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Controllable synthesis of nanoparticle-modified thin-layers 3D flower-like CuZnAl-LDHs material with high NO_2 gas sensing performance at room temperature

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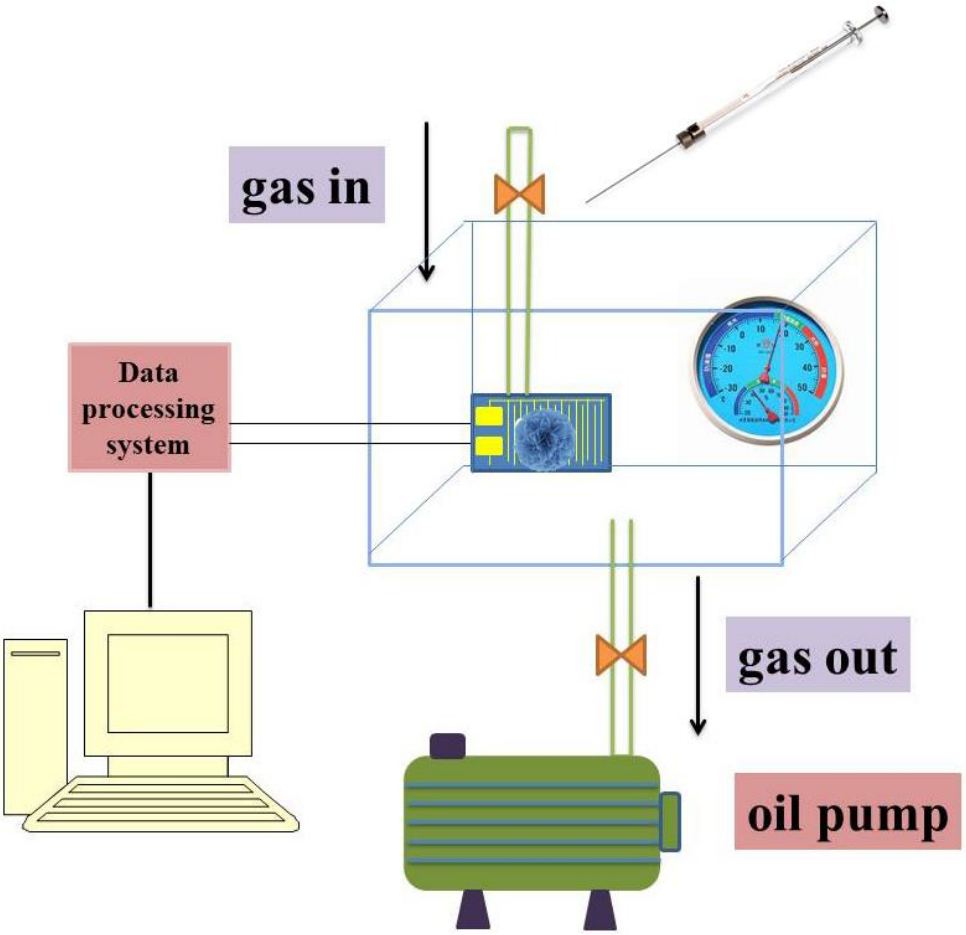
Table S1 Comparison of LDHs based sensor gas sensing performances of the current work with other reported literatures.

Samples	Operating temperature	Application	Gas concentration	Sensitivity (R_a/ R_g)	Response (S)	Ref
CoAl-LDHs	RT	NO_x	100 ppm	17.09	4.27	[27]
NiAl-LDHs	RT	O_3	700 ppb	1.84	8	[28]
ZnTi-LDHs/RGO	RT	NO_2	10 ppm	97%	4	[29]
Ti_3C_2Tx-ZnTi-LDHs	RT	NH_3	500 ppb	1.97	11	[1]
Expanded graphite/NiAl-LDHs	RT	NO_x	100 ppm	17.65	2	[2]
PANI/ZnTi-LDHs	RT	NH_3	50 ppm	18.22	3	[3]
PS@Co-LDHs	200 ℃	Ethanol	4.3 ppm	2.48	4	[4]
Ni–Fe–Al-LDHs	RT	NO_x	100 ppm	86%	2.6	[5]
CuZnAl-LDHs	**RT**	**NO_2**	**100 ppm**	**22.30**	**2.66**	**This work**



Scheme S1 Self-assembled gas sensor diagram

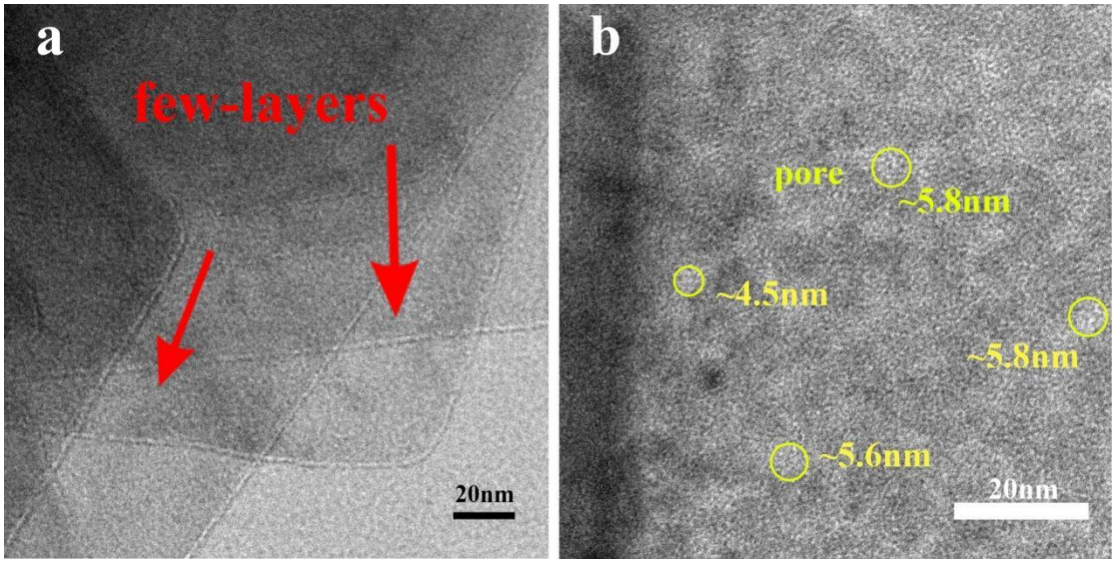


Fig. S1 HRTEM image of CZA-2.

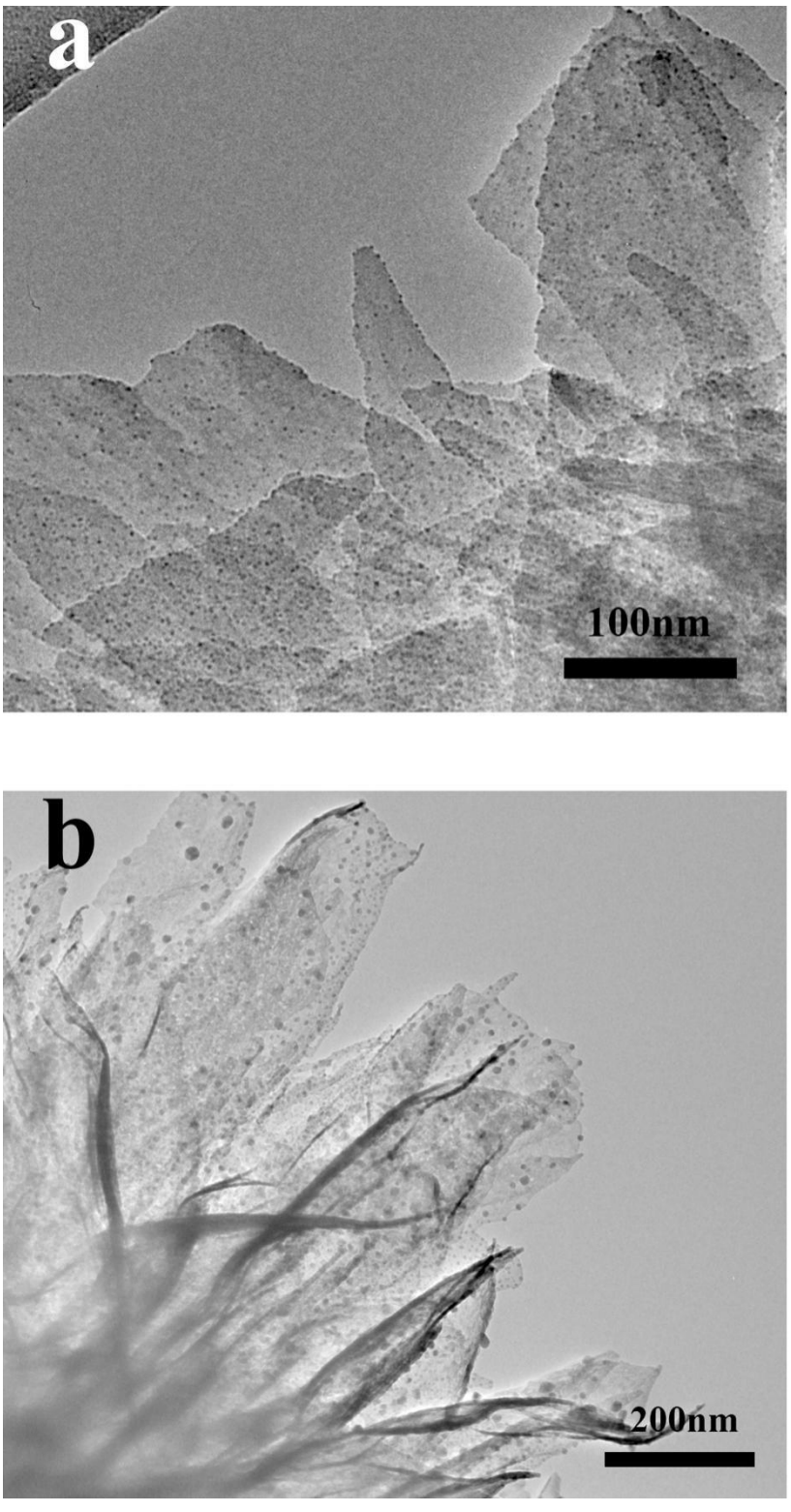


Fig. S2 TEM image of CZA-2.

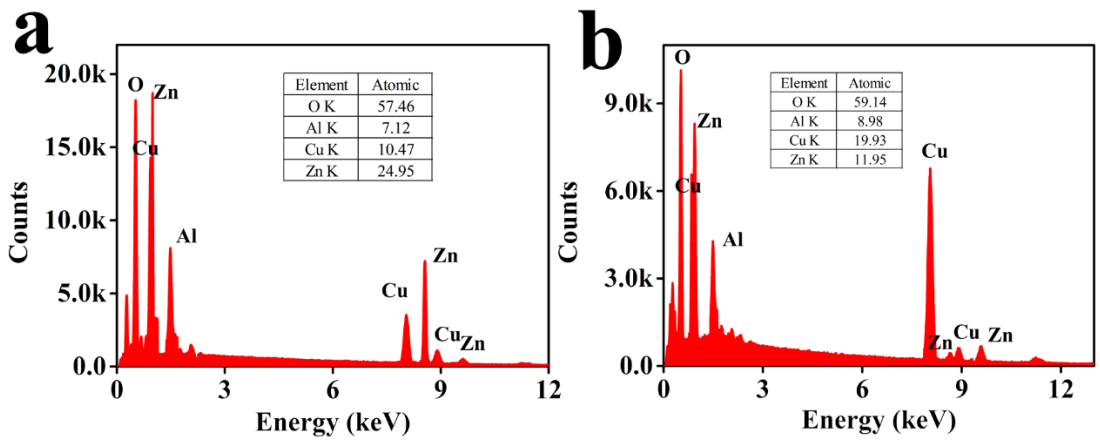


Fig. S3 EDS spectra of (a) CZA-1 and (b) CZA-3.

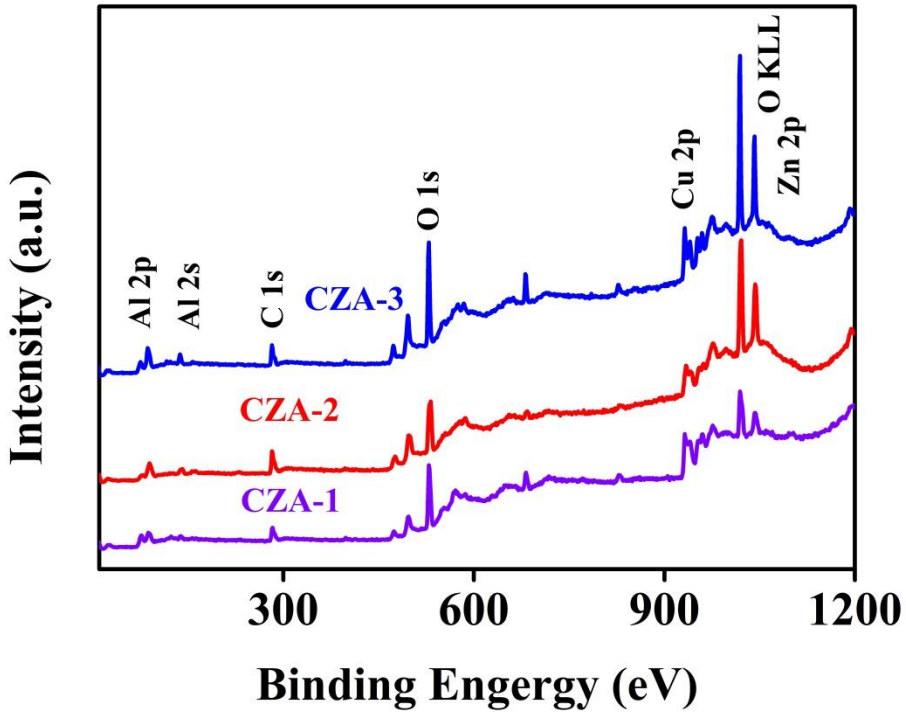


Fig. S4 XPS spectra of CZA-LDHs

Table S2 XPS peaks fitting results of O 1s of CZA-1, CZA-2 and CZA-3

Samples	CZA-1			**CZA-2**			CZA-3		
Peaks	O_1	O_a	O_2	**O_1**	**O_a**	**O_2**	O_1	O_a	O_2
Position (eV)	528.60	529.28	530.03	**528.39**	**529.05**	**529.78**	528.48	529.16	529.94
Area ratio (%)	34.29	36.05	29.66	**28.63**	**41.02**	**30.35**	34.89	36.25	28.86

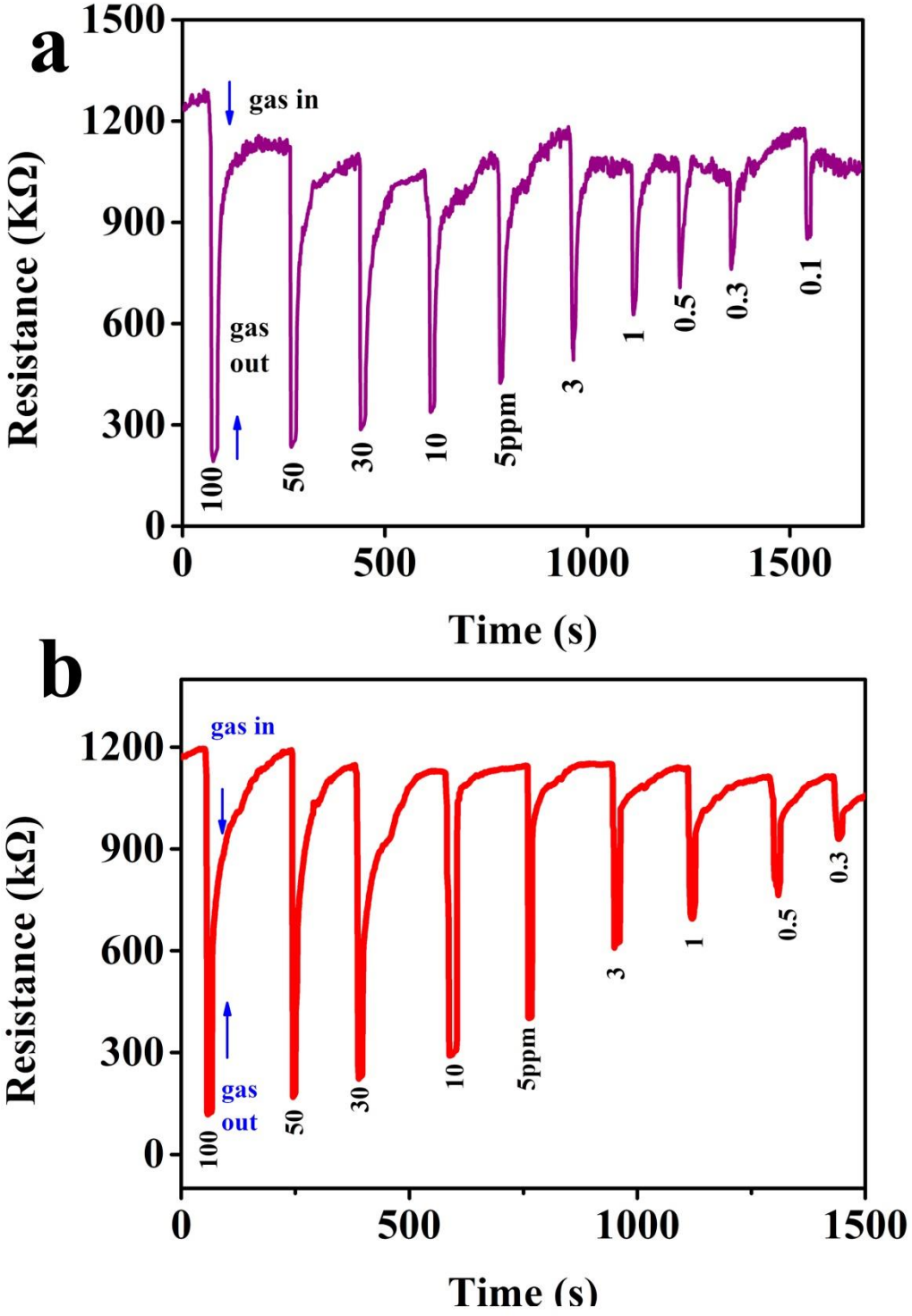


Fig.S5 Dynamic response and recovery curve of the (a) CZA-1 and (b) CZA-3 gas sensor to NO_2 at RT (RH 26%)

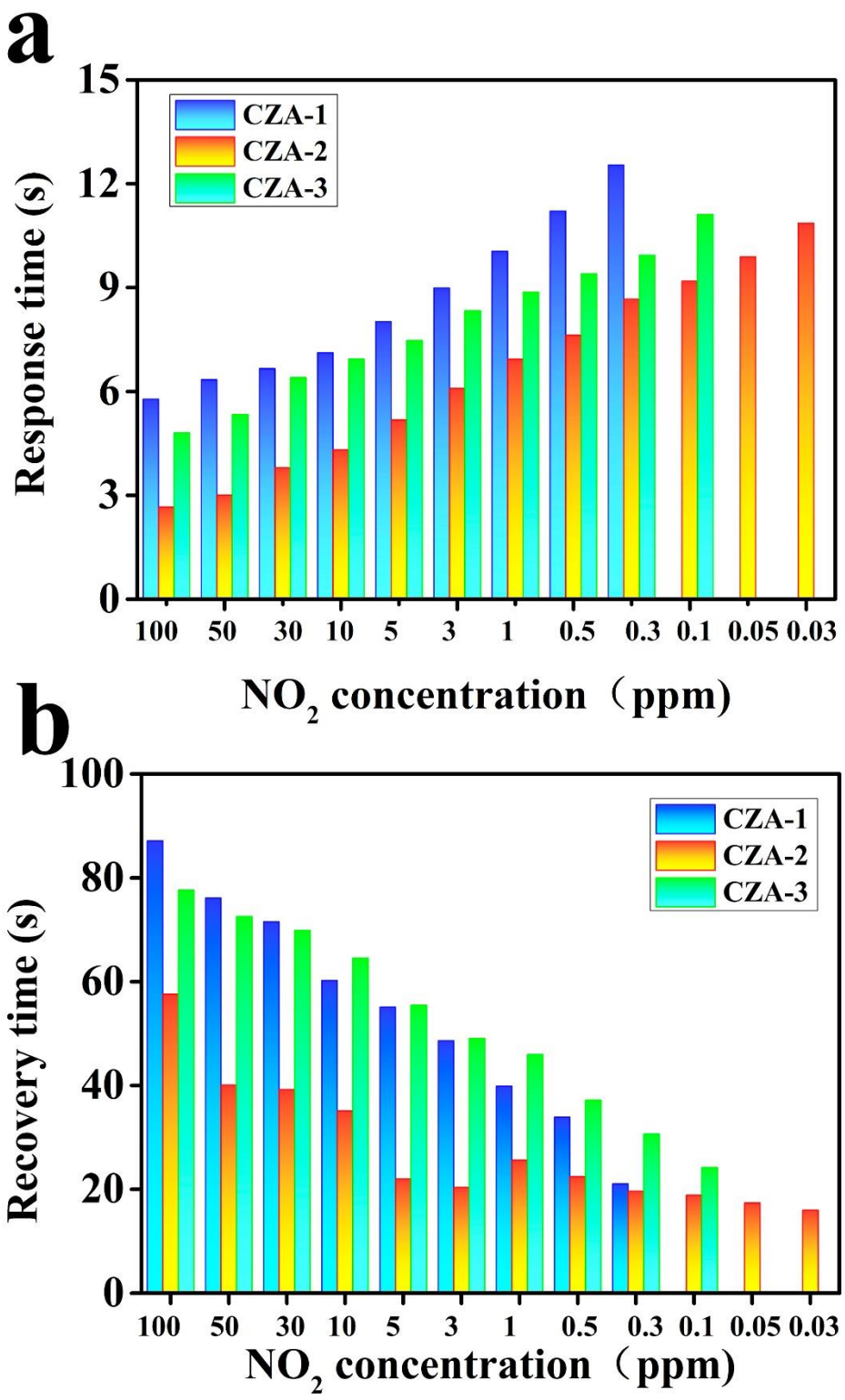


Fig.S6 The response time (a) and recovery time (b) of CZA-1, CZA-2 and CZA-3.

Table S3. The response, response time and recovery time of three samples at room temperature for different amounts of NO_2

Samples	**CZA-1**			**CZA-2**			**CZA-3**		
NO_2(ppm)	**R**	**Tr_1/s**	**Tr_2/s**	**R**	**Tr_1/s**	**Tr_2/s**	**R**	**Tr_1/s**	**Tr_2/s**
100	6.56	5.78	87.15	**22.30**	**2.66**	**57.60**	10.23	4.80	77.60
50	5.15	6.34	76.11	**13.95**	**3.01**	**40.12**	8.54	5.33	72.53
30	4.11	6.66	71.53	**10.50**	**3.80**	**39.21**	6.81	6.40	69.87
10	3.65	7.12	60.23	**7.26**	**4.31**	**35.11**	5.15	6.93	64.53
5	3.07	8.02	55.10	**4.36**	**5.18**	**22.04**	3.88	7.47	55.47
3	2.56	8.99	48.65	**3.06**	**6.09**	**20.40**	2.85	8.33	49.07
1	1.88	10.05	39.89	**2.11**	**6.93**	**25.63**	1.90	8.87	45.94
0.5	1.45	11.21	33.89	**1.72**	**7.63**	**22.45**	1.64	9.40	37.20
0.3	1.18	12.54	21.09	**1.39**	**8.67**	**19.66**	1.43	9.93	30.64
0.1				**1.31**	**9.19**	**18.89**	1.16	11.11	24.21
0.05			1	**1.23**	**9.89**	**17.41**			
0.03				**1.17**	**10.86**	**16.00**			

***R: Response** **Tr_1: Response time** **Tr_2: Recovery time**

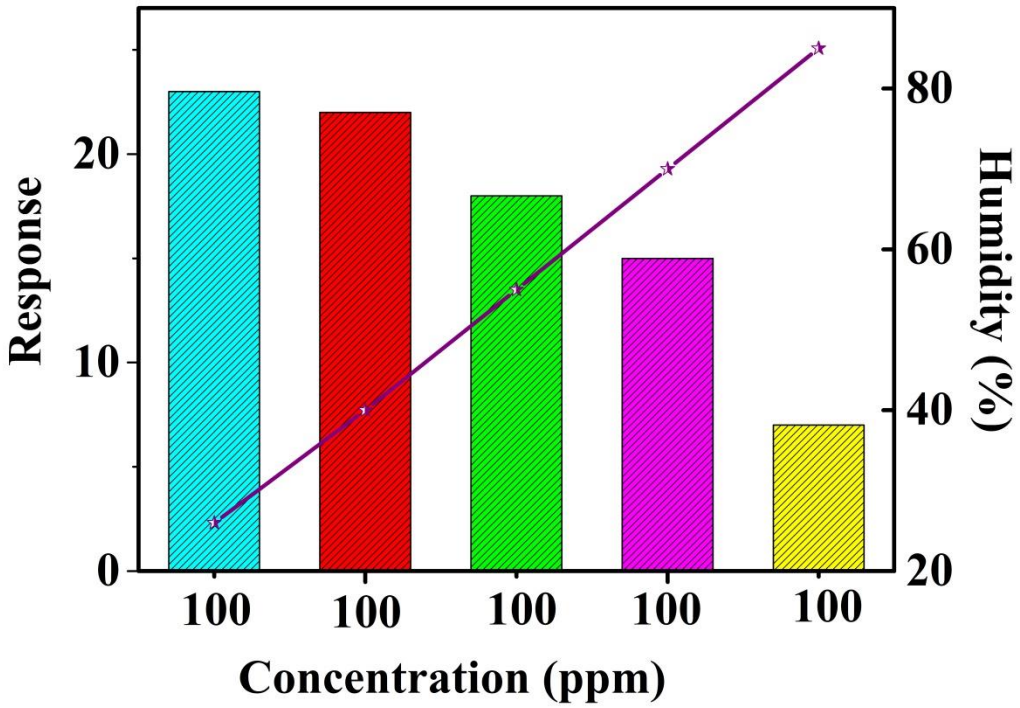


Fig. S7 The response value of CZA-2 sensor to 100 ppm NO_2 under different humidity (26%, 40%, 55%, 70%, 85%) at room temperature.

Table S4 XPS peaks fitting results of O 1s of CZA-2 and CZA-2 of absorption NO_2

Samples	CZA-2			CZA-2 (after NO_2 absorption)		
Peaks	O1	Oa	O2	**O1**	**Oa**	**O2**
Position (eV)	528.39	529.05	529.78	528.40	529.20	530.15
Area ratio (%)	28.63	41.02	30.35	27.45	**50.62**	**21.93**

References:

1 Y. Qin, H. Gui, Y. Bai and S. Liu, *Sens. Actuator B-Chem.*, 2022, **352**.

2 X. Zhang, M. Ikram, Z. Liu, L. Teng, J. Xue, D. Wang, L. Li and K. Shi, *RSC Adv.*, 2019, **9**, 8768-8777.

3 Y. Qin, L. Wang and X. Wang, *Organic Electronics*, 2019, **66**, 102-109.

4 Y. Li, F. Zhou, L. Gao and G. Duan, *Sens. Actuator B-Chem.*, 2018, **261**, 537-549.

5 D. Hong, J. Zhang, A. U. Rehman, L. Gong, J. Zhou, K. Kan, L. Li and K. Shi, *RSC Adv.*, 2016, **6**, 103192-103198.