

**The hydrothermal evolution of phase and shape of ZnS
nanostructures and their gas-sensing properties** --

Supplementary Information

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Section S1.

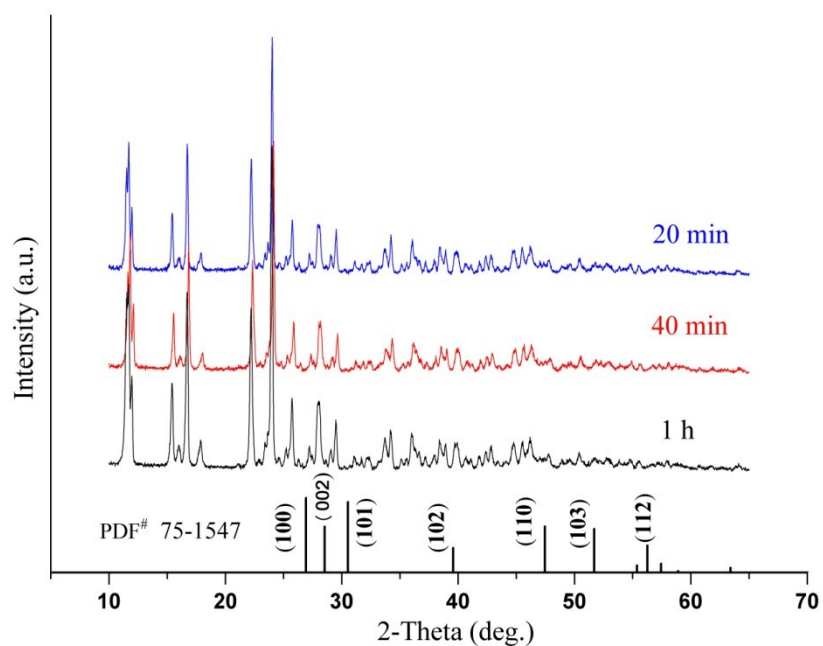


Figure S1. XRD patterns of the samples obtained with different hydrothermal holding times in the absence of surfactant: 20 min, 40 min, and 1 h. The bottom of (a and b) are the standard patterns of standard WZ ZnS (JCPDS card, NO. 75-1547).

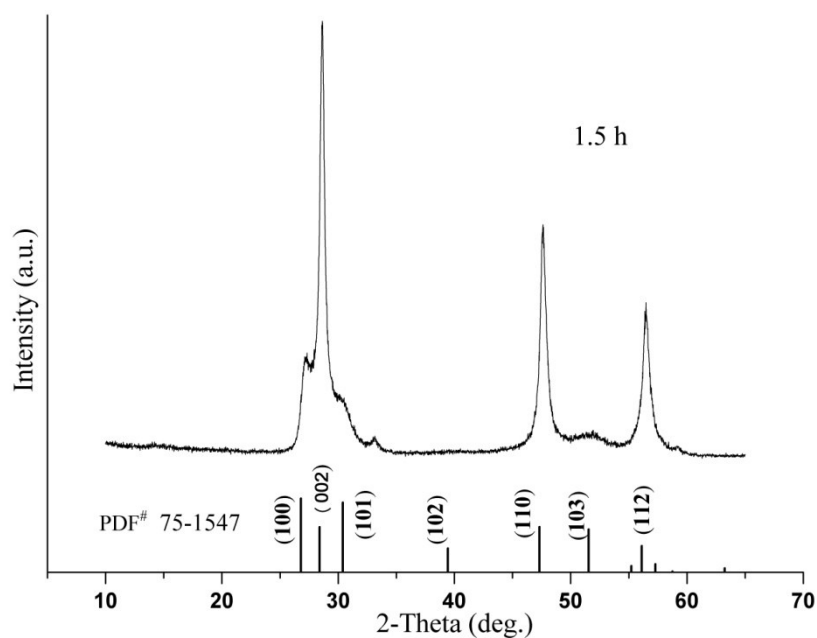
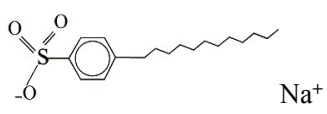


Figure S2. XRD patterns of the samples obtained with 1.5 hours in the absence of surfactant. The bottom of (a and b) are the standard patterns of standard WZ ZnS (JCPDS card, NO. 75-1547).

Section S2.

Table S1. Some physical properties of sodium dodecyl benzene sulfonate

Chemical structure of SDBS	pKa	Molar mass (g/mol)	Solubility in water	hydrophile lipophile balance value (HLB)
$\text{CH}_3(\text{CH}_2)_{11}\text{C}_6\text{H}_4\text{SO}_3\text{Na}$	3	348.48	20%	10.638
				

Section S3. The preparation of ZnS nanoparticles using other addition agents including PEG-400 (polyethylene glycol 400) and SDS (sodium dodecyl sulfate), and their XRD characterization.

All the reagents are of analytical grade. The samples ($S_{2.5\%V-PEG}$, $S_{10\%V-PEG}$, $S_{0.5CMC-SDS}$, and $S_{2CMC-SDS}$) were synthesized following a similar hydrothermal process for the sample $S_{SDBS-12CMC}$. Unlike the sample S_{0-12h} , different dosages of addition agents PEG-400 ($S_{2.5\%V-PEG}$ -- $V_{PEG}/V_{solution} = 2.5\%$; $S_{10\%V-PEG}$ -- $V_{PEG}/V_{solution} = 10\%$) and SDS (CMC = 8.6×10^{-3} mol/L, $S_{0.5CMC-SDS}$ -- 4.3×10^{-3} mol/L; $S_{2CMC-SDS}$ -- 1.73×10^{-2} mol/L) were introduced into above mother solution, respectively. Figure S1 is the XRD patterns of them. The results show that the composition of wurtzite ingredient will be increased with increasing the dosage of the addition agents PEG-400 and SDS.

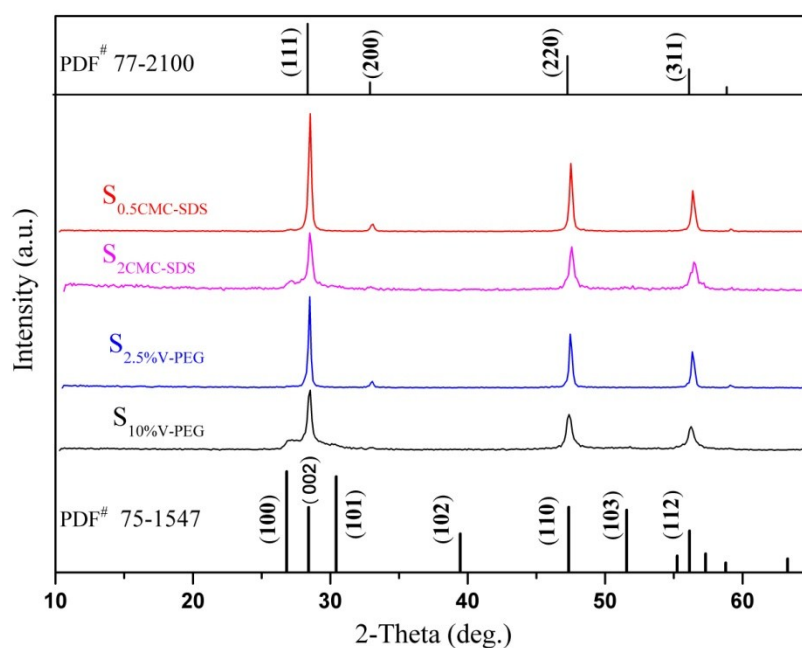


Figure S3. XRD patterns of ZnS nanocrystals prepared with hydrothermal routes under the assistant of different dosage of PEG-400 or SDS.

Section S4.

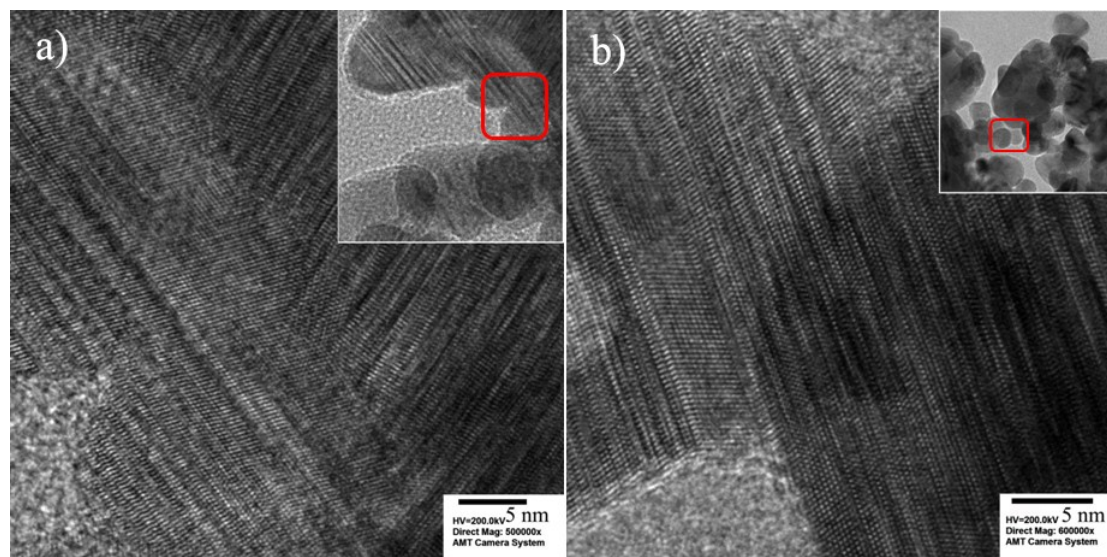


Figure S4. HRTEM photographs of the aggregates (randomly selected) in $S_{SDBS-12CMC}$.

Section S5. The preparation of ZnS nanoparticles using different source of sulfur and zinc with different hydrothermal holding time, and their XRD characterization.

With different source of sulfur and zinc (Sodium sulfide, Zinc acetate, Zinc chloride, APDC), some samples were synthesized by the similar hydrothermal process for the series of samples with zinc acetate and APDC. Their XRD patterns were illustrated in figure S5.

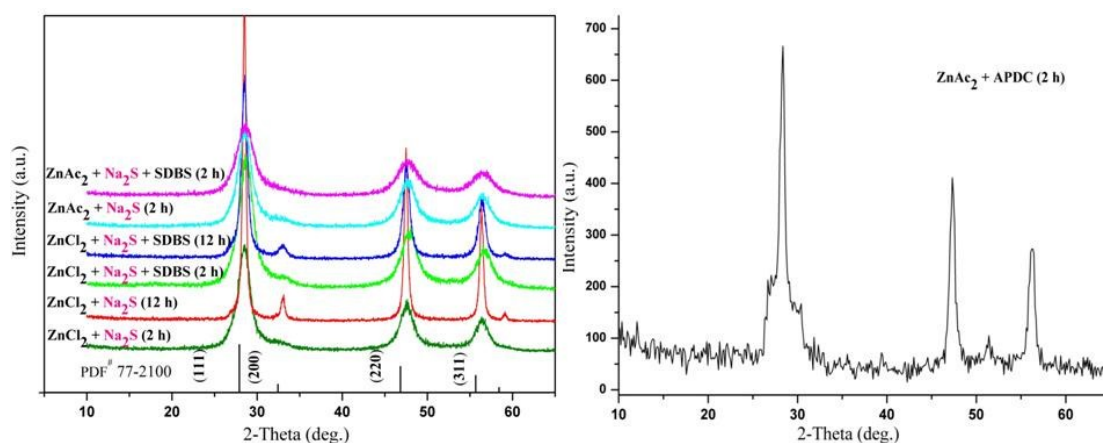


Figure S5. XRD patterns of ZnS nanocrystals prepared with different source of sulfur and zinc under different hydrothermal holding time.

Section S6.

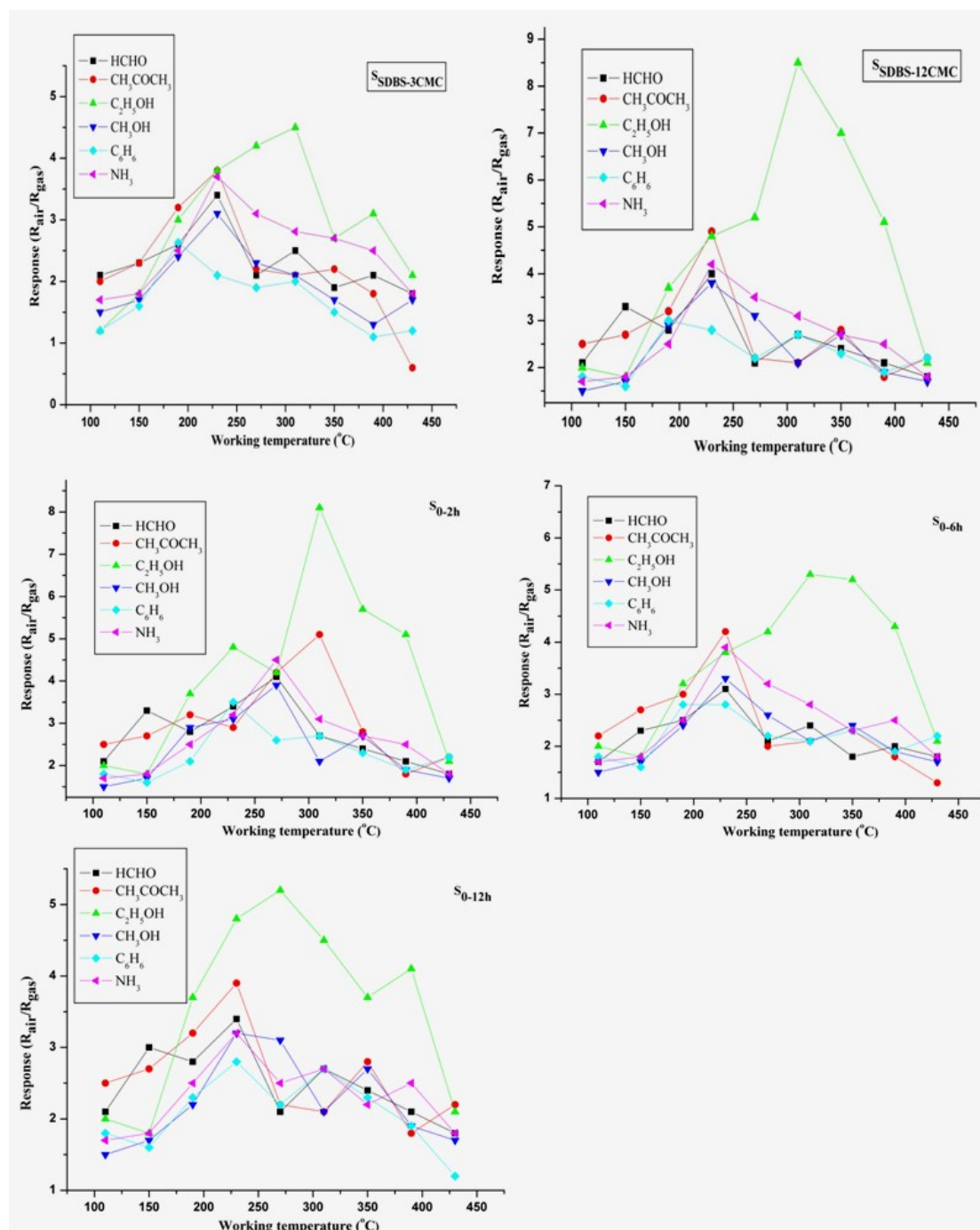


Figure S6. Relationship between working temperature and response of sensor to C_2H_5OH , HCHO, NH_3 , CH_3OH , CH_3COCH_3 , and C_6H_6 (respectively, 50 ppm) of various samples.