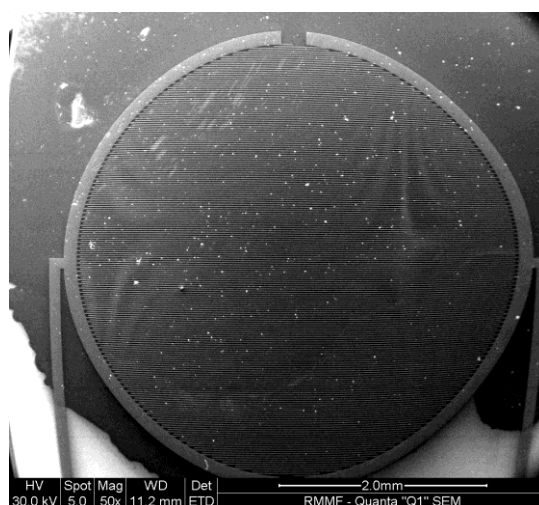
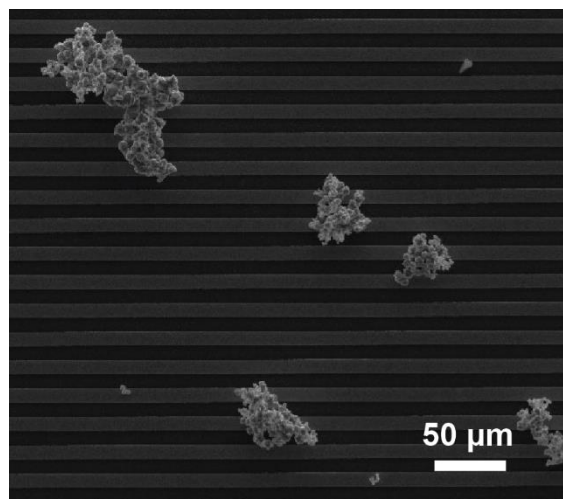


## Self-Assembly of Ultrathin Nickel Oxysulfide for Reversible Gas Sensing at Room Temperature

Nam Ha <sup>1</sup>, Kai Xu <sup>1\*</sup>, Yinfen Cheng <sup>2</sup>, Rui Ou <sup>1</sup>, Qijie Ma <sup>1</sup>, Yihong Hu <sup>1</sup>, Vien Trinh <sup>1</sup>, Guanghui Ren <sup>1</sup>, Hao Yu <sup>2</sup>, Lei Zhang <sup>3,4</sup>, Xiang Liu <sup>3,4</sup>, Jiaru Zhang <sup>1</sup>, Zhong Li <sup>2</sup> and Jian Zhen Ou <sup>1,2\*</sup>



**Figure S1.** SEM image of the overall nickel oxysulfide sensor.



**Figure S2.** SEM image for nickel sulfide particles upon a SiO<sub>2</sub> substrate.

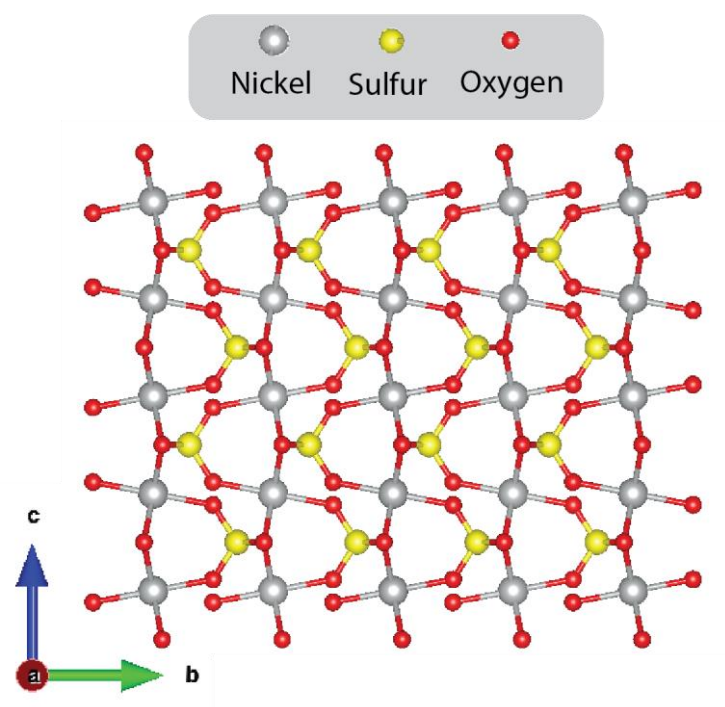


Figure S3. Theoretical crystal structure model of nickel oxysulfide ( $\text{NiSO}_4$ ).

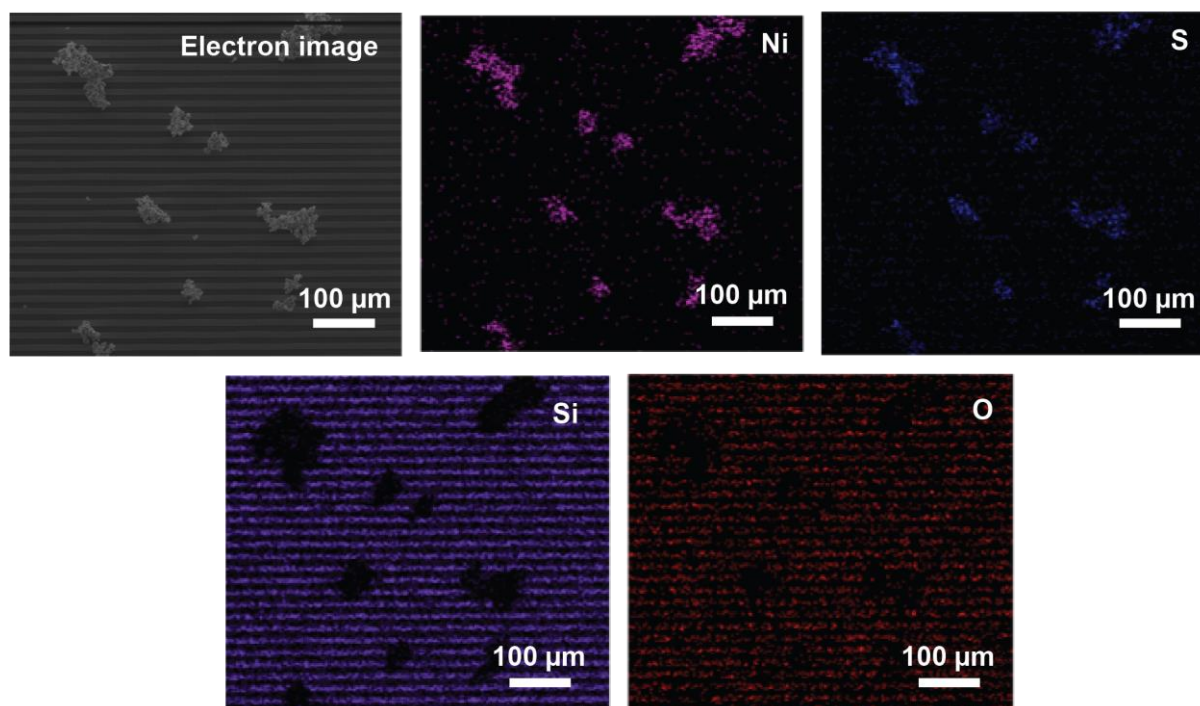
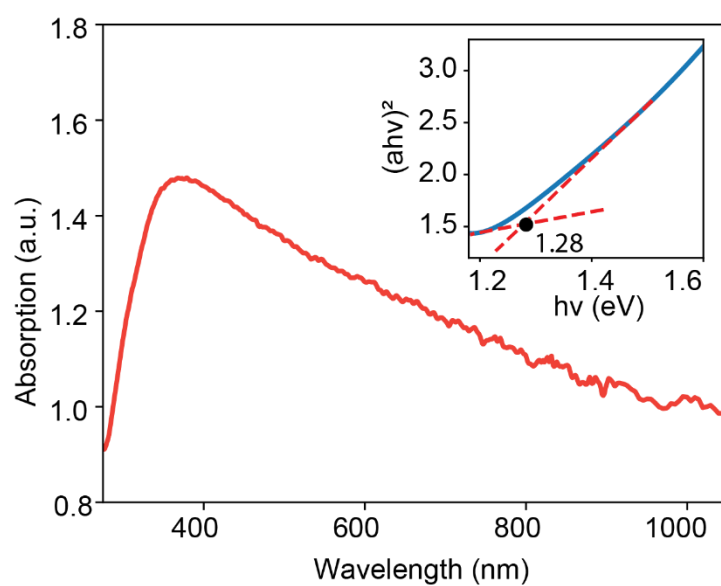
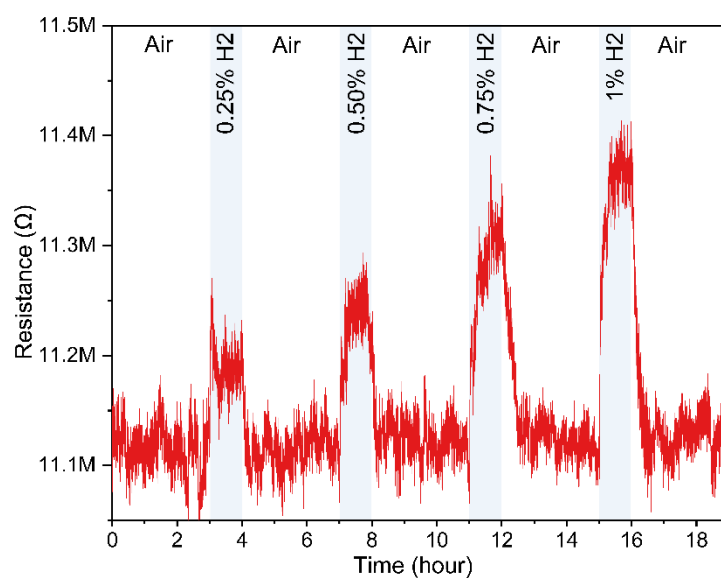


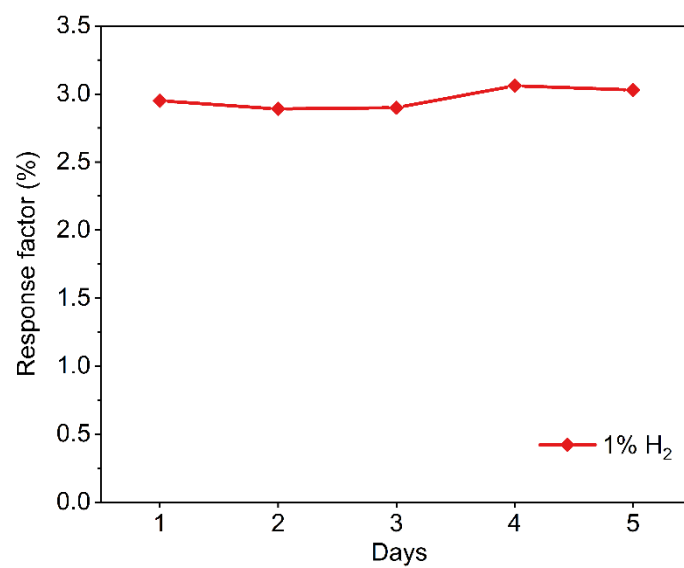
Figure S4. EDS measurement of the nickel sulfide particles upon a  $\text{SiO}_2$  substrate.



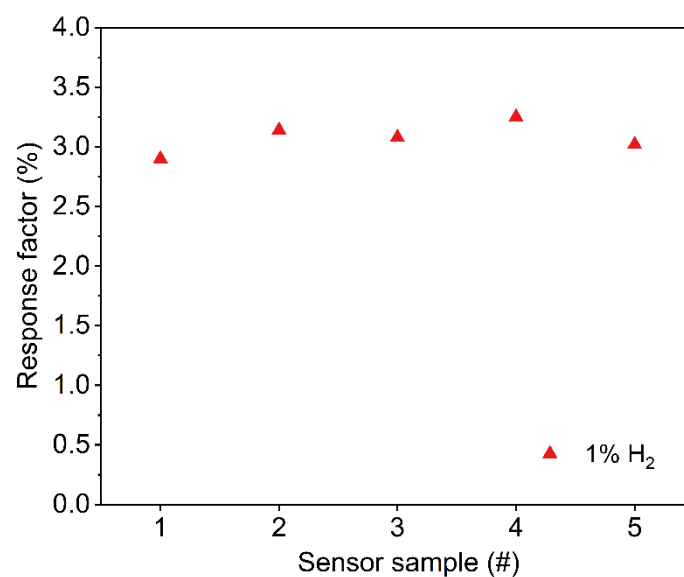
**Figure S5.** UV-Vis-NIR absorption spectra of NiS with the corresponding Tauc-plot shown in the inset.



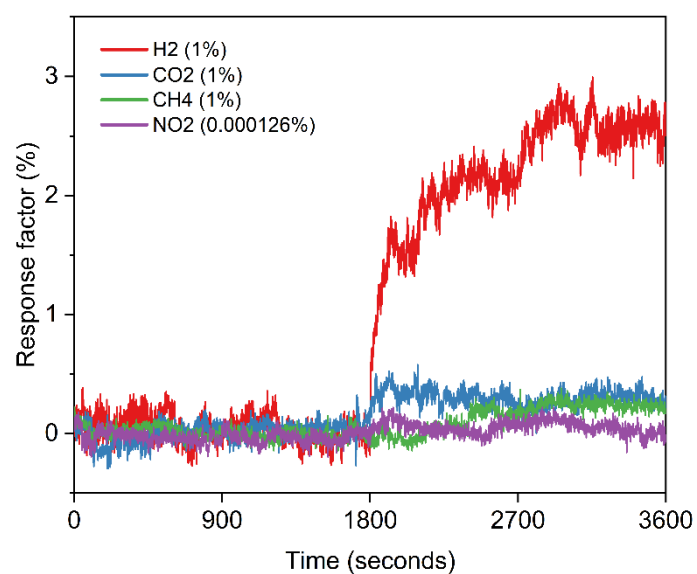
**Figure S6.** Nickel oxysulfide dynamic response in  $H_2$  (Resistance shown).



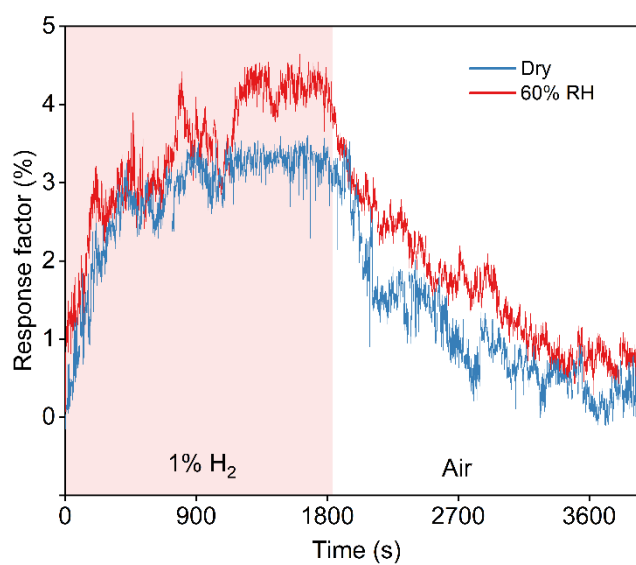
**Figure S7.** Nickel oxysulfide long-term stability results at 1% H<sub>2</sub> over 5 days.



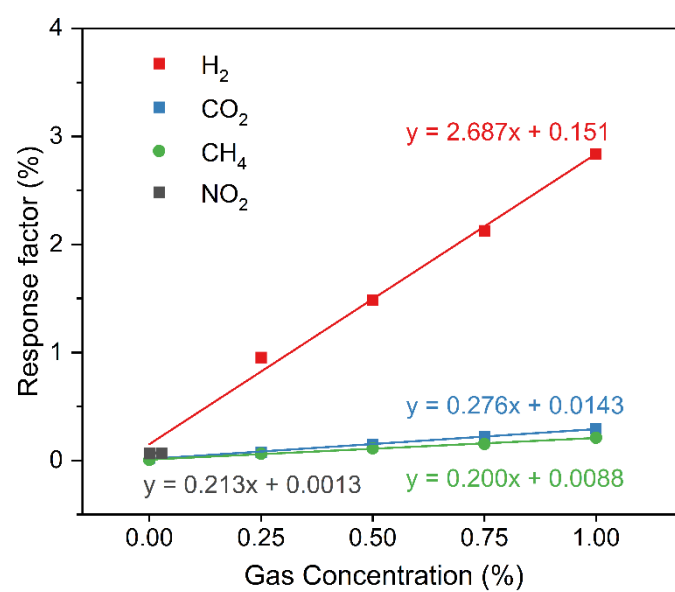
**Figure S8.** Reproducibility results at 1% H<sub>2</sub> in air where nickel oxysulfide is deposited on 5 unique sensor substrates.



**Figure S9.** Nickel oxysulfide selectivity response to 1% H<sub>2</sub>, 0.000126% NO<sub>2</sub>, 1% CH<sub>4</sub>, 1% and 1% CO<sub>2</sub>.



**Figure S10.** The response curve of nickel oxysulfide in 1% H<sub>2</sub> in dry air and 60% RH.



**Figure S11.** Nickel oxysulfide gas calibration curves for H<sub>2</sub>, CO<sub>2</sub>, CH<sub>4</sub> and NO<sub>2</sub>.