Supporting Information

Nanostructured ZnO/Ag Film Prepared by Magnetron Sputtering Method for Fast Response of Ammonia Gas Detection

Yiran Zheng [1], Min Li [1], Xiaoyan Wen [1], Ho-Pui Ho [2] and Haifei Lu [1,*]

[1] School of Science, Wuhan University of Technology, Wuhan 430070, China; yiranzzzzz@whut.edu.cn (Y.Z.); minli@whut.edu.cn (M.L.); wenxy@whut.edu.cn (X.W.)

[2] Department of Biomedical Engineering, The Chinese University of Hong Kong, Shatin, Hong Kong, China; aaron.ho@cuhk.edu.hk

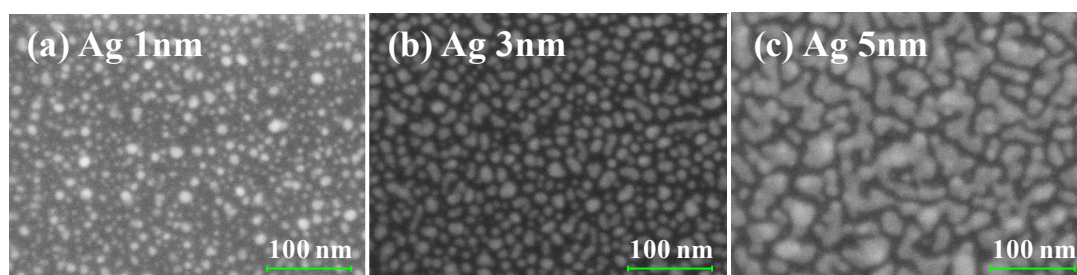***** Correspondence: haifeilv@whut.edu.cn

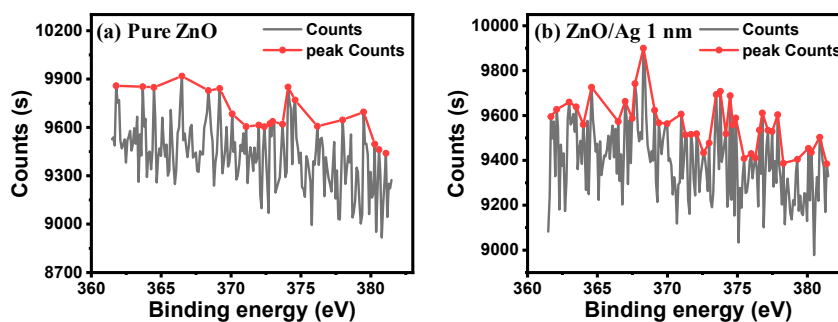**Figure S1.** The SEM micrograph of Ag layers with **(a)** 1 nm, **(b)** 3 nm, and **(c)** 5 nm.

Figure S2. The XPS spectrum of Ag element measured on the pure ZnO and ZnO/Ag (1 nm) film.

Table S1. The parameters and calculations of the average crystallite size of the ZnO crystal using Scherrer equation.

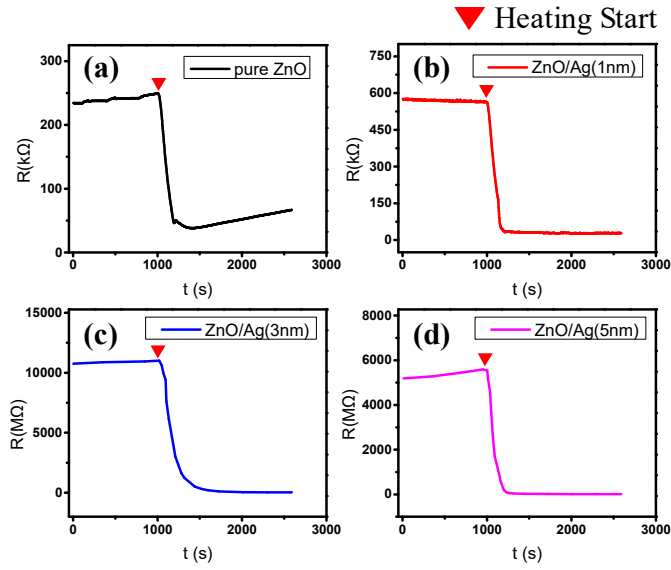|	K	λ/nm	β	θ	D/nm
Pure ZnO	0.943	0.154	0.0098298	0.296	15.450
ZnO/Ag (1 nm)	0.943	0.154	0.0051156	0.301	29.734
ZnO/Ag (3 nm)	0.943	0.154	0.0086982	0.301	17.487
ZnO/Ag (5 nm)	0.943	0.154	0.0069072	0.301	22.021

Figure S3. The resistance of ZnO films with different Ag thickness before and after heating.
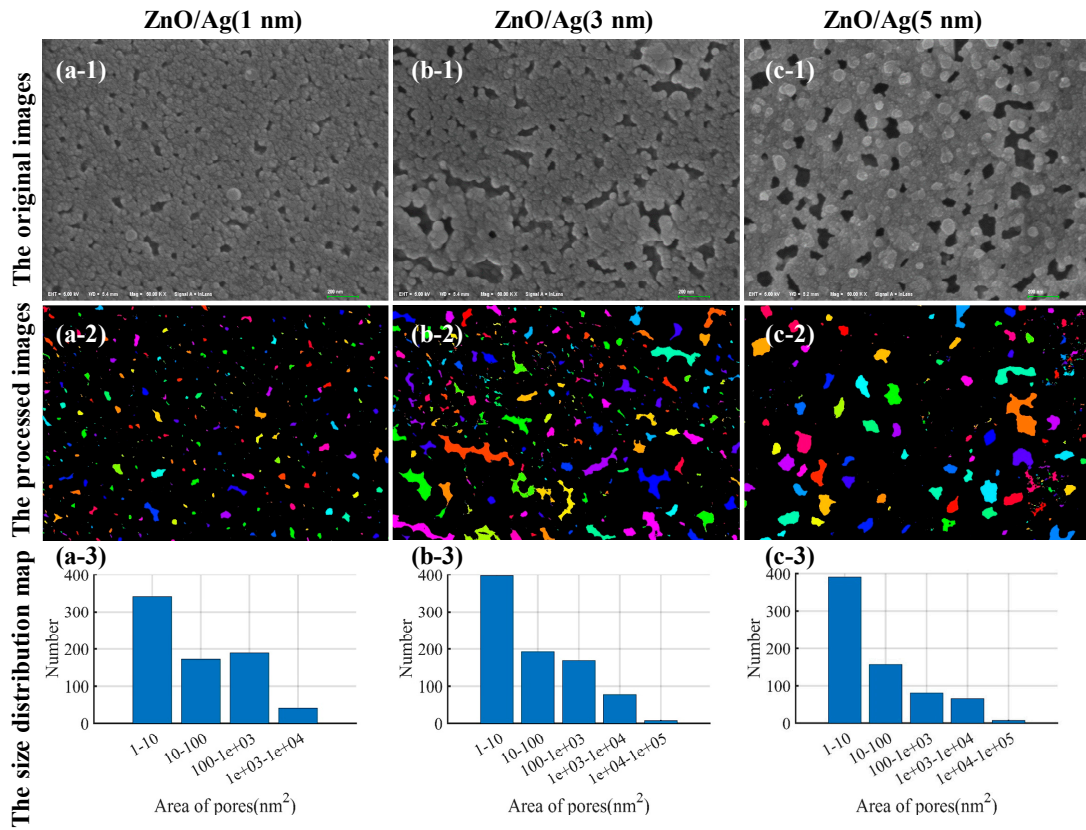

Figure S4. The statistics analysis of ZnO films with **(a)** 1 nm, **(b)** 3 nm and **(c)** 5 nm Ag: **(1)** SEM images of the three nanostructured film and **(2)** corresponding colored figures of the nanopores in the films. **(3)** The distribution diagrams of pores on the three ZnO/Ag films.

Table S2. The statistics summary of area and quantity of nanopores in the three nanostructured films.

	Total Area of Film Surface (nm²)	Quantity of all Pores	Total Area of Pore Entrance (nm²)	Area Ratio of Pore Entrance and Film Surface	Total Area of Pore Entrance above 1963.4954 nm (nm²)
ZnO/Ag (1 nm)	3417867.4073	743	143340.1763	0.041938	27368.6753
ZnO/Ag (3 nm)	3417867.4073	843	405265.0646	0.11857	289380.5096
ZnO/Ag (5 nm)	3417867.4073	605	353010.5060	0.10328	303789.3974

We have calculated the average crystallite size of the ZnO crystal using Scherrer equation $D = K\lambda/(\beta \cos\theta)$, where D is the average crystallite size, K is the shape constant (K = 0.89 when the particles are spherical or K = 0.943 when the particles are cubic), λ is the X-ray wavelength(0.154 nm), β is the half-width of the full maximum (HWFM) and θ is the angle value. The average crystallite sizes of the ZnO/Ag (1, 3, 5) are 29.73 nm, 17.49 nm, 22.02 nm, respectively. Scherrer equation applies only to unstressed films. Thus, the average crystallite size of pure ZnO films is 15.45 nm for reference only.
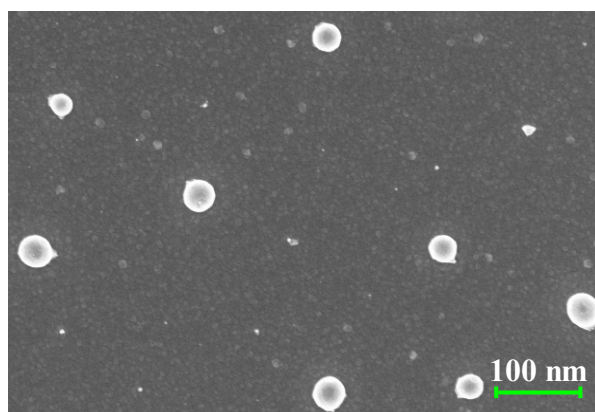

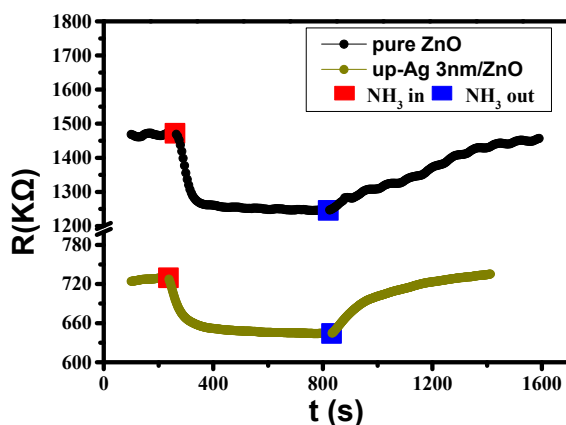**Figure S5.** The SEM micrograph of up-Ag 3 nm/ZnO films.

Figure S6. Sensing performance of ZnO films with 5 nm Ag exposed to 300 ppm NH3, comparing to pure ZnO.
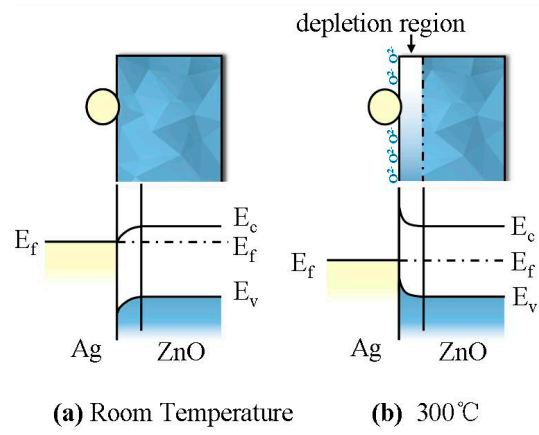
Figure S7. Schematic of the band diagram of silver and ZnO nanograins under **(a)** room temperature and **(b)** 300 °C.