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Hollowed polyhedron assembled from $ZnCo_2O_4$ nanoparticles for ethanol sensor and sensing mechanism by near ambient pressure XPS

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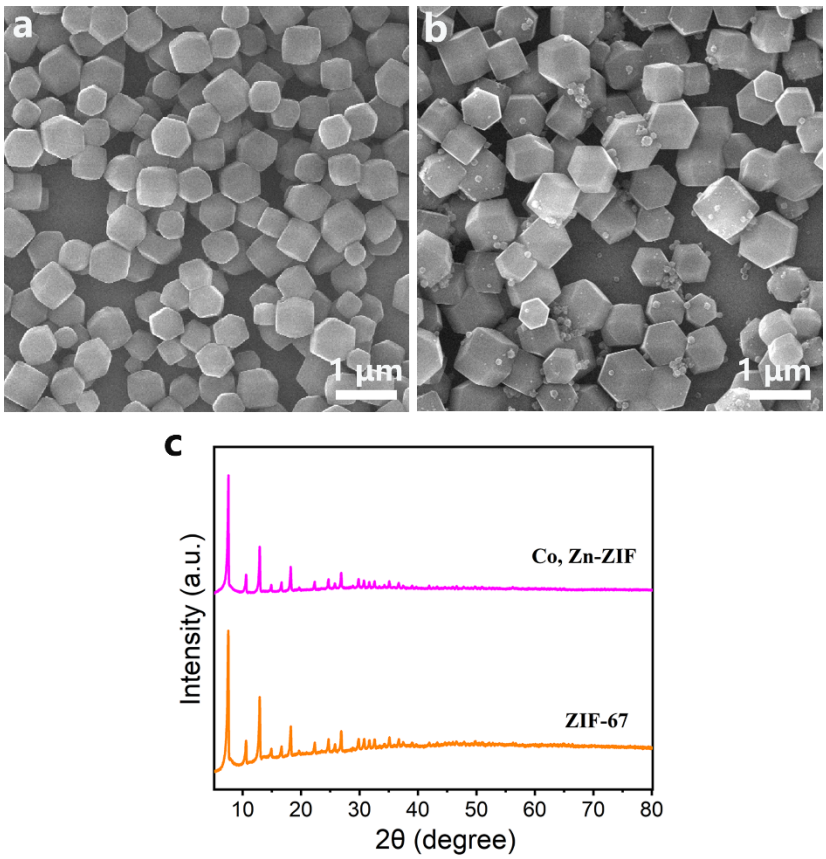

Figure S1 the SEM images of (a) ZIF-67 and (b) Co, Zn-ZIF; (c) XRD patterns of ZIF-67 and Co, Zn-ZIF

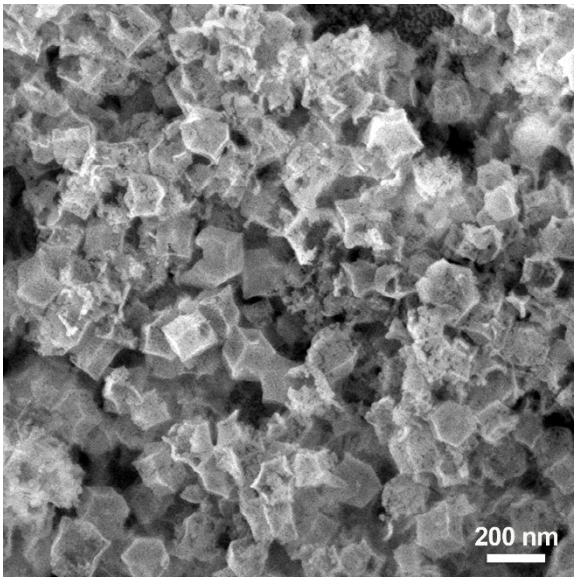

Figure S2 The SEM image of as-prepared ZnO nanoparticles

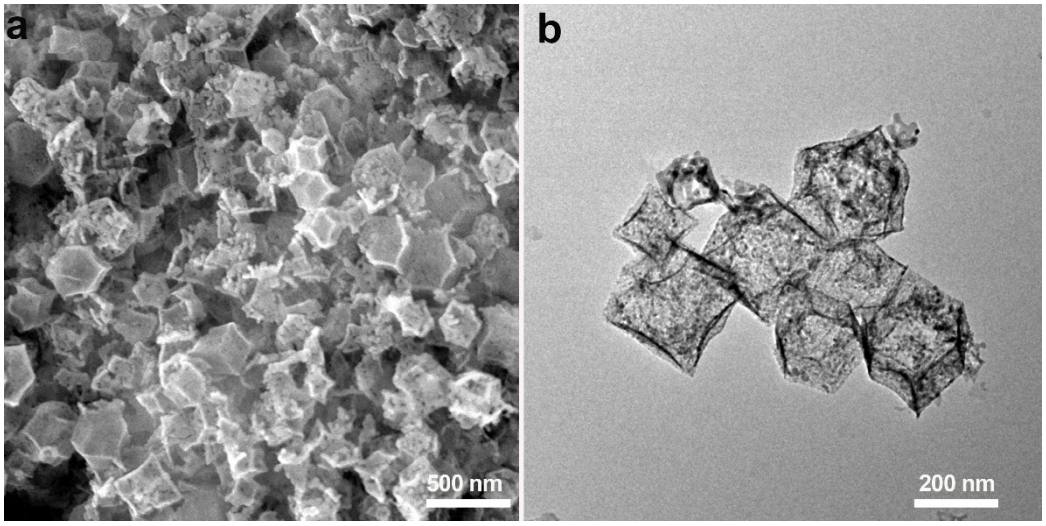

Figure S3 the SEM (a) and TEM (b) images of ZIF-67 derived Co_3O_4 nanoparticles.

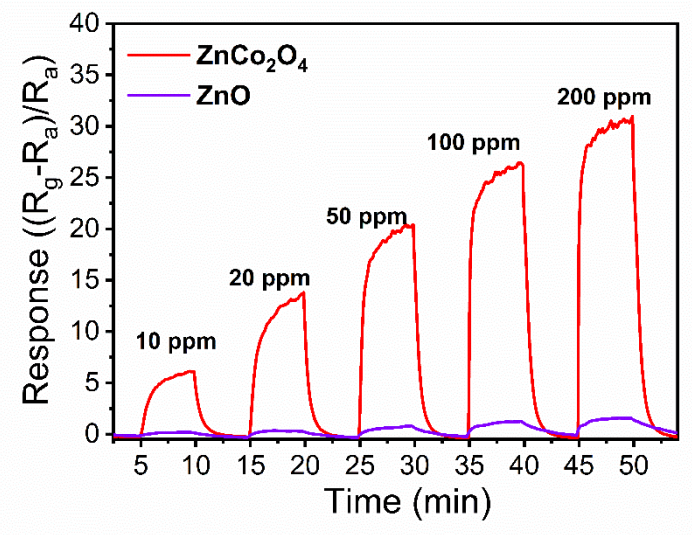

Figure S4 the response curves of ZIF-8 derived ZnO and $ZnCo_2O_4$ HP versus time at 200 ℃.

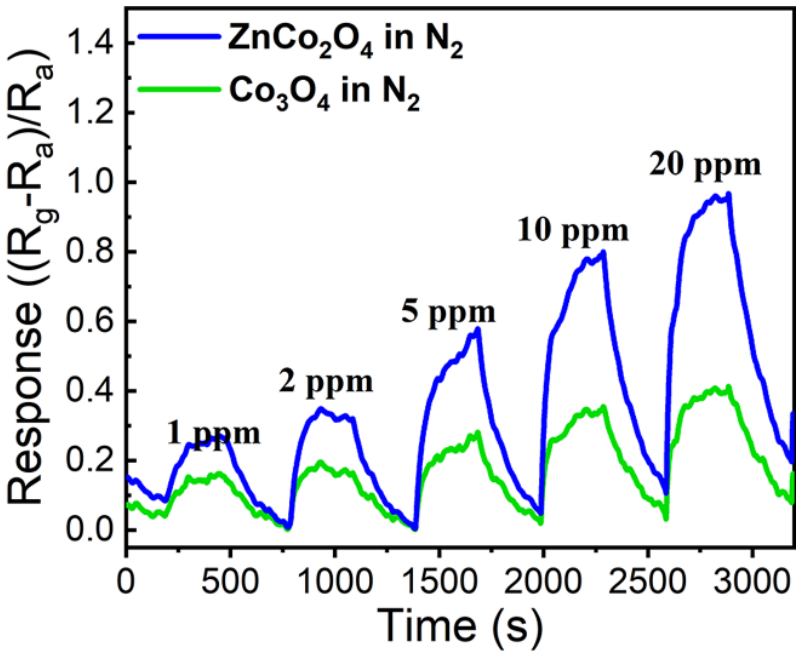

Figure S5 The response curves of porous Co_3O_4 and $ZnCo_2O_4$ HP at concentrations of ethanol ranging from 1 ppm to 20 ppm in N_2 at 200 ℃.

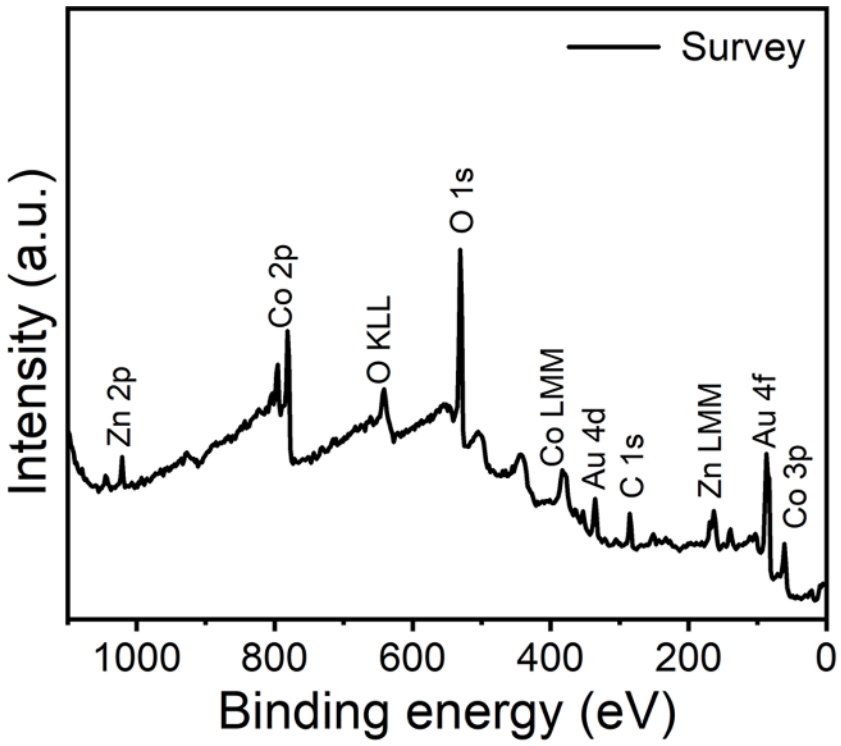

Figure S6 XPS survey of $ZnCo_2O_4$ HP at room temperature under UHV condition

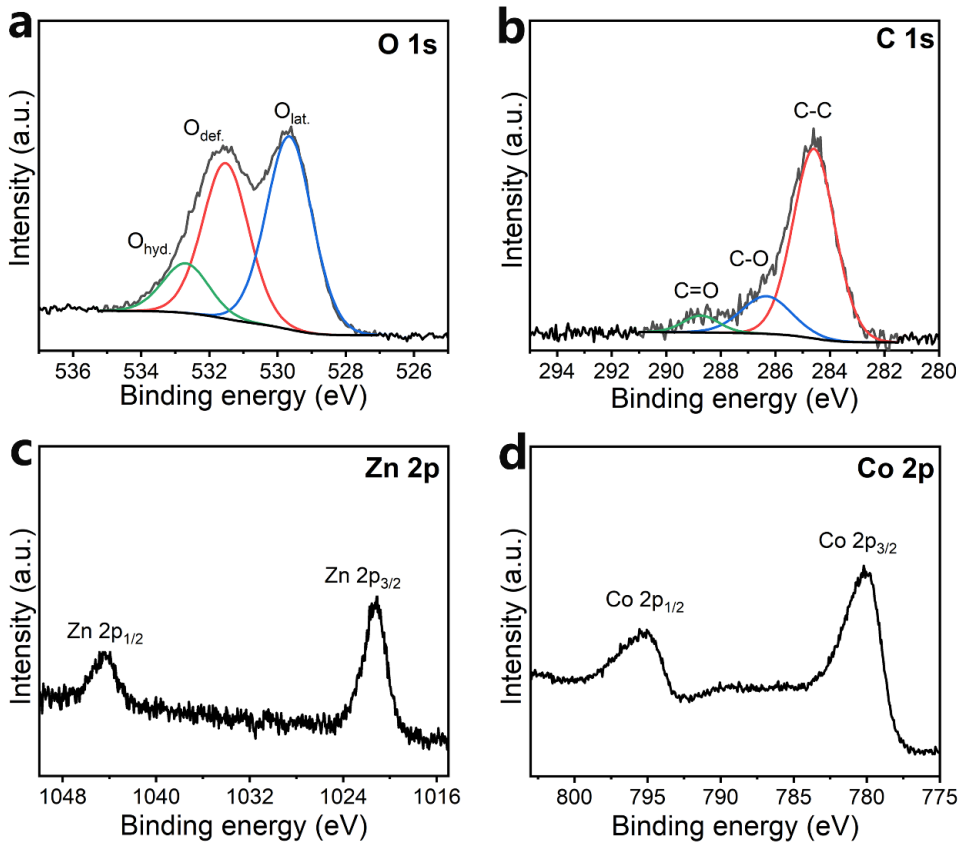

Figure S7 (a) O 1s, (b) C 1s, (c) Zn 2p and (d) Co 2p XPS spectra taken from the $ZnCo_2O_4$ HP sensor at room temperature under UHV condition, respectively.

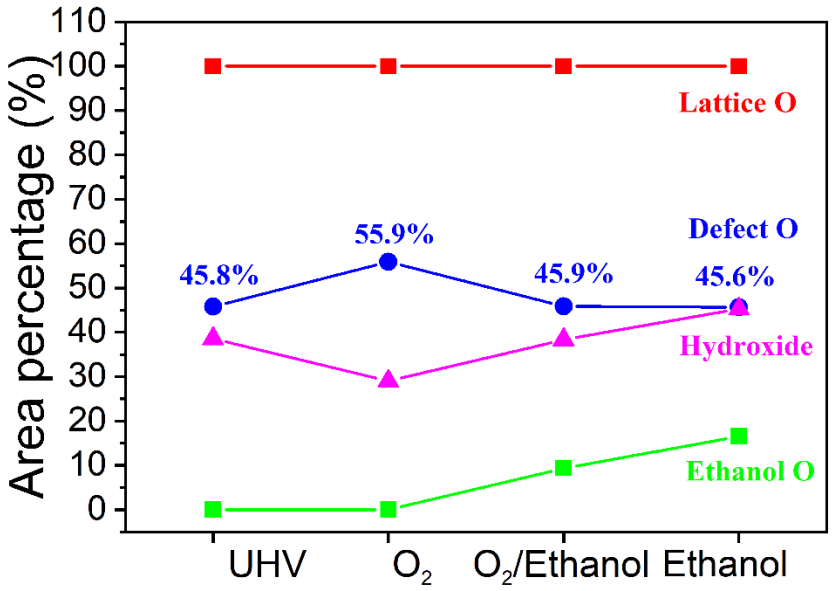

Figure S8 Scatter plots of area percentage of different oxygen species(set the percentage of lattice O as 100%).

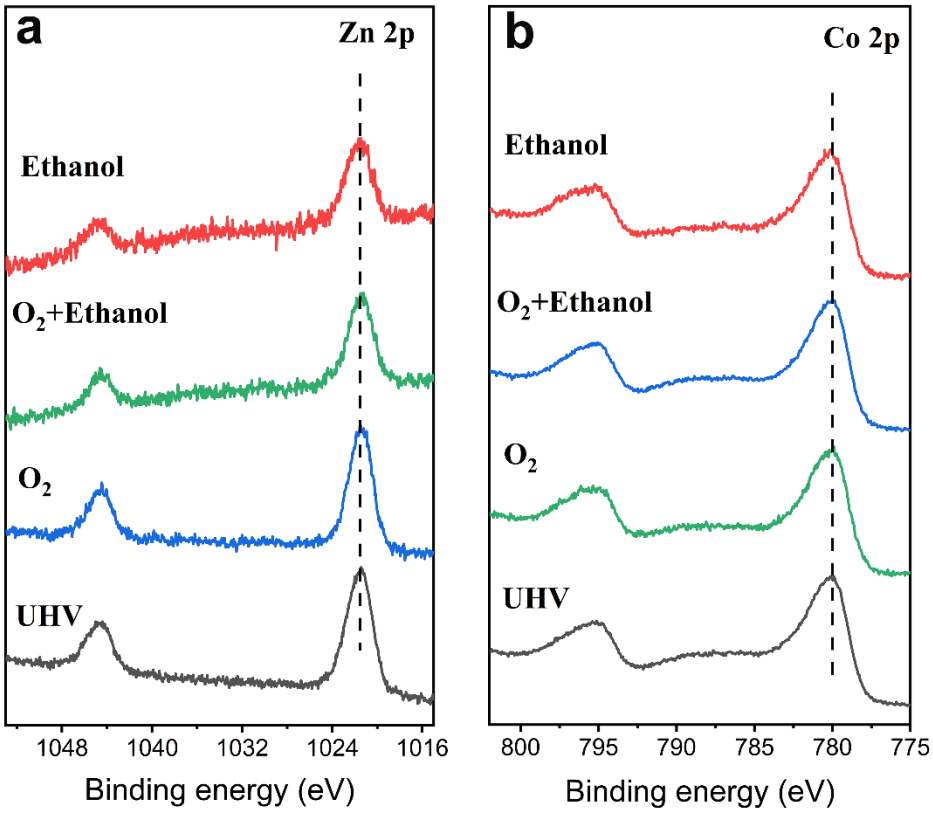

Figure S9 (a) Zn 2p and (b) Co 2p APXPS spectra taken from the $ZnCo_2O_4$ HP sensor exposed to different analytes at 200 °C.

Table S1 the fitting parameters of O 1s spectra.

Working condition	Position	FWHM	Area	%Area
O_2/ethanol	529.7	1.54	21803.8	51.69
	531.5	1.54	10069.7	23.83
	532.3	1.54	8331.1	19.71
	533.7	1.54	2020.4	4.77
Ethanol	529.7	1.54	22412.9	48.29
	531.7	1.54	10280.8	22.11
	532.5	1.54	10064.8	21.64
	534.1	1.54	3708.4	7.96
O_2	529.7	1.57	39478.6	54.24
	531.8	1.57	18186.3	24.94
	532.6	1.57	15184.7	20.81
UHV	529.7	1.58	47221.9	55.43
	531.7	1.58	21315.5	24.98
	532.6	1.58	16721.9	19.58