CVD Growth of WS_2 and MoS_2 Centimenter Scale Films

Giuseppe Valerio Bianco[1]
Marco Grande[1,2], Alberto Sacchetti[1], Giovanni Pace[1], Pio Capezzuto[1], Giovanni Bruno[1]

[1]Istituto di Nanotecnologia–CNR-NANOTEC, Via Orabona, 4, 70125 - Bari, Italy;
[2]Dipartimento di Ingegneria Elettrica e dell'Informazione, Politecnico di Bari, Via Re David 200, 70125 - Bari, Italy.
giuseppevalerio.bianco@cnr.itl

Abstract

Technological applications exploiting optoelectronic properties of Transition Metal Dichalcogenides, TMDs, (e.g., WS_2 and MoS_2) need synthesis methodologies able to deposit TMDs as a few layer continuous film with homogeneous thickness. Specifically, the thickness control is needed due to the strong thickness/band structure correlation in TMDs that provides an indirect-to-direct bandgap transition when going from bulk to monolayer form. Currently, WS_2 and MoS_2 films are typically deposited by two-step growth based on the physical deposition of the metal oxide (i. e, WO_3 and MoO_3) and the subsequent thermal treatment with sulfur. Although the two-step approach can lead to high quality TMDs crystals, the growth of continuous films 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 centimeter scale with a high substrate throughput. A full optical (Raman, Photoluminescence, ellipsometry), structural (FE-SEM), and electrical characterization (mobility, transport gap) of the deposited TMDs film is provided. The effect of post-growth chemical treatment on the physical properties of WS_2 and MoS_2 films is also presented.

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.

Figures

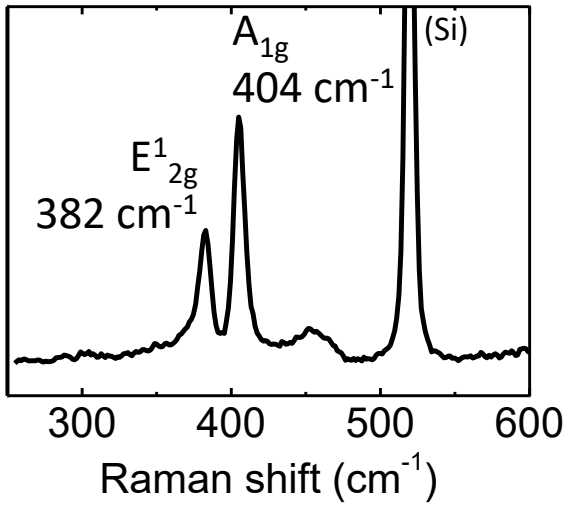

Figure 1. Raman spectrum of MoS_2 on Si/SiO_2 substrate

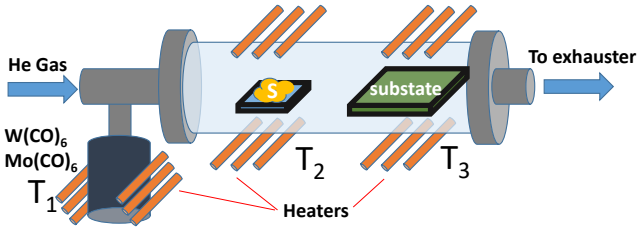

Figure 2. Schematic illustration of the CVD system used for the growth of WS_2 and MoS_2 films [1].