Supplementary Material

Fingertip-Chip Sensor Based on Pd Nanocluster Sensitized 3D NiO Nanotube Arrays for Real-time, Selective Methane Detection

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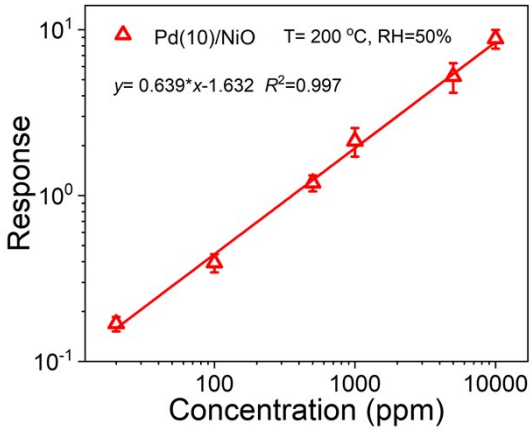

Fig. S1 The theoretical limit of detection (LOD) calculation

The theoretical limit of detection (LOD) is defined as three times the relative standard deviation (σ) of sensor noise divided by the slope of the linear fit (LOD (ppb)=3*σ/slope): LOD=3*0.015/0.639=0.07ppm=70 ppb. The factor 3 corresponds to 99.7% confidence in distinguishing signal from noiseThe σ is the relative standard deviation (RSD) of the baseline noise measured in clean air; and the slope corresponds to the sensitivity of the sensor in ppm^{-1} , which is derived from fitting a linear response region.

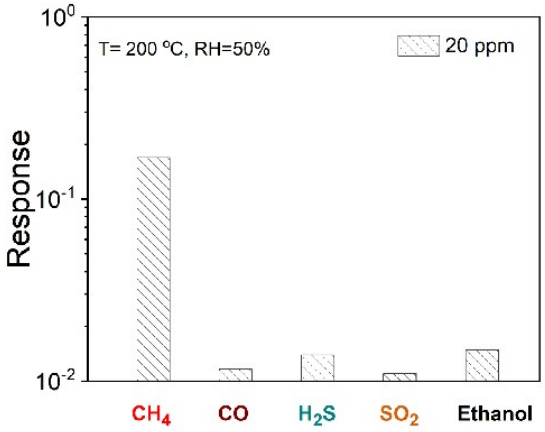

Fig. S2 Selectivity against the interfering gases (@20 ppm)

Table S1 Gas concentration range and sensor verification index

Monitoring scenario	Gas	Ref. Conc	Val. Conc.	Significance
Natural gas pipeline		Early leakage≤100 ppm	100 ppm	Early leakage of natural gas
Mine environment	**CH_4**	Alarm≥5000 ppm	500 ppm	10% of alarm threshold
		LEL≥50000 ppm	1000 ppm	20% of alarm threshold
	H_2S	Safety ceiling≤6.6 ppm	\	\
	CO	Safety ceiling≤24 ppm	\	\

Table S2 CH_4 sensing performance comparison based on typical metal oxide-based gases.

Materials	Temperature	Response	RH	Selectivity	*LOD*	Ref.
3D Pd/NiO	**200°C**	**1.2@500 ppm**	**10~85%**	**H_2S, CO, SO_2, and ethanol**	**70 ppb**	**This work**
Ag/ZnO	200°C	19.15@5000 ppm	\	CO, NH_3, C_7H_8, HCHO, CH_3OH	166 ppb	1
Zn_2SnO_4/ZnO	250°C	14.36@400 ppm	30%	CO, NH_3, H_2O	1.48 ppm	2
NiO/ZnO-2	100°C	7.61@5000 ppm	30~80%	CO, H_2S, NH_3, CH_3OH	4 ppm	3
ZnO	RT	0.02@100 ppm	25~85%	CO, H_2, O_3	12 ppm	4
Pd/In_2O_3	50°C	14.317@500 ppm	\	CO, NH_3, C_7H_8, HCHO, CH_3OH	1.78 ppm	5
Ni/In_2O_3	140°C	71.727@200 ppm	20%	CO, C_7H_8, HCHO, CH_3OH	1600 ppb	6
V_2O_5/NiO	200°C	0.57@4000 ppm	30~70%	H_2, CO, SO_2, C_2H_6	50 ppm	7

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