Synthesis of centimeter-scale TMDs film with a high substrate throughput

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Abstract

Transition metal dichalcogenides (TMDs) such as MoS₂ and WS₂ provide an indirect-to-direct bandgap transition when going from bulk to monolayer form. Technological applications exploiting TMDs optoelectronic properties need synthesis methodologies able to deposit TMDs as a few layer continuous film with homogeneous thickness due to their strong thickness/band structure correlation. Currently, TMDs film are typically deposited by two-step growth based on the physical deposition of the metal oxide (WO₃, MoO₃, etc) and the subsequent thermal treatment with sulfur or selenium. Although these two-step approach can lead to high quality TMDs crystals, the growth of continuous few-layer film with controlled thickness results challenging. We propose a one-step growth methodology for the deposition of WS₂ and MoS₂ that exploits volatile metal precursors for the deposition of few layer continuous films on the centimetre scale on several substrates also including graphene. A full optical (Raman, Photoluminescence, ellipsometry), structural (FE-SEM), and electrical characterization (mobility, transport gap) of the deposited TMDs film is provided.

References


Figure 1: Raman spectrum of MoS₂ on Si/SiO₂ substrate

Figure 2: Schematic illustration of the CVD system used for the growth of WS₂ and MoS₂ films

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