

## Enhanced Chemical Vapor Sensing with MoS<sub>2</sub> Using 1T/2H Phase Contacts/Channel

Paul M. Campbell<sup>1</sup>, Adam L. Friedman<sup>2</sup>, F. Keith Perkins<sup>1</sup>, James C. Culbertson<sup>1</sup> and Aubrey T. Hanbicki<sup>2</sup>

<sup>1</sup>Electronics Science and Technology Division, Naval Research Laboratory, 4555 Overlook Ave., S.W., Washington, DC, USA 20375

<sup>2</sup>Materials Science and Technology Division, Naval Research Laboratory, 4555 Overlook Ave., S.W., Washington, DC, USA 20375

[Paul.Campbell@NRL.Navy.mil](mailto:Paul.Campbell@NRL.Navy.mil)

**Abstract** Transition metal dichalcogenides show remarkable potential for use in chemical vapor sensor devices. They are inexpensive, inherently flexible, low-power, can be grown in large areas, and have shown high sensitivity and selectivity to electron donor analyte molecules important for explosives and nerve gas detection. However, for most devices the conductance response is dominated by Schottky contacts, to the detriment of the sensitivity and obscuring the intrinsic sensing capability of the devices. We use contact engineering to transition the contacts in a MoS<sub>2</sub> FET-based chemical vapor sensor to the 1T conducting phase, leaving the channel in the 2H semiconducting state, thus providing functional Ohmic contacts to the device. We show that the resultant sensors have greatly improved electrical characteristics, are more selective, and recover fully after chemical vapor exposure—all major improvements to previous MoS<sub>2</sub> sensor devices. We identify labile nitrogen-containing electron donors as the primary species that generate a response in MoS<sub>2</sub>, and we study the dynamics of the sensing reactions identifying two possible models for the chemical sensing reaction.

Keywords: MoS<sub>2</sub>, transition metal dichalcogenides, 2-D materials, chemical vapor sensing, phase transitions.

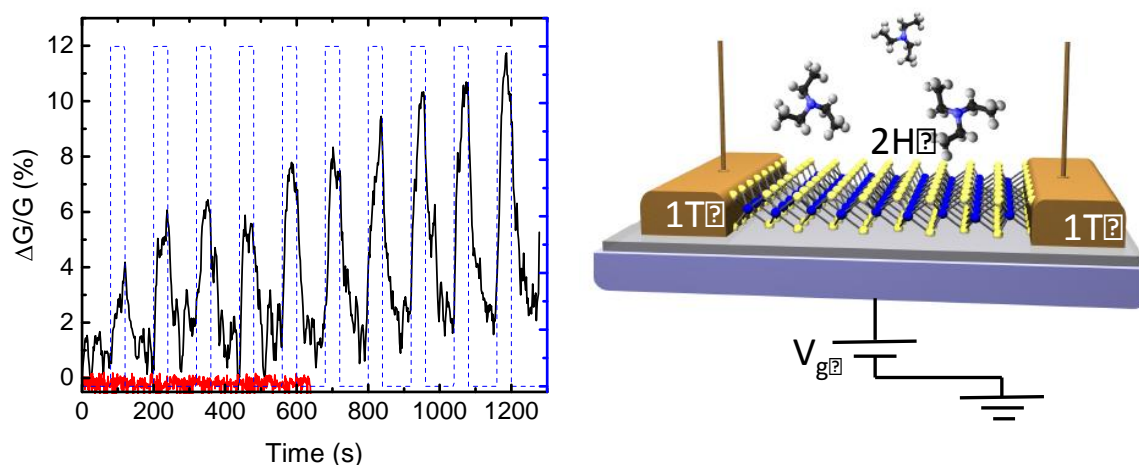
### References

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### Figure



Left: Conductance response of a 1T/2H contact/channel device to a series to 10 pulses of 30 ppm trimethylamine at  $V_g=0$ . The red line is the response to nitrogen only, giving the expected null response. Right: Device sensing schematic.