MOF-derived CuCo(O)@ carbon-nitrogen framework as an efficient synergistic catalyst for hydrolysis of ammonia borane

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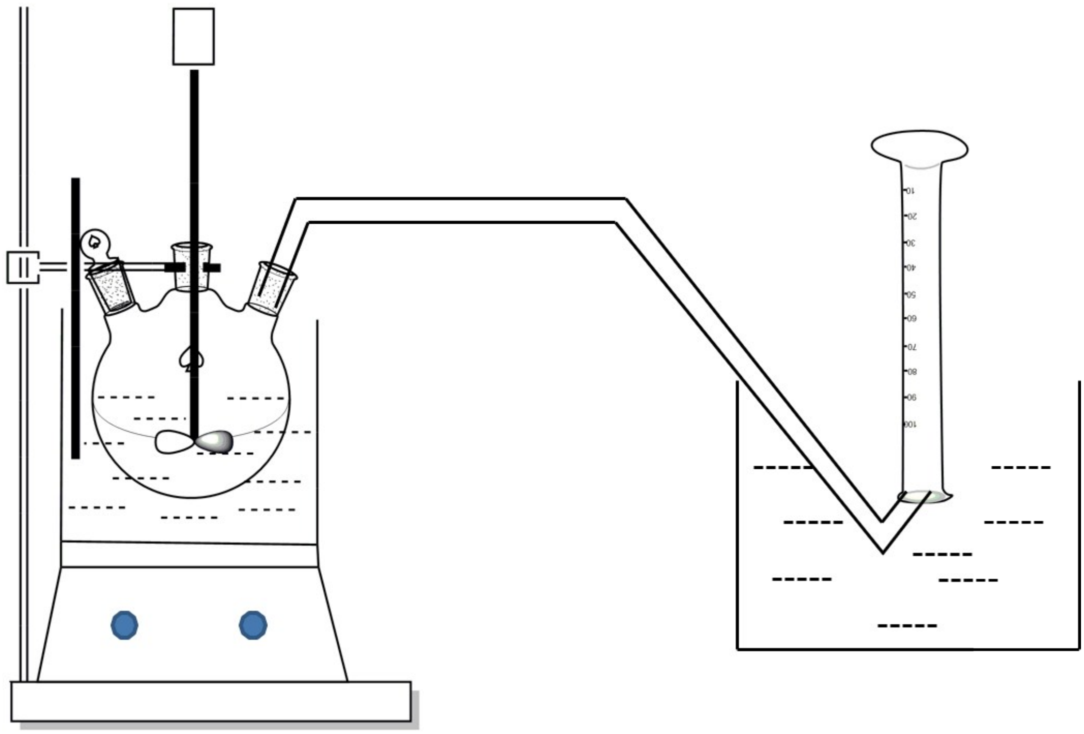

Fig S1 Catalytic test equipment diagram

Table S1 Element contents analysis of different Samples

Sample	ICP	
	Cu(wt%)	Co(wt%)
Co(O)@CN	0	42.86
CuCo(O)@CN-I	1.50	35.00
CuCo(O)@CN-II	5.19	42.38
CuCo(O)@CN-III	5.14	53.06

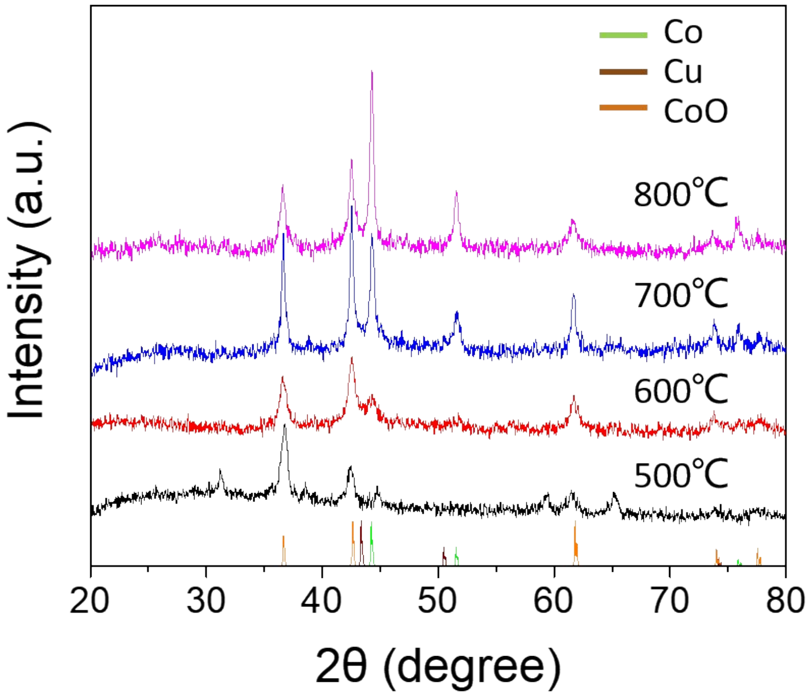

Fig S2 XRD of samples obtained by calcination at different temperatures

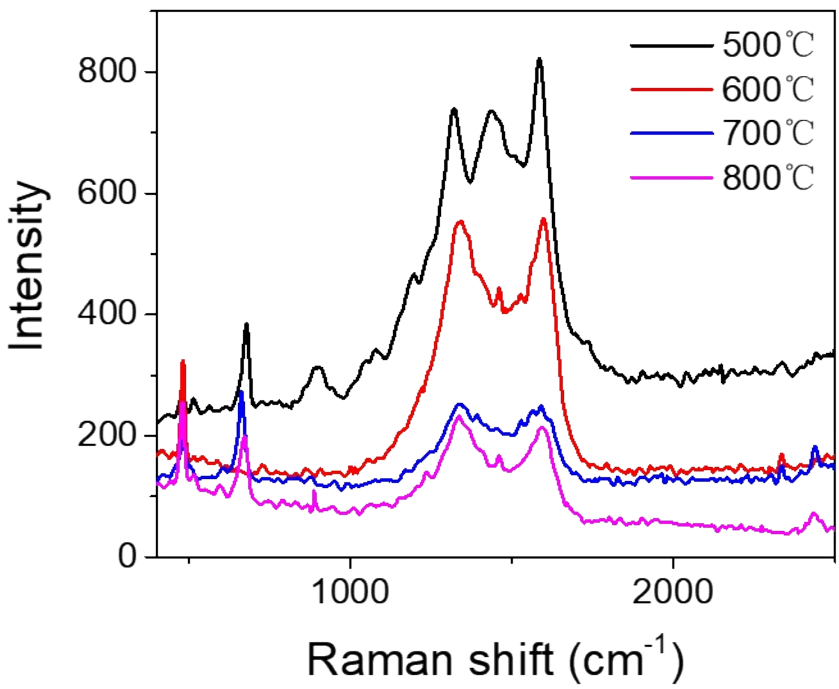

Fig S3 Raman spectra of samples obtained by calcination at different temperatures

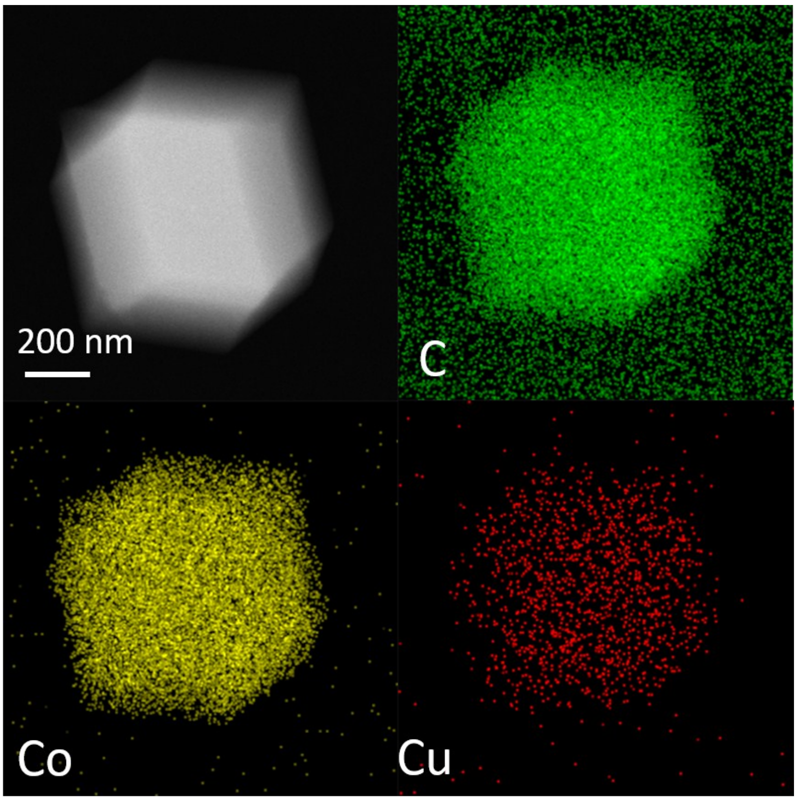

Fig S4 STEM elemental mapping of CuCo-ZIF-III

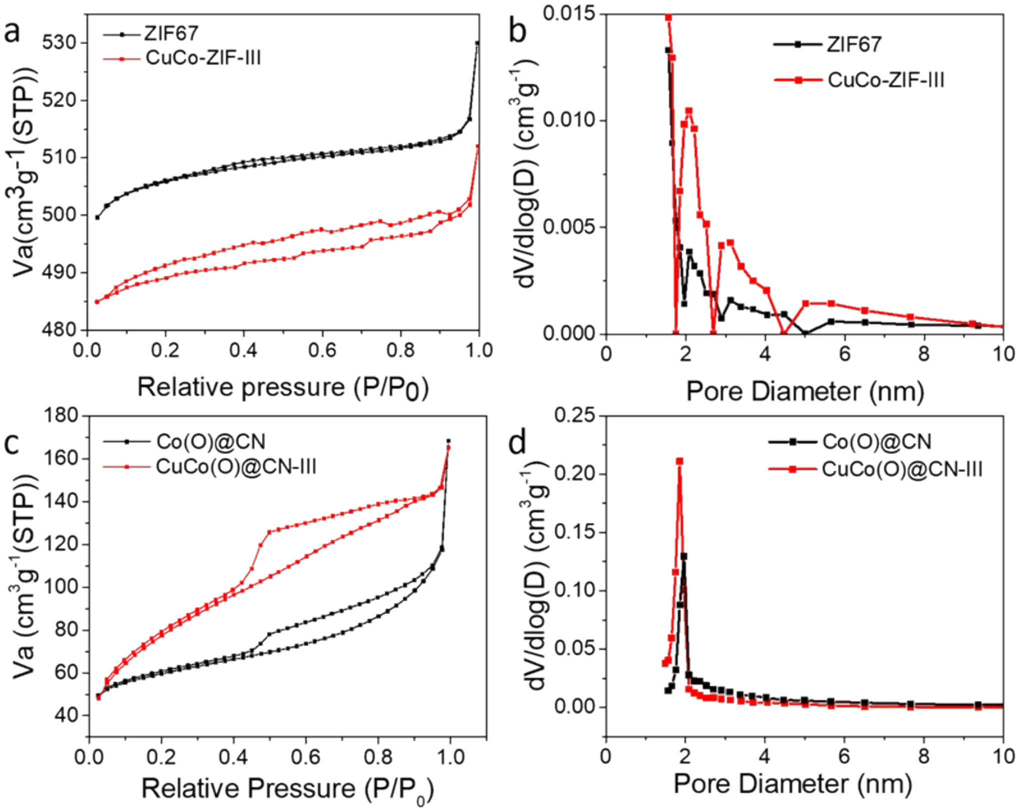

Fig S5 (a) N_2 adsorption-desorption isotherms (b) pore size distribution curves of ZIF-67 and CuCo-ZIF-III (c) N_2 adsorption-desorption isotherms (d) pore size distribution curves of Co(O)@CN and CuCo(O)@CN-III

Table S2 Specific surface area and Pore volume of different Samples

Sample	Specific surface area (m^2g^{-1})	Pore volume (m^3g^{-1})
ZIF67	1742	0.8159
CuCo-ZIF-III	1694	0.7939
Co(O)@CN	209.3	0.2609
CuCo(O)@CN-III	380.1	0.2498

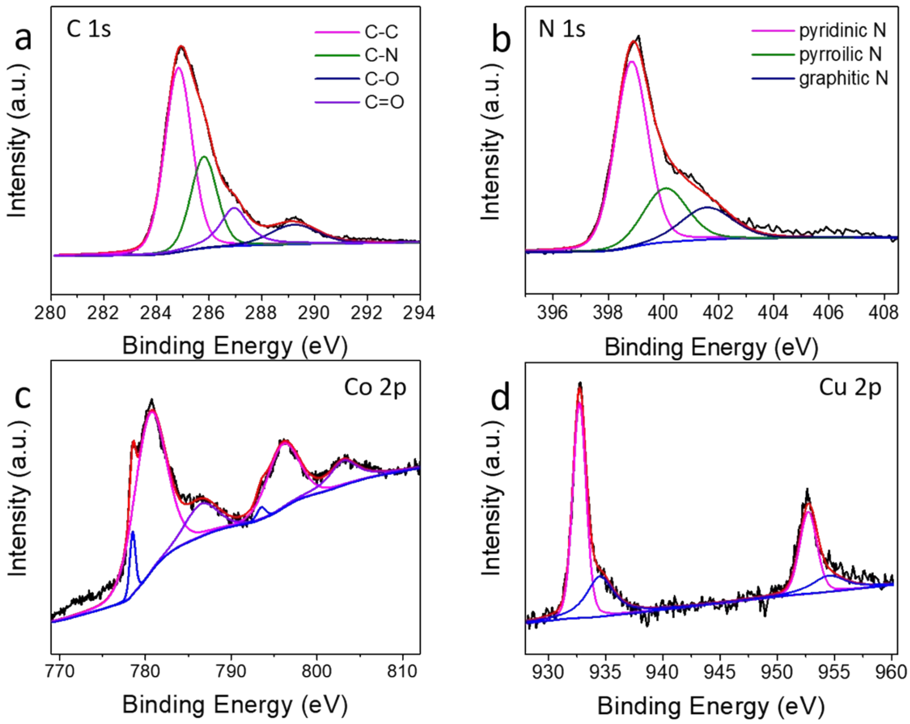

Fig S6 The XPS pattern of CuCo (O)@CN-III after catalytic reaction: (a) C1s; (b) N1s; (c) Co2p; (d)Cu2p

Table S3 Catalytic activities of different catalysts used for the hydrolytic dehydrogenation of AB at room temperature

catalyst	H_2 generation Rate ($mL \cdot min^{-1} g^{-1}$)	TOF (mol $H_2 \cdot$(mol cat)$^{-1}$$min^{-1}$)	Ea (kJ mol^{-1})	Reference
CuCo (O)@CN-III	4524	12.39	33.84	This work
$Co_{0.52}Cu_{0.48}$	2179	3.4	37.3	Int. J. Hydrogen Energy 42 (2017) 30691–30703.
$Cu_{0.64}Ni_{0.36}$-TiO_2(B)NTs	5763.86	15.9	36.14	Inorg. Chem. Front. 5(2018) 2038–2044.
$Cu_{0.4}Co_{0.6}$-BNNFs	3387.1	8.42	21.8	J. Power Sources 431 (2019) 135–143
$Cu_{0.2}Co_{0.8}$/HPC	2960	——	47.3	J. Alloy. Comp. 651 (2015) 382–388.
$Cu_{0.8}Co_{0.2}$O-GO	——	70.0	——	Angew. Chem. Int. Ed., 55, (2016) 11950–11954
CuCo/graphene	——	9.18	——	J. Mater. Chem. 22 (2012) 10990–10993
$Cu_{0.5}Ni_{0.5}$-CN	——	——	39	J. Mater. Chem. A 1 (2013) 14790–14796.
Co/SAG	3013	7.17	46.4	RSC Adv. ,5,(2015)13985-13992.
Ni NPs/C	——	8.8	——	J. Am. Chem. Soc., 132, (2010) 1468-1469.
In-situ $Fe_{1-x}Ni_x$ NPs	——	10.9	——	J. Power Sources 194,(2009) 478-481.
Co-Co_3O_4/carbon dots	6816	17.93	40	J. Energy Chem., 48 (2020) 43–53.
Co-CoO_x @NCS-	5562	13.58	46.37	ACS Sustainable Chem. Eng. 7 (2019), 9782-9792.
Co@N-C	——	5.6	31	Catal. Sci. Technol., 6, (2016) 3443–3448.
CuCo@MIL-101	——	19.6	——	Catal. Sci. Technol., 5, (2015)525−530.
Cu-Co/PDDA-HNTs	——	30.8	36.15	Appl. Surf. Sci., 427, (2018)106−113.
Co/hydroxyapatite	2200	4.54	50	Catal. Today, 183, (2012)17−25.
$Cu_6Fe_{0.8}Co_{3.2}$@MIL-101	——	23.2	37.1	Int. J. Hydrogen Energy (2019)10.1016/j.ijhydene.2019.06.075
Co-Mo-B nanoparticles	5818	——	59.3	Int. J. Hydrogen Energy, 44,(2019)23267-23276
Co/NPCNW	2638	7.29	25.4	Mater. Horiz., 4, (2017) 268–273.

Co@NMC	——	——	41.6	J. Power Sources, 399, (2018)89–97.
Co@N-C	——	8.4	36.1	Langmuir, 35, (2019) 671−677.