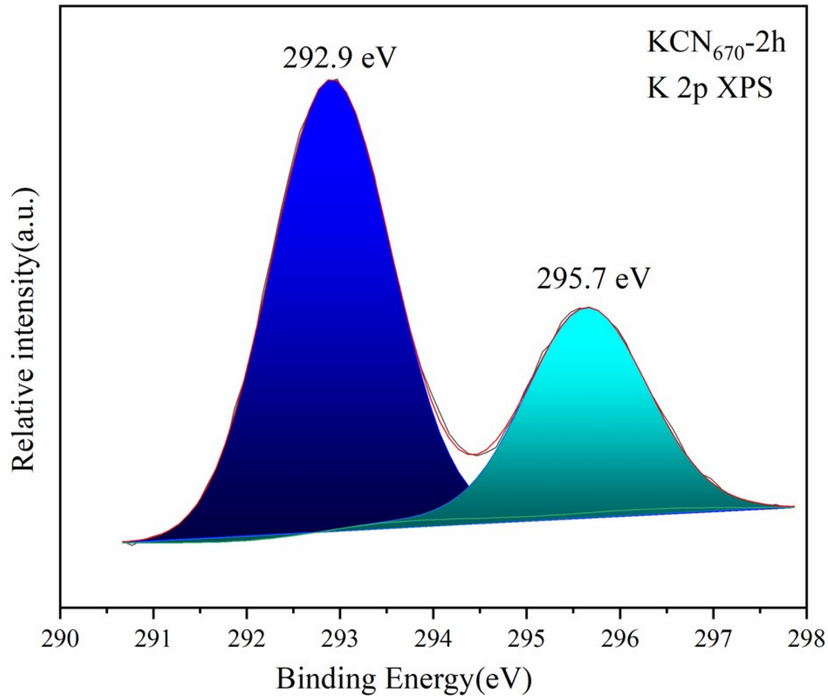

Fig.S8 K 2p XPS spectra of KCN_{670}-2h samples.

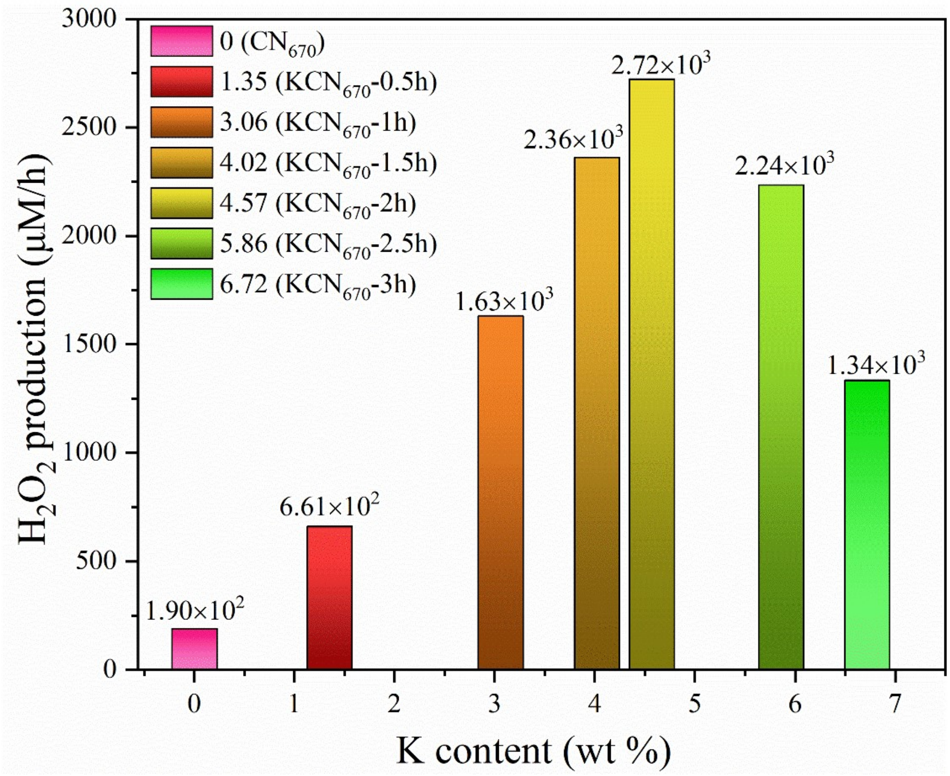

Fig. S9 H_2O_2 production rate dependence on K content for KCN_{670}-y samples.

Table. S2 Summary table of H_2O_2-production by different g-C_3N_4-based materials.

Catalysts	Light Source	Reaction Conditions	H_2O_2 Production ($\mu M\ h^{-1}$)	Reference
KCN_{670}-2h	**solar simulator (AM 1.5 G,100 mW cm^{-2})**	**Aqueous (50 mg catalyst, 100 mL, IPA) +Air**	**2.72×10^3**	**This work**
PDI/CNA	solar simulator (AM 1.5 G,100 mW cm^{-2})	Aqueous (50 mg catalyst, 50 mL, IPA) +O_2	1.61×10^3	[1]
MPCN	300 W Xenon lamp (λ>420 nm)	Aqueous (50 mg catalyst, 100 mL, IPA) + Air	2.21×10^3	[2]
KTCN	300 W Xenon lamp (λ>420 nm)	Aqueous (30 mg catalyst, 30 mL, IPA) +O_2	7.2×10^2	[3]
KCN-1	300 W Xenon lamp (λ>400 nm)	Aqueous (30 mg catalyst, 100 mL, IPA) + O_2	1.35×10^3	[4]
K, P, O, S-g-C_3N_4	300 W Xenon lamp (λ>420 nm)	Aqueous (150 mg catalyst, 150 mL, IPA) + Air	1.18×10^3	[5]
K-g-C_3N_{4-x}	300 W Xenon lamp (λ>420 nm)	Aqueous (10 mg catalyst, 50 mL, EDTA) + O_2	7.07×10^2	[6]
KOH-doped g-C_3N_4	500 W Xenon lamp	Aqueous (30 mg catalyst, 30 mL, IPA) +Air	21	[7]
SCN	300 W Xenon lamp (λ>420 nm)	Aqueous (20 mg catalyst, 40 mL, IPA) + Air	14	[8]
Nv-M	300 W Xenon lamp (λ ≥ 420 nm)	Aqueous (50 mg catalyst, 50 mL, IPA) + Air	31	[9]
KDCN-0.2	300 W Xenon lamp (λ>420 nm)	Aqueous (50 mg catalyst, 100 mL, IPA) +Air	2.79×10^2	[10]

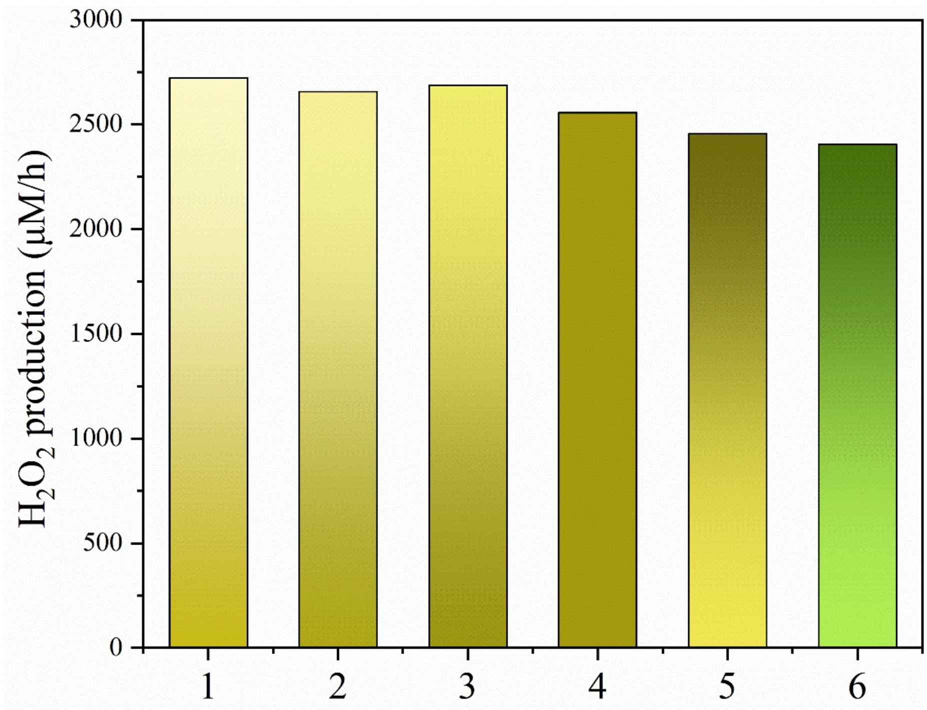

Fig. S10 Cycling experiments of H_2O_2 production over KCN_{670}-2h sample.

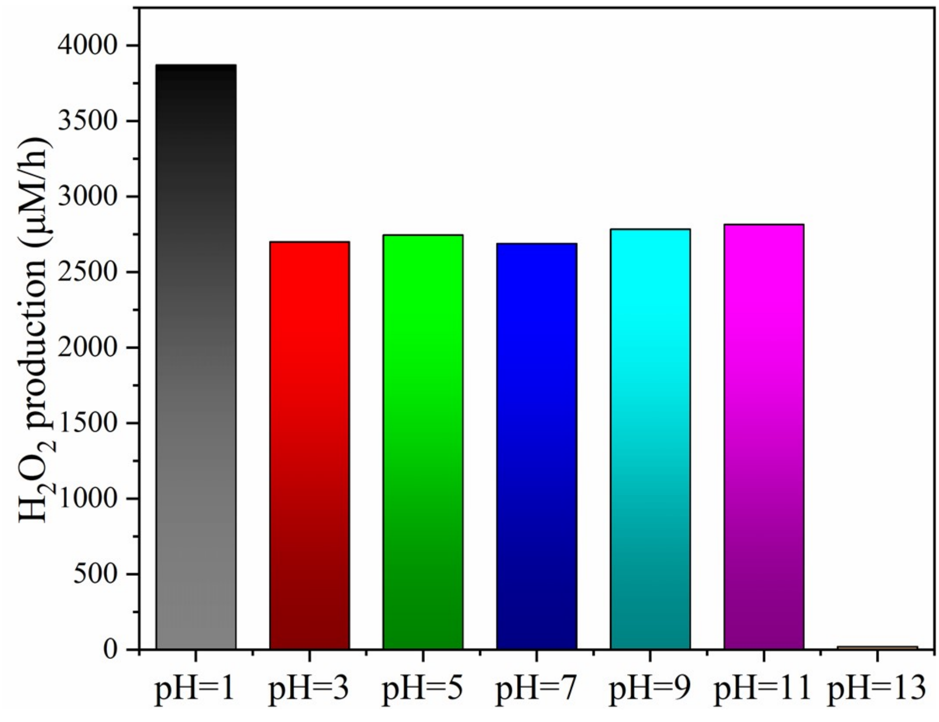

Fig. S11 H_2O_2 production rates under different pH conditions

Table S3 Values of elements in equivalent circuit resulted from fitting the EIS data.

Sample	R_s(Ω cm^{-2})	R_{ct}(Ω cm^{-2})	CPE(F cm^{-2})
CN_{550}	32.5	9.62E5	3.42E-5
CN_{670}	81.1	4.18E5	2.34E-5
KCN_{670}-1h	84.6	2.43E5	2.35E-5
KCN_{670}-2h	28.5	1.55E4	3.71E-5
KCN_{670}-3h	28.1	1.16E5	2.24E-5

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