Supplementary Information:

Table 1. A detailed table listed the photoelectric gas sensors based on ZnO.

Sample style	Light	Detection gas	Detection limitation		Detection upper limitation	
			Concentrations	Sensitivity	Concentrations	Sensitivity
ZnO nanoribbons[1]	UV	O_2	0.59Torr	/	14.11Torr	/
		H_2O	2.9 Torr	/	12.18Torr	/
ZnO[2]	UV	HCHO	25ppm	2.4	50ppm	11.7
ZnO[3]	UV	CH_3CH_2OH	10ppm	0.75	60ppm	0.8
ZnO nanorods[4]	UV	HCHO	1.8ppm	/	1100ppm	/
Copper-doped ZnO[5]	UV	CH_3CH_2OH	/	/	1120 ppm	64
		CH_3COCH_3	/	/	1120 ppm	63
ZnO Ru(dcbpy)$_2$(NCS)$_2$[6]	UV	HCHO	5ppm	0.9	50ppm	18.4
		CH_3CH_2OH	5ppm	0.4	50ppm	2.6
		CH_3OCH_3	5	0.2	50ppm	0.8
ZnO/SnO_2[7]	UV	NO_2	/	/	500 ppb	1266
TiO_2-doped ZnO[8]	UV	CH_3CH_2OH	50ppm	ΔVg=1.6	200ppm	ΔV g=1.8
ZnO[9]	λ=500 nm	PCBs	1μM	15%	15μM	50%
CdS/ZnO[10]	λ>450 nm	HCHO	110 ppm	126%	660ppm	381%

Because of the traditional heated-treatment gas sensor has to be operated at high temperatures, and the high operation temperature restricts the application of gas sensor in many areas, such as explosive environment and low temperature environment. Therefore, the light irradiation is introduced, to get gas sensors to work at room temperature in recent years. As a new type of gas sensor, the research of photoelectric gas sensor is still on the exploratory stage. ZnO, with a wide band gap of 3.37 eV, only can be excited under UV light. Therefore, people by synthesized pure ZnO, Copper-doped ZnO，ZnO modified with Ru(dcbpy)$_2$(NCS)$_2$, ZnO/SnO_2 et al to detect gas under UV light irradiation. From the table 1, it can be seen that ZnO modified with Ru(dcbpy)$_2$(NCS)$_2$ have a better response under UV light irradiation. Besides that, compared with pure ZnO,

Copper-doped ZnO have a better response. This is demonstrated that doped and sensitized can improve the response of ZnO. However, compared to the UV light region, there are much more energy which produced by the sunlight in the visible light region. In order to extend the photoelectric response of wide band gap semiconductors into the visible spectral range and utilize solar energy effectively, Zhai et al by synthesized CdS/ZnO to detect HCHO under visible light. But there are little reports about the photoelectric gas senor under visible light irradiation until now. Therefore, in our paper, we try to synthesis In_2O_3-sensitized ZnO nanoflowers and detect HCHO under visible light irradiation.

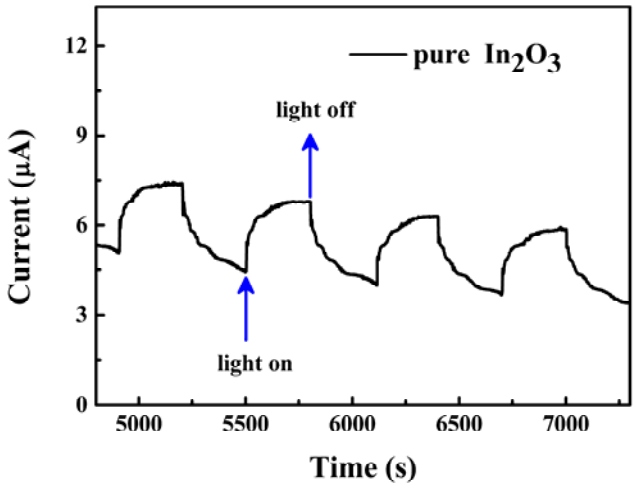

Fig.1. Surface photocurrent of the pure In_2O_3 exposed to light on-off with a bias voltage of 10V under 460nm light illumination.

Among a variety of semiconductor, In_2O_3 with a narrow indirect band gap which has an excellent electric conductance, transparency to visible light and good stability. But because of it's narrow indirect band gap, the recombination of photo-generated electrons and holes can happened easily. Besides it, In_2O_3 has an excellent electric conductance, and thus the current of In_2O_3 which produced by photo-generated electrons is not obviously. The surface photocurrent of pure In_2O_3 was detected and the result was shown in Fig.1. We can see that the current of pure In_2O_3 under visible light irradiation is about 6.2 μA and the current under the dark is about 4.2 μA. Therefore, in our experiment, pure In_2O_3 is not suitable for photoelectric gas sensor.

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