Area-Selective Deposition of 2D-MoS_2 using Self-Assembled Monolayer

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Layered two-dimensional molybdenum sulfide (MoS_2) has attracted great interest for a promising candidate material for opto-electronics and photo sensors applications due to its unique characteristics such as tunable bandgap, high electron mobility and high current on/off ratio. Significant efforts have been placed to apply MoS_2 in industrial fields, leading to significant progress in the deposition method of MoS_2.[1],[2] However, patterning technology for MoS_2 remains a challenge. In particular, 2D materials like MoS_2 have extremely thin and weak interlayer bonding due to the absence of dangling bonds, making it difficult to apply traditional top-down patterning approach. Therefore, we demonstrated a new area-selective deposition method for MoS_2 using self-assembled monolayer (SAM). To prevent the degradation of SAM, the deposition of MoS_2 was carried out using a pulsed metal-organic chemical vapor deposition (MOCVD) method, which allowed for the synthesis of high-quality MoS_2 at a low temperature. The growth of MoS_2 was effectively prevented by the SAM patterned using photolithography processes. The selectivity for MoS_2 according to the length of the SAM backbone was investigated using X-ray Fluorescence spectroscopy and Raman measurement. Additionally, the influence of the SAM coating process on the crystallinity and impurity concentration of the MoS_2 film was confirmed using X-ray diffraction and X-ray photoelectron spectroscopy. Furthermore, the potential of area-selective deposition of MoS_2 using SAM was demonstrated by fabricating a MoS_2 gas sensor.

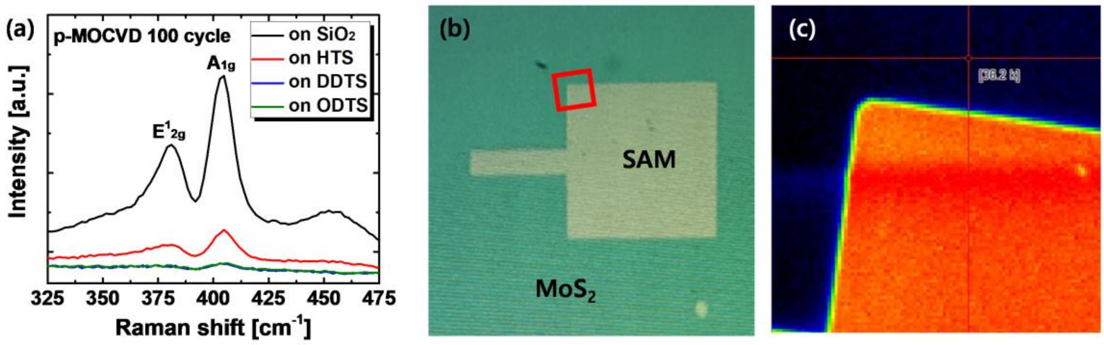

Fig1. (a) Raman spectra of MoS_2 thin films deposited on bare SiO_2 and on SAM coated area. (b) The optical microscope image of MoS_2 patterned using SAM. (c) Raman mapping image of area indicated by the red rectangle in (b).

References [1] Hyun, Cheol-Min, et al. *Journal of Alloys and Compounds*, 2018, 765: 380-384.

[2] Kang, Kibum, et al. *Nature*, 2015, 520.7549: 656-660.