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## Synthesis of 2D MoS<sub>2</sub> for flexible gas sensor at low temperature

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The effective synthesis two-dimensional molybdenum disulfides (2D MoS<sub>2</sub>) at low temperature is essential for their use in flexible devices. In this work, 2D MoS<sub>2</sub> was grown directly at a low-temperature of 200 °C on both hard substrates (SiO<sub>2</sub>) and soft substrates (PI) using chemical vapor deposition (CVD) with Mo(CO)<sub>6</sub> and H<sub>2</sub>S. We investigated the effect of the growth temperature and Mo concentration on layered growth by Raman spectroscopy and microscopy. The optical microscopy, Raman spectroscopy, X-ray photoemission spectroscopy, photoluminescence, and transmission electron microscopy measurements indicate that the low temperature CVD MoS<sub>2</sub> is layered structure with good uniformity, stoichiometry and controlled layer number. Furthermore, we demonstrated the realization of 2D MoS<sub>2</sub> based flexible gas sensor on PI substrate without any transfer process, and the sensor shows competitive sensor performance and mechanical durability at room temperature.

This study develops a low-temperature method for the deposition of MoS<sub>2</sub> on substrate with low plastic deformation temperatures and to characterize the gas sensing properties of the prepared materials. The utility of the prepared material for sensing NO<sub>2</sub> and NH<sub>3</sub> over a wide range of concentrations. The strategies presented herein will be useful in the future development of flexible sensors.

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