

## Supplementary Information

### Hysteresis in the Transfer Characteristics of MoS<sub>2</sub> Field Effect Transistor: Gas, Temperature and Photo Irradiation Effect

*Muhammad Shamim Al Mamun, \*<sup>1,4</sup> Yasuyuki Sainoo,<sup>2</sup> Tsuyoshi Takaoka,<sup>2</sup> Atsushi Ando,<sup>3</sup> Tadahiro Komeda<sup>2</sup>*

<sup>1</sup> Department of Chemistry, Graduate School of Science, Tohoku University, Aramaki-Aza-Aoba, Aoba-Ku, Sendai 9808578, Japan

<sup>2</sup> Institute of Multidisciplinary Research for Advanced Materials (IMRAM, Tagen), Tohoku University, 2-1-1, Katahira, Aoba-Ku, Sendai 9800877, Japan

<sup>3</sup> National Institute of Advanced Industrial Science and Technology, 1-1-1 Umezono, Tsukuba, Ibaraki 305-8568, Japan

<sup>4</sup> Chemistry Discipline, Khulna University, Khulna, 9208, Bangladesh

Email: s.mamun@chem.ku.ac.bd

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## 1. Threshold Voltage Determination

From the  $I_d$ - $V_g$  plot we obtain a characteristics  $I_d$  which varies linearly with the  $V_g$  for a fixed  $V_d$ . The  $I_d$ - $V_g$  behavior in the linear regime is extrapolated to zero  $I_d$  and abscissa we obtain is a good evaluation of the threshold voltage ( $V_{th}$ ).<sup>1-3</sup>

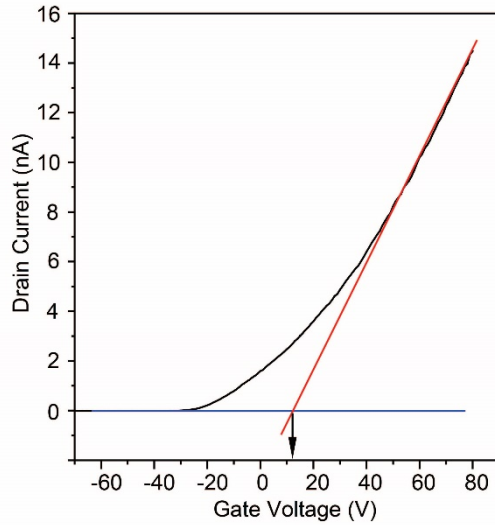


Figure. S1. Threshold voltage determination method for the pristine device.

## 2. Depiction of UHV system

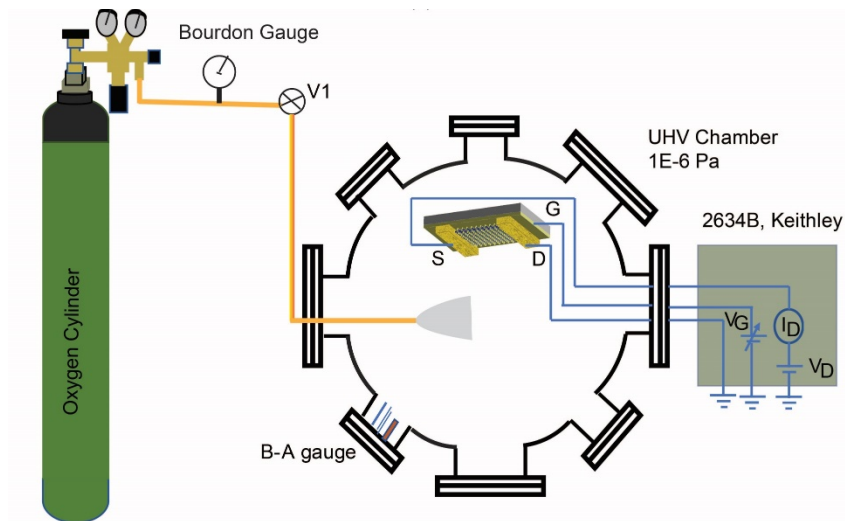


Figure. S2. UHV system connected with external gas source.

### 3. AMF height profile of MoS<sub>2</sub>-FET device

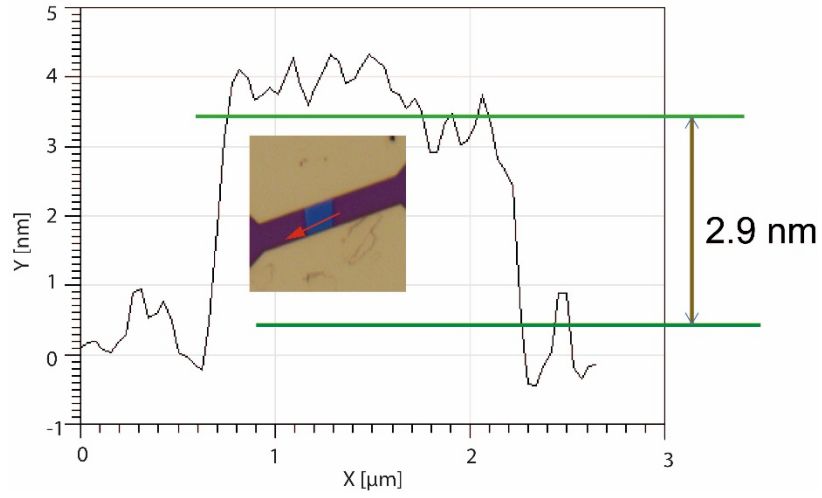


Figure. S3. AFM height profile for MoS<sub>2</sub>-FET device.

### 4. Gate voltage inversion

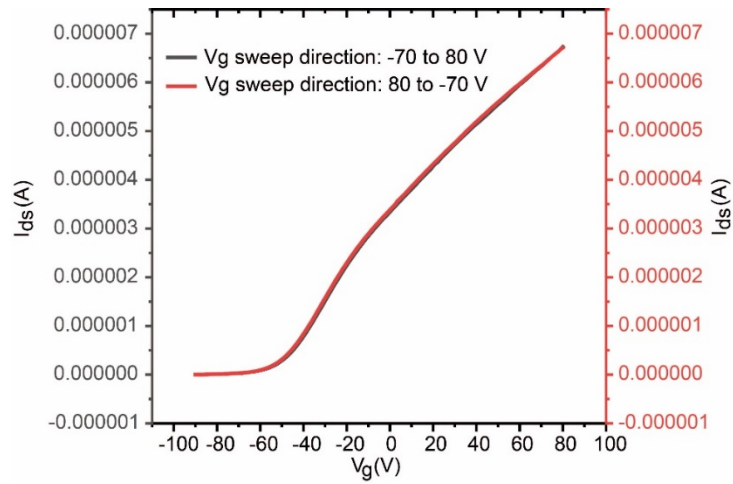


Figure. S4. Alternation of gate voltage ( $V_g$ ) sweeping direction.

## 5. Data reproducibility from two different MoS<sub>2</sub>-FETs.

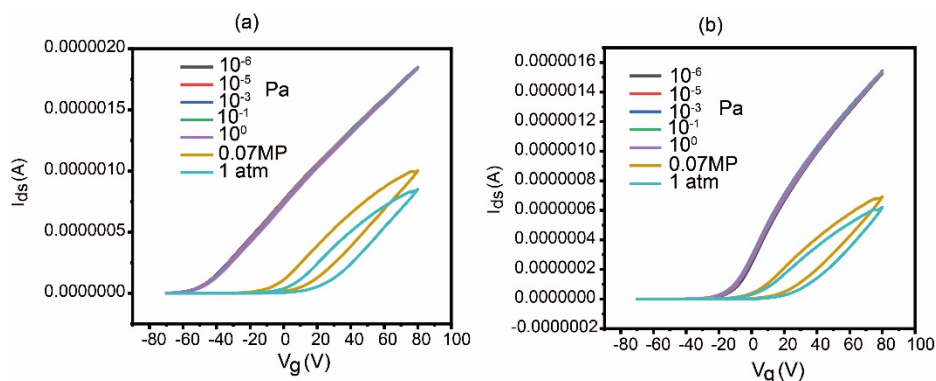


Figure. S5. Reproducibility of hysteresis behavior with two different devices (a) device-1. (b) device-2.

## References

1. Al Mamun, M. S.; Waizumi, H.; Takaoka, T.; Wang, Z.; Ando, A.; Komeda, T., In-situ methyl red doped MoS<sub>2</sub> field effect transistor made by atomically thin MoS<sub>2</sub> channel. *Organic Electronics* **2024**, *126*, 106989.
2. Mamun, M. S. A.; Sainoo, Y.; Takaoka, T.; Waizumi, H.; Wang, Z.; Alam, M. I.; Ando, A.; Arafune, R.; Komeda, T., Chemistry of the photoisomerization and thermal reset of nitro-spiropyran and merocyanine molecules on the channel of the MoS<sub>2</sub> field effect transistor. *Physical Chemistry Chemical Physics* **2021**, *23* (48), 27273-27281.
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