Electronic Supplementary Information

2D-MoO_3 nanosheets for superior gas sensors

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Sample sensor response images

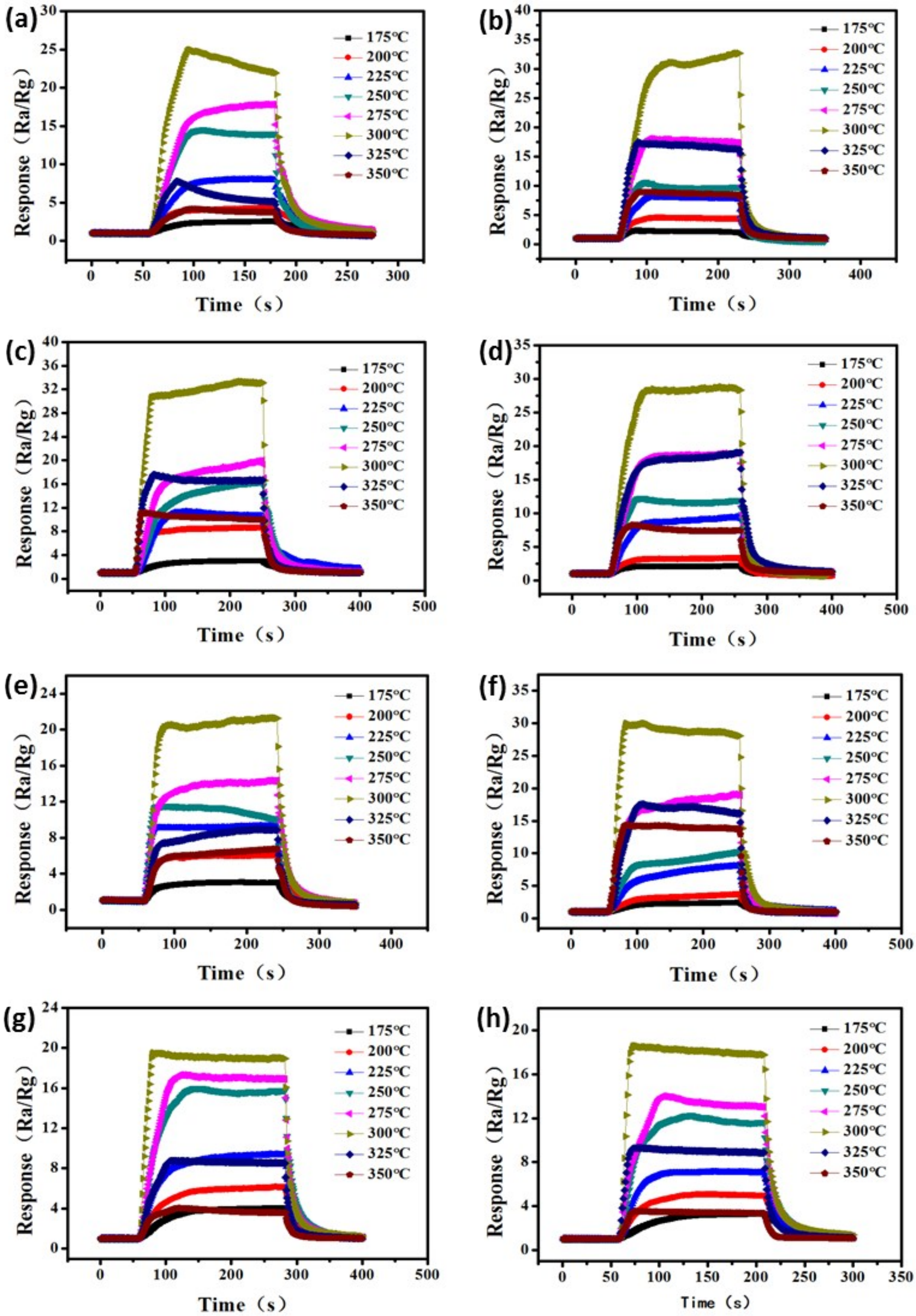

Fig. S1 Sensor response toward 100ppm alcohol vapor at different operating temperatures. The 2D-MoO_3 material was prepared using different solvents. (a), deionized water; (b), 25vol% ethanol/water mixture; (c), 50vol% ethanol/water mixture; (d), 75vol% ethanol/water mixture; (e), ethanol; (f), IPA; (g), DMF; (h), DMSO.

Hansen solubility parameters

It has been established in the field that the dispersion of nanomaterials can be partially predicted by the Hansen solubility parameters (HSP). There are three key HSP parameters used to describe the solvent: δD, δP, and δH, which describes the dispersive, polar, and hydrogen-bonding characteristics respectively. The HSP distance R_a is used to evaluate the level of adaptation [Eq. (1)].

$$R_a = [4(\delta_{D,solv} - \delta_{D,solu})^2 + (\delta_{P,solv} - \delta_{P,solu})^2 + (\delta_{H,solv} - \delta_{H,solu})^2]^{0.5} \quad \text{[Eq. (1)].}$$

The smaller the R_a value, the higher the expected solubility. If the HSP parameters of a nanomaterial are known, the R_a value can be used as a guide for finding a single efficient solvent for its dispersion. For solvent mixtures, the HSP theory can be expended using a linear combination technique for all above three parameters [Eq. (2)].

$$\delta_{blend} = \sum \emptyset_{n,comp}\delta_{n,comp} \quad \text{[Eq. (2)]}$$

where $\emptyset$ is the volume fraction for each composition.

Therefore, Equations (1) and (2) enable us to predict the solubility of different nanomaterials in various solvent mixtures, which effectively allows us to design ideal solvent systems.

Conditioning curve

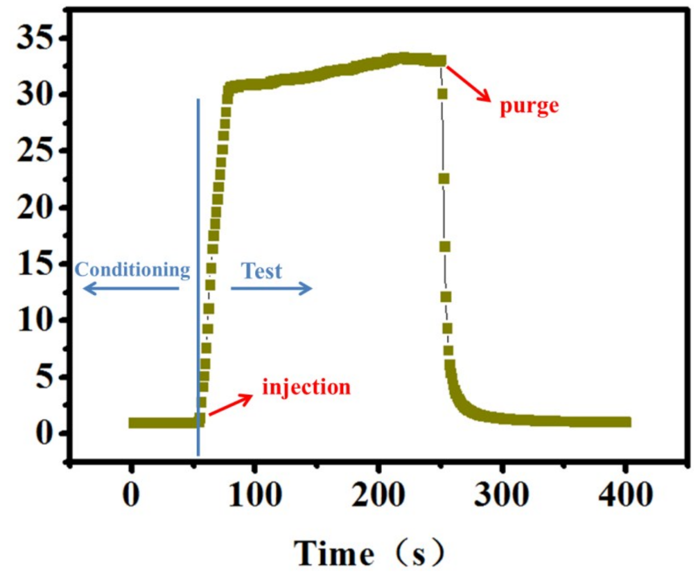

Fig. S2 The conditioning curve for the gas sensor test**.**

The stability test of gas sensor

For metal oxide material, the gas sensing performance is stable, and the sensing properties will have no too big change within three months. The following figures show the reproducibility of temporal response of 2D-MoO_3 exposed to 100 ppm alcohol vapor at 300℃. It is seen that the sensors maintain its initial response amplitude without a clear decrease upon successive sensing tests, indicating that 2D-MoO_3 possesses good repeatability.

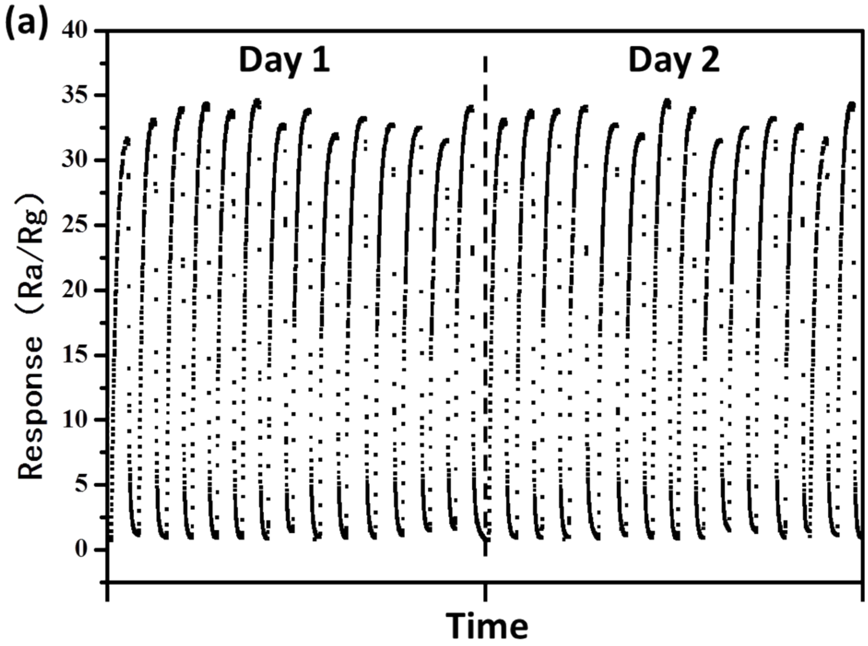

Fig. S3(a) Sensor response as a function of test time for two days, with 14 cycles tested for each day.

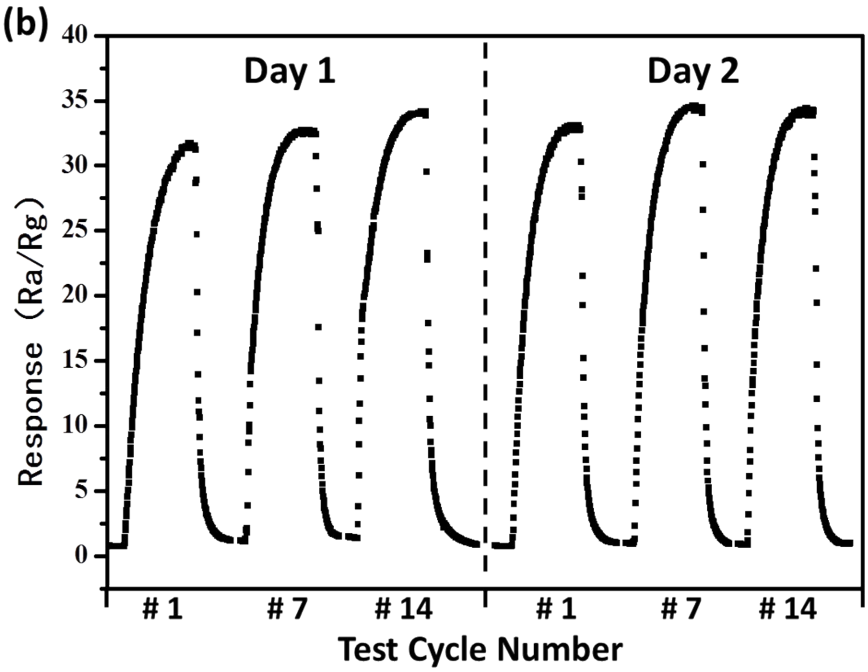

Fig. S3(b) Sensor response as a function of test time for two days. Only 3 typical cycles shown for each day.

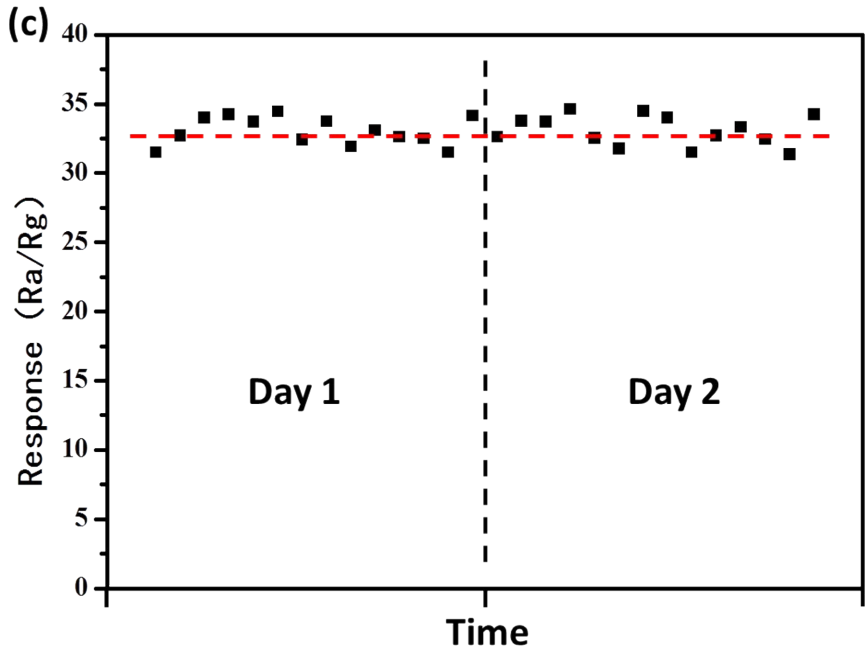

Fig. S3(c) Sensor response value as a function of test cycles for two days, with 14 cycles tested for each day.

SEM images

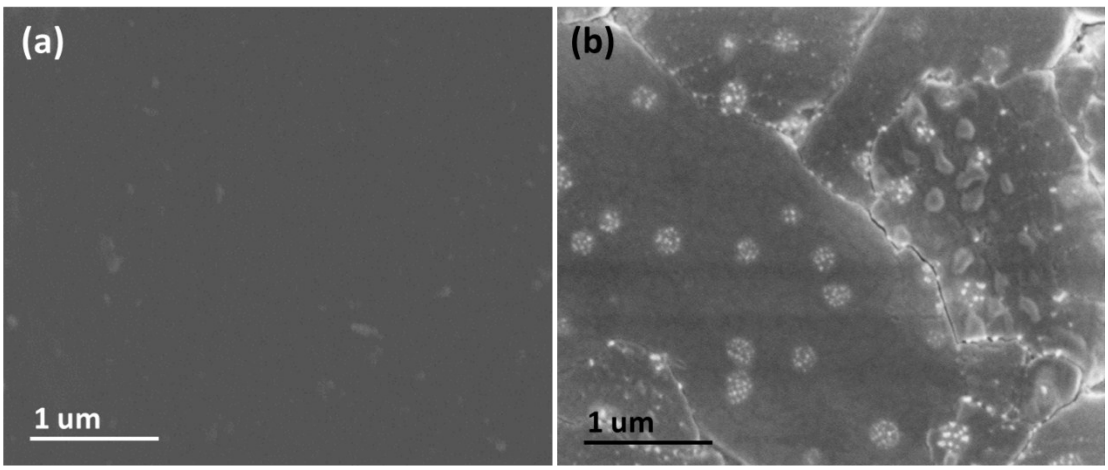

Fig.S4 SEMs before(a) and after(b) gas sensing experiments.

Table S1 The saturated concentration of MoO_3 nanosheets in different solvents.

Solvent	deionized water	25% ethanol	50% ethanol	75% ethanol	ethanol	IPA	DMSO	DMF
Concentration (mg/ml)	0.022	0.139	0.182	0.104	0.034	0.08	0.118	0.098

Table S2 The specific response data of MoO_3 nanosheets in different solvents.

Temperature/℃	175	200	225	250	275	300	325	350
Bulk MoO_3	1.3	1.8	2.8	3.9	4.7	8.0	7.0	5.4
deionized water	2.6	4.3	8.0	14.0	17.8	22.0	5.1	3.7
25% ethanol	2.0	4.4	7.7	9.8	17.3	31.5	16.2	8.4
50% ethanol	3.1	8.7	10.6	16.5	20.0	33.1	16.7	9.9
75% ethanol	2.2	3.3	9.4	12.0	19.0	28.3	19.1	7.4
ethanol	3.1	6.1	9.3	10.0	14.3	21.3	8.9	6.8
IPA	2.5	3.7	8.0	10.3	19.1	28.1	16.1	13.7
DMSO	4.1	6.2	9.1	15.8	16.9	18.9	8.5	3.6
DMF	3.3	4.9	7.0	11.6	13.0	17.8	8.8	3.3

Table S3 The sensor response time and recovery time of MoO_3 nanosheets tested at the optimum working temperature (300℃).

	Bulk MoO_3	deionized water	25% ethanol	50% ethanol	75% ethanol	ethanol	IPA	DMSO	DMF
Response time/s	27	25	25	21	24	22	23	23	21
Recovery time/s	26	16	11	10	14	11	13	21	17