Electronic Supplementary Information

Enhanced room-temperature ethanol sensing performance of porous $MoO_3/V_{0.13}Mo_{0.87}O_{2.935}$ heterostructures self-assembled with 2D nanosheets

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Materials

Ammonium molybdate tetrahydrate ($(NH_4)_6Mo_7O_{24}\cdot 4H_2O$, AR, Aladdin Reagent Company)，ammonium metavanadate (NH_4VO_3, AR, Tianjin Guangfu Fine Chemical Research Institute), ethanol (CH_3CH_2OH, AR, Tianjin Chemical Reagent Institute), and ethanolamine (C_2H_7NO, AR, Sinopharm Chemical Reagent Company) were reagent grade without further purification.

Characterization

Crystalline structures of various samples were measured by an X-ray diffractometer (XRD, D8-ADVANCE of Bruker Corporation, Cu Ka radiation source of λ = 1.54186 A) in the 2θ range of 15 to 80°. The morphologies of different samples were tested by the field-emission scanning electron microscope (FESEM, QUANTA 260 FEG, FEI, U.S.A.) and transmission electron microscopy (TEM/HRTEM, Tecnai F20, FEI). Surface chemical analysis can be investigated by the X-ray photoelectron spectroscopy (XPS, ESCALAB 260). Raman spectra were conducted by the high-resolution Raman spectrometer (LabRAM HR Evolution，HORIBA JOBIN YVON SAS). UV-vis diffuse reflectance spectra were obtained in UV-vis spectrometer (Hitachi U-4100). The specific surface area and pore size distribution were acquired by the multifunction adsorption instrument (MFA-140, Builder Company, Beijing).

Gas-sensing measurement

CGS-4TPs (Beijing Elite Tech Co., Ltd.) was employed for estimating the gas-sensing performances of different samples. The as-prepared powders were mixed with the deionized water to form a paste, which was coated on the Ag-Pd interdigital electrodes. The sensor was kept drying at room temperature for 12 h to improve the stability. Gas response was defined as |Ra-Rg|/Ra × 100 %, where Ra and Rg are measured as the resistance of sensors in air and in target gas, respectively.

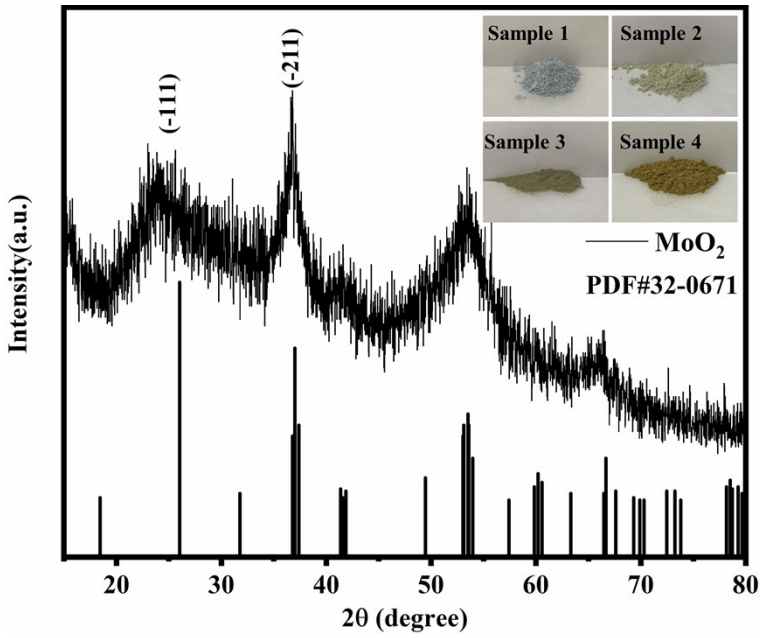

Fig. S1. XRD pattern of MoO_2 precursors.

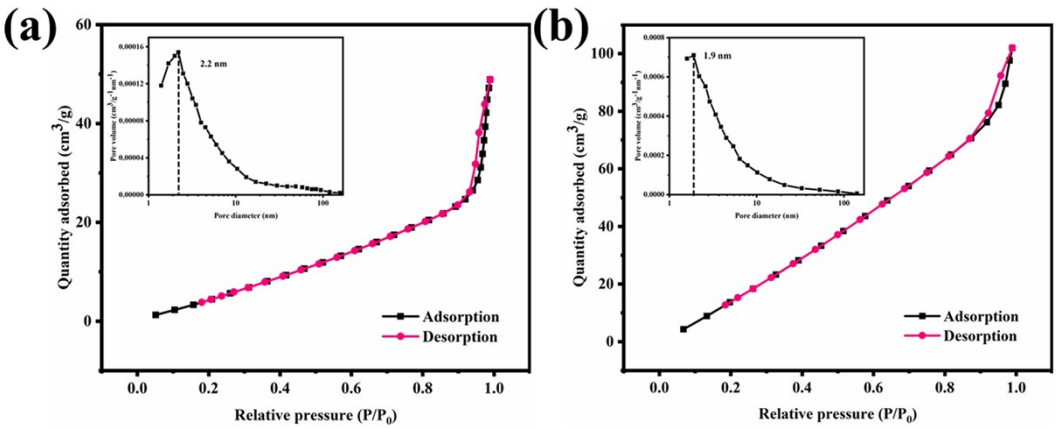

Fig. S2. Nitrogen adsorption/desorption isotherms and the inset pore size distributions of (a) Sample 1 and (b) Sample 3.

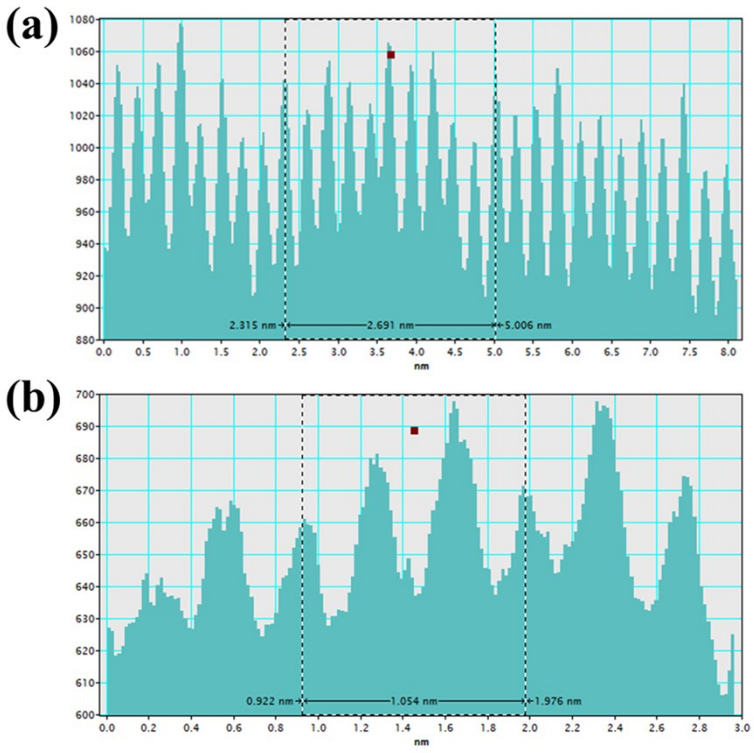

Fig. S3. The lattice spacings of (a) MoO_3 (101) and (b) $V_{0.13}Mo_{0.87}O_{2.935}$ (210) in Sample 3.

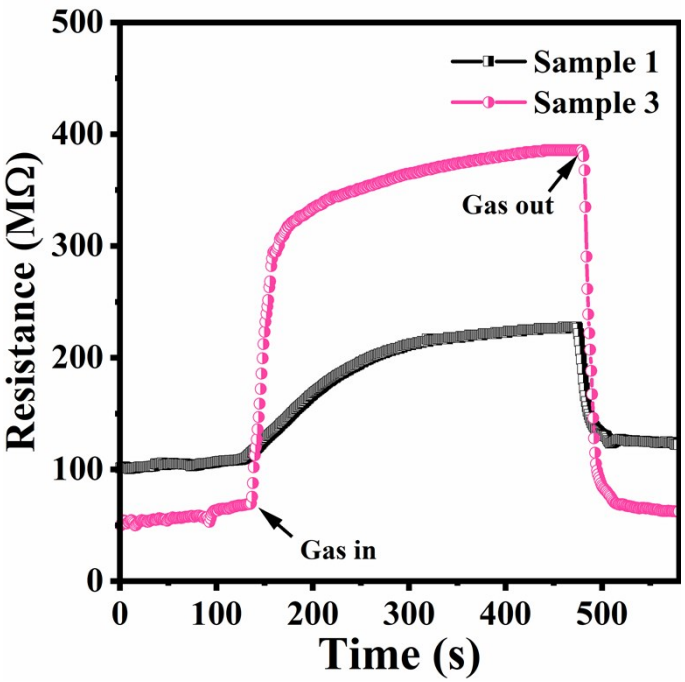

Fig. S4. The resistance variation of Sample 1 and 3 to 100 ppm ethanol at different operating temperatures

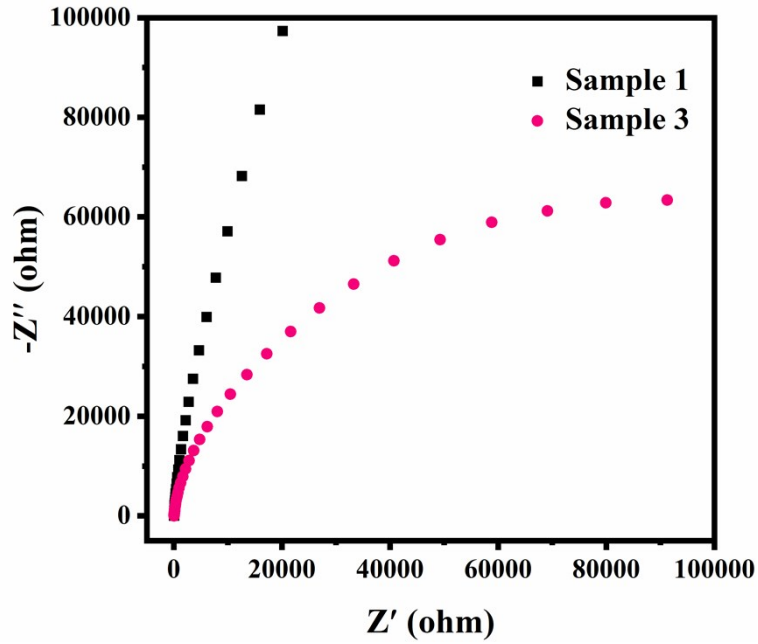

Fig. S5. Electrochemical impedance spectroscopy of Sample 1 and 3.

Table S1 Comparison of ethanol sensing characteristics of MoO_3-based sensors.

Samples	Concentration (ppm)	Temperature (℃)	Response	Response/recovery time (s)	References
MoO_3 microboxes	100	260	78	15/5 s	S1
C/A-C/S MoO_3 nanorods	500	180	56	-/-	S2
α-MoO_3/ZnO nanobelts	100	250	19	2.5/5 s	S3
Zn doped MoO_3 nanobelts	5	240	2.4	46/76 s	S4
MoO_3-rGO nanoflakes	100	310	53	6/54 s	S5
MoO_3/In_2O_3 nanoflowers	100	185	7	11/94 s	S6
MoO_3/$V_{0.13}Mo_{0.87}O_{2.935}$ microspheres	100	30	480 %	124.8/17.6 s	This work

References

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