Electronic Supplementary Material (ESI) for CrystEngComm.


# Supporting Information

# Design of hierarchical $SnSe_2$ for efficient trace detection of $NO_2$ at room-temperature

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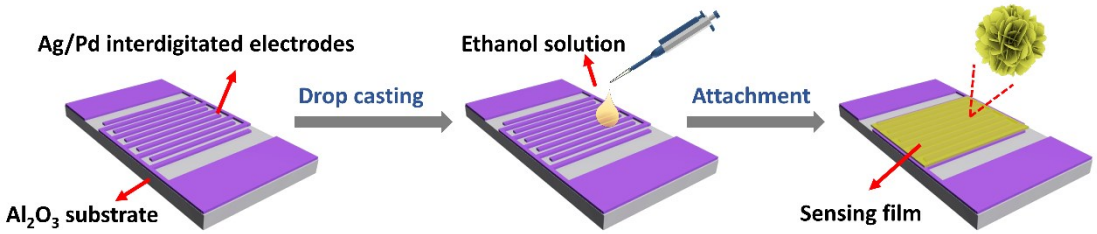


**Fig. S1** Fabricated technological process diagram of gas sensor.

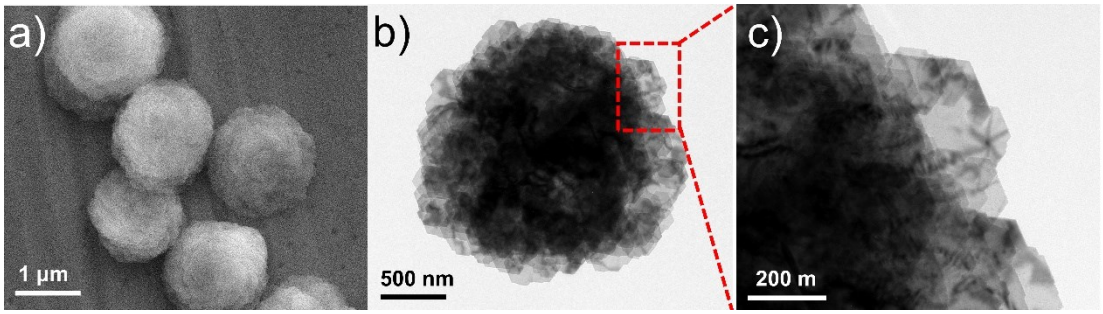


**Fig. S2** (a) SEM and (b-c) TEM images of $SnSe_2$-36h sample.

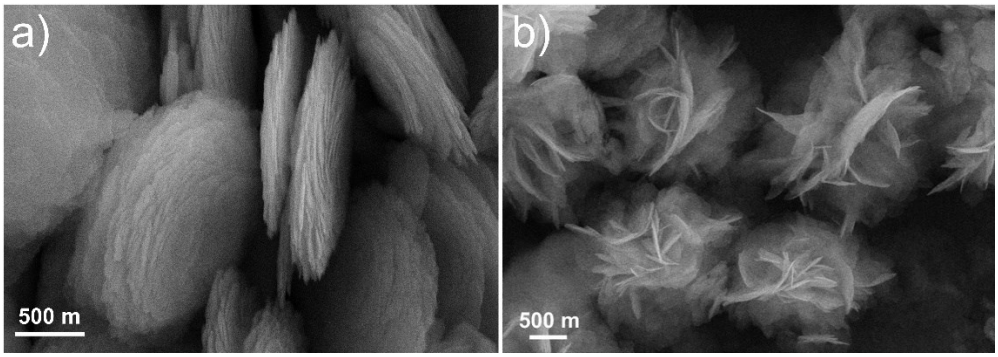


**Fig. S3** SEM images of (a) $SnSe_2$-48h and (b) $SnSe_2$-60h samples.

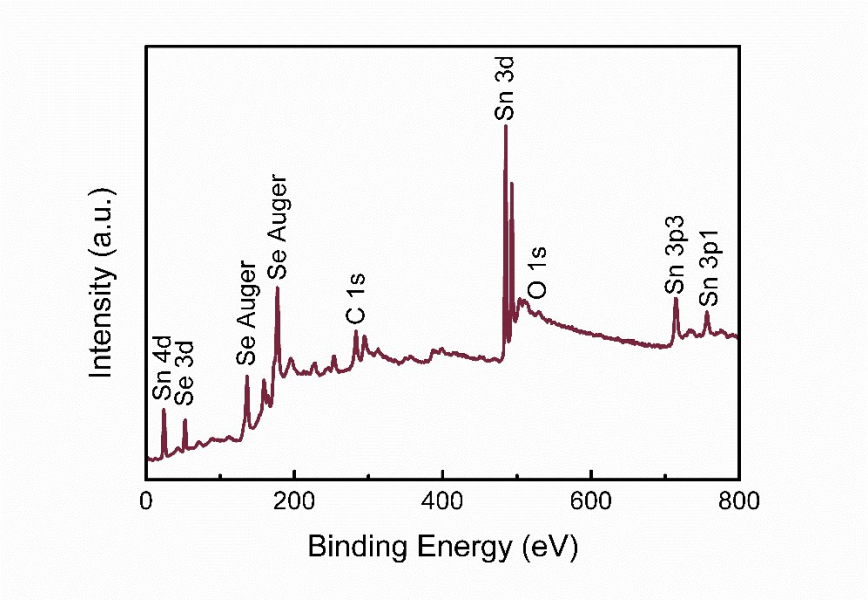


**Fig. S4** Survey XPS spectrum of the $SnSe_2$ hierarchical nanostructures.

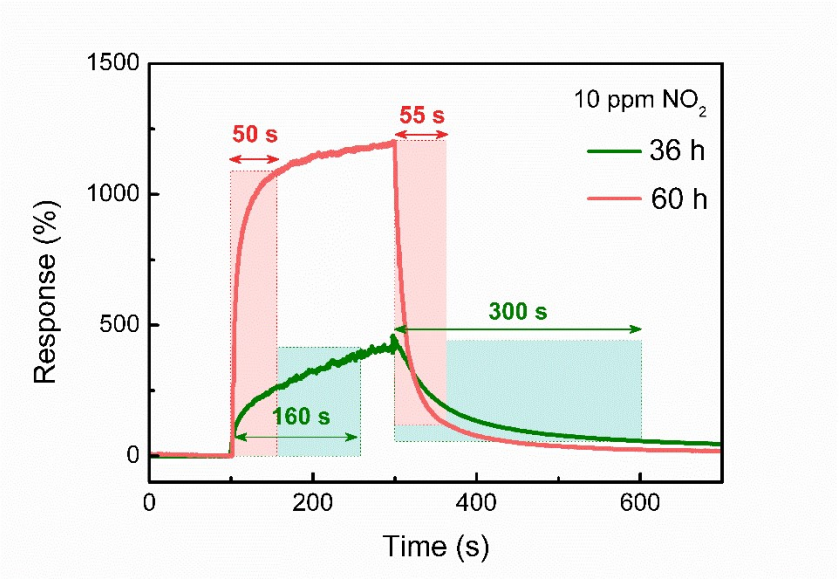


**Fig. S5** Response/recovery curves of $SnSe_2$-36h and $SnSe_2$-60h to 10 ppm $NO_2$.

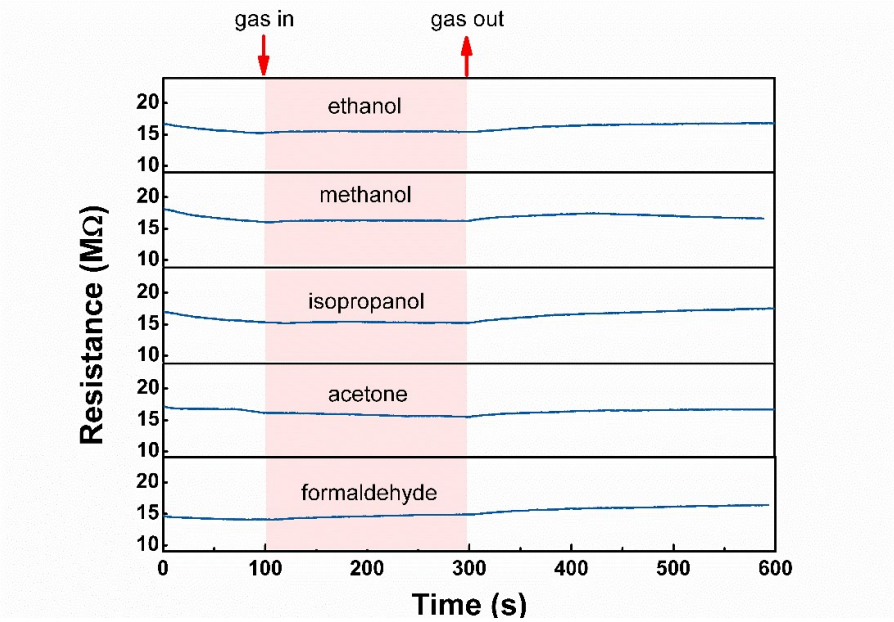


**Fig. S6** Selectivity response of $SnSe_2$ sensor toward 100 ppm VOCs (ethanol, methanol, isopropanol, acetone, and formaldehyde).

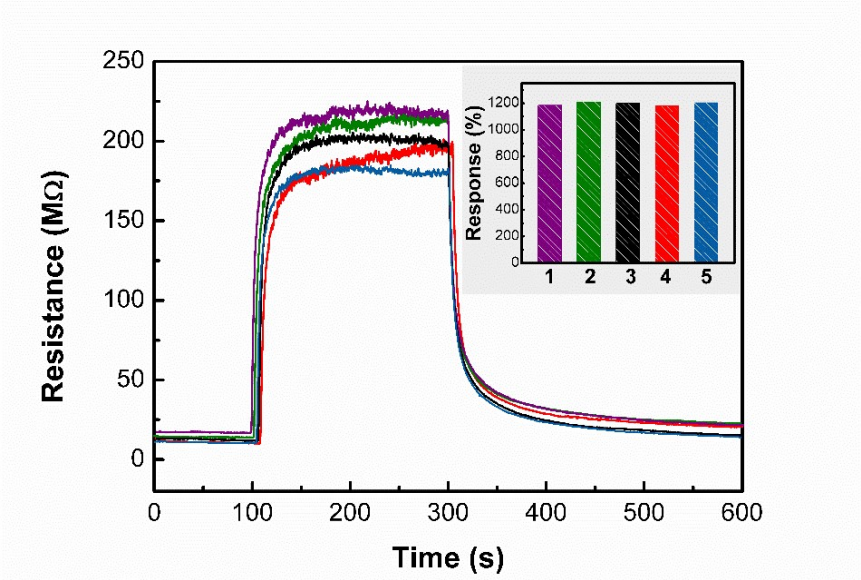


**Fig. S7** The resistance variations and sensing response (inset) of the $SnSe_2$ hierarchical structures toward 10 ppm $NO_2$ on 5 different sensing devices.

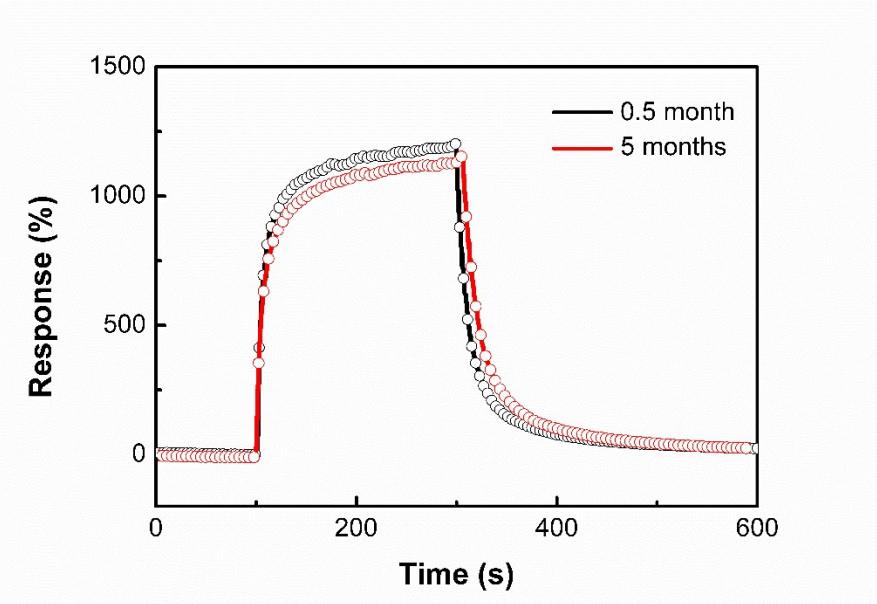


**Fig. S8** The response and recovery curve of the $SnSe_2$ sensor after aging 0.5 month and 5 months to 10 ppm $NO_2$ at room-temperature.

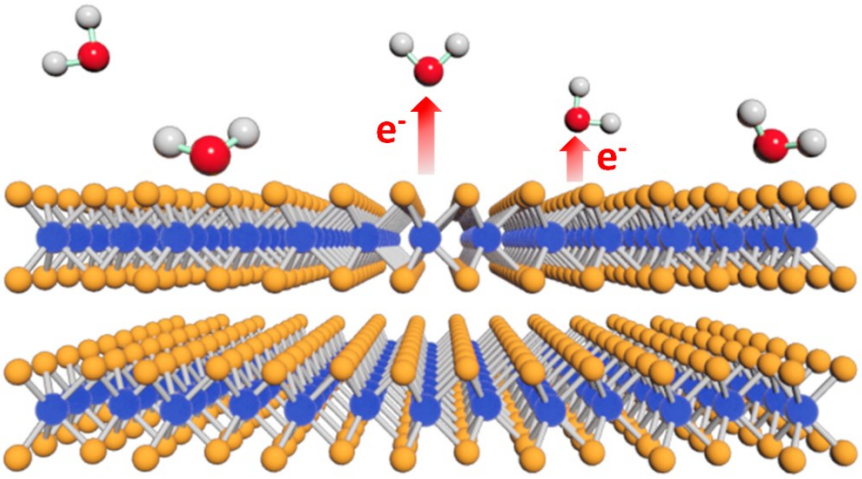


**Fig. S9** Sensing mechanism of $SnSe_2$ exposed to $NO_2$.

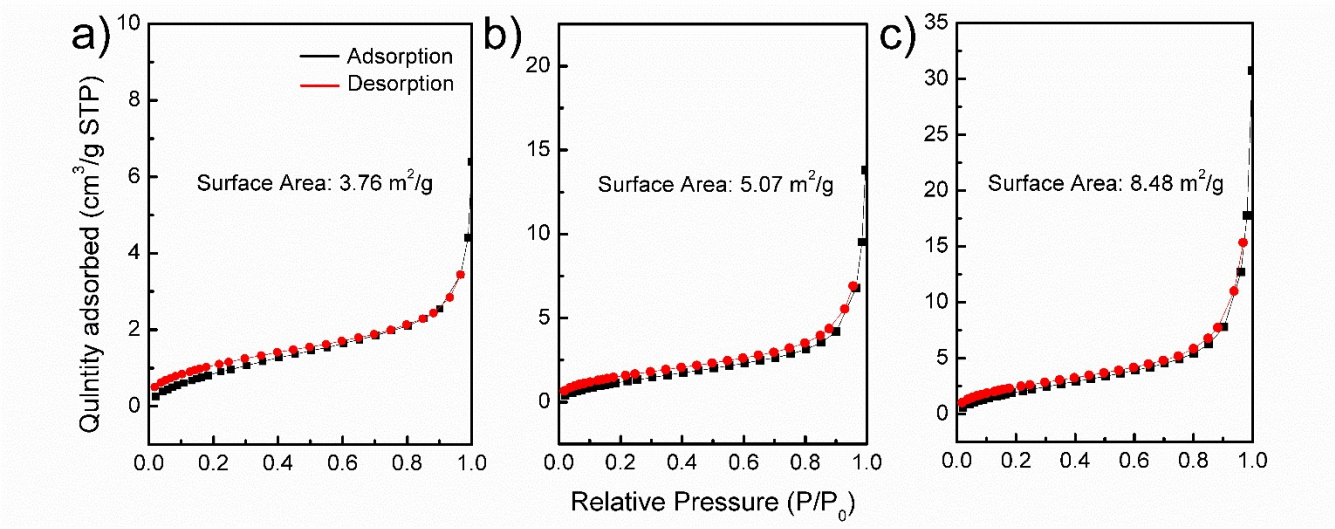


**Fig. S10** Nitrogen adsorption/desorption isotherms of (a) $SnSe_2$-36h, (b) $SnSe_2$-48h and (c) $SnSe_2$-60h samples.

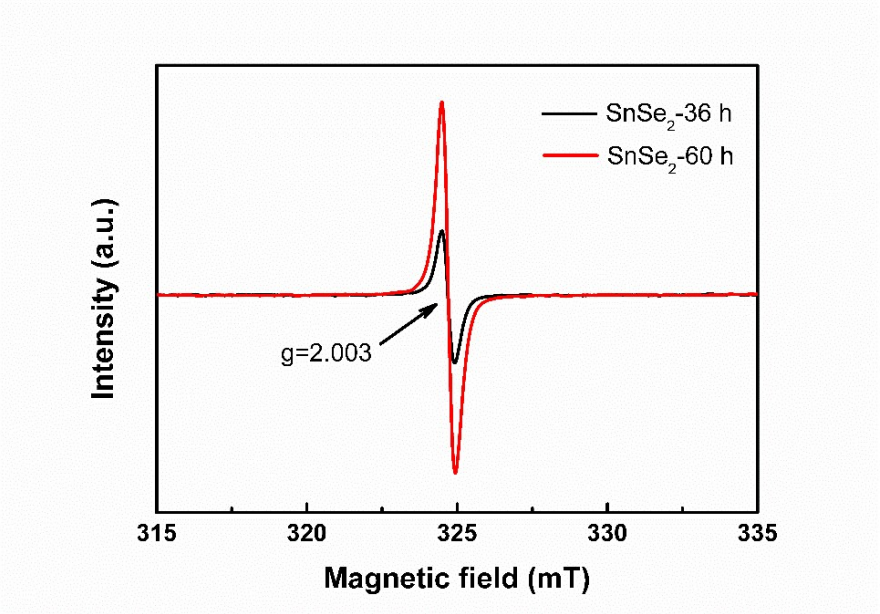


**Fig. S11** EPR spectra of $SnSe_2$-36h and $SnSe_2$-60h samples.

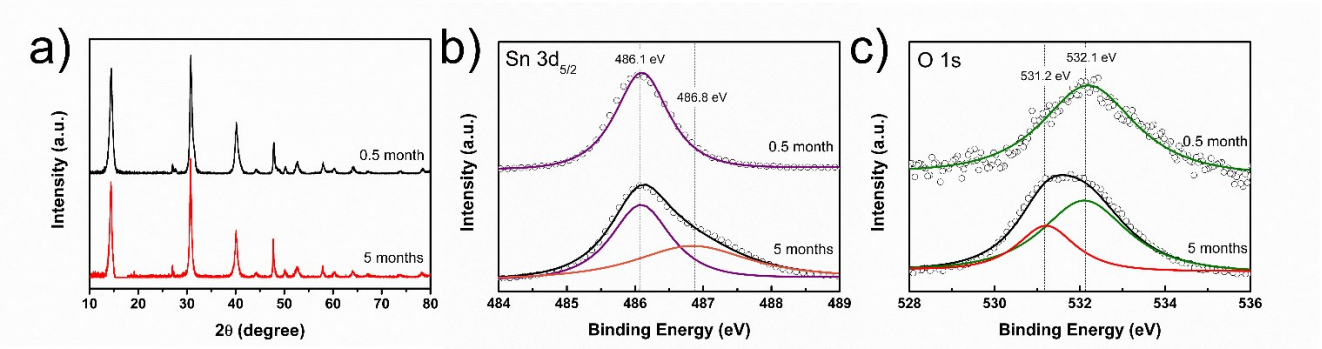


**Fig. S12** (a) XRD patterns and XPS spectra of (b) Sn 3d orbital and (c) O 1s orbital of the $SnSe_2$ sensor after aging 0.5 month and 5 months.

Two peaks in the Sn $3d_{5/2}$ spectrum can be seen at 486.1 and 486.8 eV, belonging to the Sn–Se bond of $SnSe_2$ and Sn–O bond of $SnO_2$, respectively.[1,2] The peak at 532.1 eV in the O 1s spectra can be attributed to the chemically adsorbed oxygen,[3] and the peak at 531.2 eV can be correlated to the Sn–O–Sn lattice oxygen.[4] These results indicate that $SnSe_2$ is slightly oxidized after 5 months.

## References

[1]. M. Park, J.-Y. Kim, H. J. Son, C.-H. Lee, S. S. Jang and M. J. Ko, *Nano Energy*, 2016, **26**, 208–215.

[2]. T. Xu, Y. Han, L. Lin, J. Xu, Q. Fu, H. He, B. Song, Q. Gai and X. Wang, *J. Alloys Compd.*, 2019, **790**, 941–946.

[3]. D. Gu, X. Li, Y. Zhao and J. Wang, *Sens. Actuators, B*, 2017, **244**, 67–76.

[4]. H. Chen, X. Pu, M. Gu, J. Zhu and L. Cheng, *Ceram. Int.*, 2016, **42**, 17717–17722.