Raman Characterisation of layered MoS_2 produced by a non-Catalytic CVD method

A. Michail[1], K. Papagelis[1,2], C. Galiotis[1,2] and J. Parthenios[*1]

[1]*Foundation for Research and Technology Hellas, Institute of Chemical Engineering Sciences P.O. Box 1414 GR-26504 Patras (Greece)*
[2]*Department of Materials Science University of Patras, GR-26504 Patras (Greece)*

Molybdenum disulphide (MoS_2) is a layered semiconductor which exhibits an indirect (1.2eV) to direct (1.8eV) bandgap transition with decreasing number of layers. This makes MoS_2 a promising candidate to override graphene in some applications due to the absence of a bandgap of the former material. A non-catalytic CVD synthesis method to fabricate MoS_2 crystals on Si/SiO_2 substrate is presented. MoS_2 is produced by sulphurisation of MoO_3 in a quartz tube furnace under N_2 flow. The main aim is to refine the growth parameters (temprature, pressure, gas flow rate) in order to produce two-dimensional MoS_2 crystals with qualities comparable to their exfoliated counterparts. Preliminary results show that triangular crystallites of about 10 to 30 microns in lateral dimensions can be produced. The synthesized crystals are comprised of areas with different number of layers (monolayer to bulk) as it is evident from the Raman and Photoluminescence (PL) maps (fig.1c, d). The frequency difference value, $\Delta\omega$, of the A_{1g} and E_{2g} Raman modes of MoS_2 (fig. 1b) is indicative of the number of layers [1]. Additionally, the PL intensity increases dramatically by decreasing the layer number (fig. 1d), signifying the indirect to direct bandgap transition. Finally, CVD grown MoS_2 is compared with the one produced by micromechanical exfoliation.

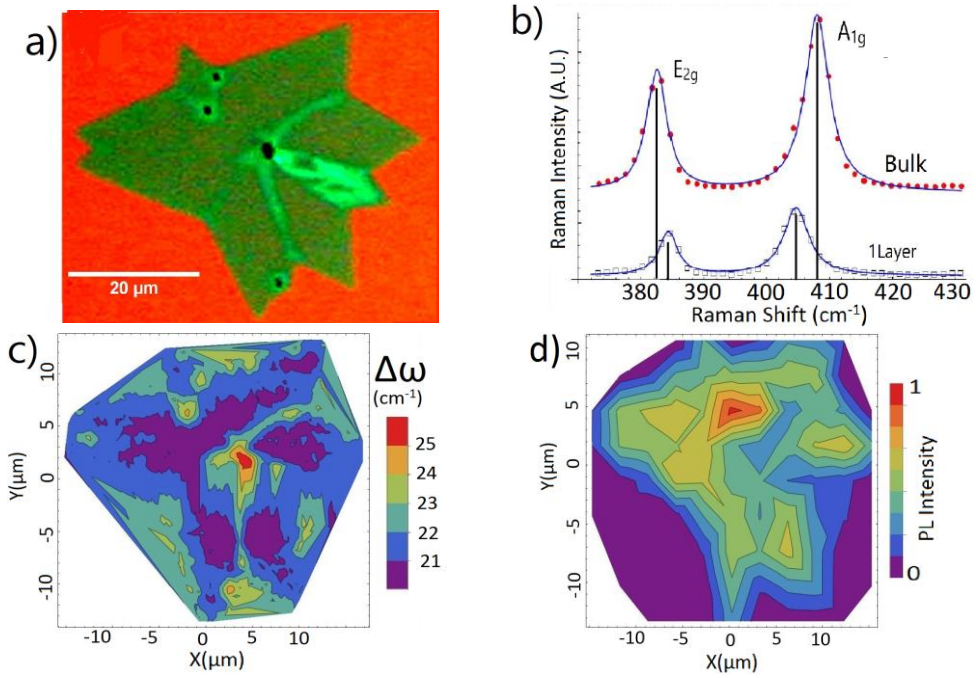

Figure 1: a) Optical image of MoS_2 crystallite, b) Raman spectra of bulk and monolayer MoS_2 where the difference $\Delta\omega$ is evident, c) $\Delta\omega$ and d) photoluminescence map of the crystallite shown in (a).

References

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[*] jparthen@iceht.forth.gr