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

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Abstract

Transition metal dichalcogenides (TMDs) such as MoS_2 and WS_2 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 (WO_3, MoO_3, 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 WS_2 and MoS_2 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

[1] G. V. Bianco, M. Losurdo, M. M. Giangregorio, A. Sacchetti, P. Prete,N. Lovergine, P. Capezzuto G. Bruno, RSC Adv., 5 (2015), 98700.

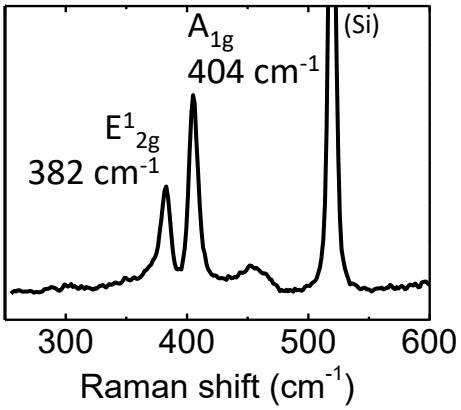

Figure 1: Raman spectrum of MoS_2 on SI/SiO_2 substrate

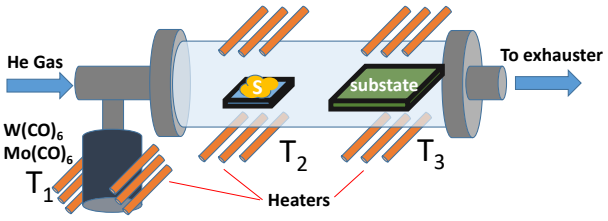

Figure 2: Schematic illustration of the CVD system used for the growth of WS_2 and MoS_2 films

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