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Synthesis of large-scale MoS₂ films using gas phase precursor

JINHWAN LEE, Department of Mechanical Engineering, Sungkyunkwan Univ., YOUNGBIN LEE, JEONG HO CHO, SKKU Advanced Institute of Nanotechnology (SAINT) and Center for Human interface Nano, JONG-HYUN AHN, School of Electrical and Electronic Engineering, Yonsei Univ., CHANGGU LEE, SKKU Advanced Institute of Nanotechnology (SAINT) and Center for Human interface Nano, and Department of Mechanical Engineering, Sungkyunkwan Univ. — We present layer-controlled synthesis of large-scale and uniform molybdenum disulfide films on insulating substrates. For the synthesis, we used gas phase sulfuric precursor and molybdenum metal source. By controlling the deposition thickness of the metal, we could vary the synthesized film thickness in the precision of number of layers. From the synthesis, 2, 4, 8, 12 layers were grown on 2-in scale Si/SiO₂ and quartz substrates up to 8 cm with almost perfect uniformity over the entire area. Also on one substrate, films with different thicknesses were grown in separate areas with layer (or atomic)-level uniformity. AFM, TEM, XPS, and optical spectroscopy characterizations show that the films have high crystalline quality without a sign of amorphous phase. The films synthesized on quartz substrate were transparent and the transparency depended linearly on the film thickness. We also fabricated arrays of field effect transistor device for electrical characterization. 90% among the devices operated with functionality and the measured mobility was on the level of 0.1 cm²/Vs and on/off ratio was 10⁵.

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