Electronic Supplementary Information (ESI)

High content of hydrogenated pyridinic-N in SnO_2/NGO heterogeneous material as an ultra high sensitive formaldehyde sensor

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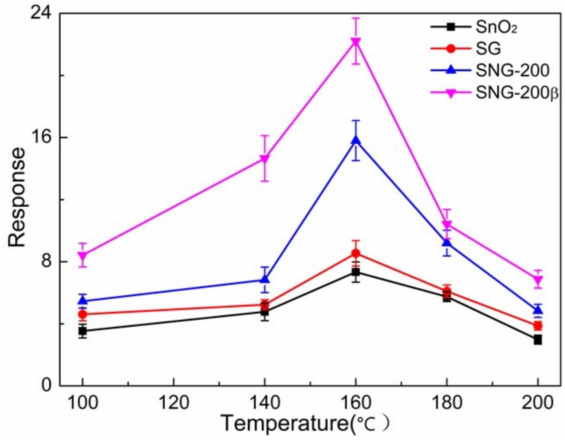

Fig. S1 Optimal working temperature of SnO_2, SG, SNG-1 and SNG-2 sensing materials at 10ppm formaldehyde concentration.

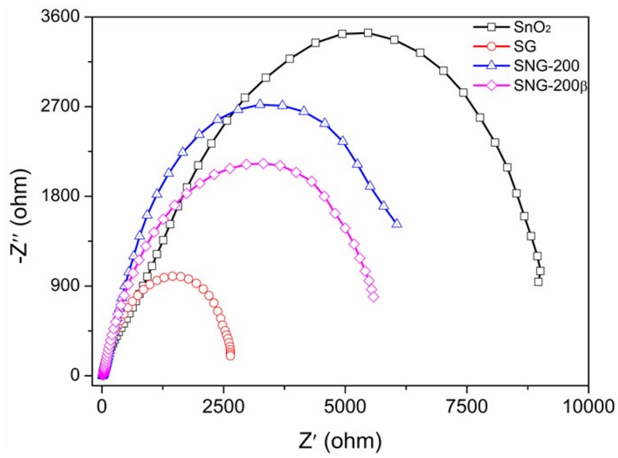

Fig. S2 The impedance test of SnO_2, SG, SNG-1 and SNG-2 sensing materials.

Table S1 Relative content of different forms of oxygen

	O_V	Sn-O	Sn-O-C	C-O/C=O
SnO_2	13.4	86.6	—	—
SG	11.48	57.53	16.87	14.13
SNG-1	15.86	57.07	18.48	8.59
SNG-2	15.49	54.07	21.06	9.38

Table S2 Relative content of different forms of nitrogen

	pridinic-N	pyrrolic-N	hydrogenated pyridinic-N	graphitic-N	pyridinic N-O-
SNG-1	18.1	10.8	55.9	—	15.2
SNG-2	—	—	81.9	18.1	—

Table S3 The response-recovery time of SnO_2, SG, SNG-1 and SNG-2 sensing material

	response time/recovery time									
	Formaldehyde concentration (ppb)					Formaldehyde concentration (ppm)				
sample	100	300	500	700	900	1	3	5	7	9
SnO_2	—	—	—	—	—	41/92	55/49	66/59	41/84	49/82
SG	—	—	—	—	—	34/91	55/98	58/100	61/123	46/100
SNG-1	64/105	62/69	63/68	64/68	68/70	31/110	54/100	74/94	64/95	56/93
SNG-2	46/63	41/51	48/60	41/61	49/68	38/90	36/107	49/93	37/94	33/93

Table S4 Comparison of HCHO sensing performance of SnO_2 based sensors

Material	Concentration(ppm)	Response(Ra/Rg)	Response time/recovery time(s)	Practical detection limit (ppb)	Ref
SnO_2 nanofibers/nanosheets	100	57	4.7/11.6	500	1
SnO_2 microspheres	100	38.3	38.26	1000	2
mesoporous tubular SnO_2	50	20	Not report	10	3
SnO_2/ZnO nanospheres	20	38.2	12/24	500	4
polyporous SnO_2/ZnO composites	10	2	Not report	100	5
CuO/SnO_2 core-shell nanowires	6	1.2	52/80	1500	6
Ag-Zn_2SnO_4/SnO_2 nanospheres	5	10	9/5	250	7
SnO_2/rGO nanocomposites	100	138	Not report	1000	8
SnO_2 nanofibers/GO	100	32	66/10	500	9
SnO_2 nanosheets/GO	100	2275.7	81.3/33.7	250	10
mesoporous spherical SnO_2/GO	1	4.9	1/75	1000	11
SnO_2/NGO	5	14.6	49/93	100	This work

Notes and references

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