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2D MoS_2 and heterostructures: Processing by CVD and ALE and Raman spectroscopy based quality control

Vapour deposition techniques have gained a lot of interest for growth of two dimensional (2D) materials[1-4]. In the recent past there has been a surge in the number of researchers studying atomic planes of other Van der Waals solids and heterostructures created by stacking layers with complementary characteristics to achieve novel functionality [5]. For successful scaling up of prototypical applications demonstrated to date, technologies and processes for large area deposition of these materials need to be developed. Here we present the technology employed and study of the impact of process parameters on a chemical vapour deposition (CVD) process for the production of single-layer MoS_2 using a gas-phase S precursor (H_2S) and solid Mo precursor ($MoCl_5$). Strategies for optimising crystalline quality via direct control of deposition variables and the impact of process parameters on defect density is analysed qualitatively using Raman spectroscopy [6] (Figure 1a). We build on this technique by demonstrating large area Graphene/MoS2 vertical heterostructures (figure 1b). Finally, we apply this technique towards the characterization of atomic scale etching of layered bulk MoS_2 for controlled thinning of Van der Waals structures without causing structural damage (Figure 1c).

References

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Figures

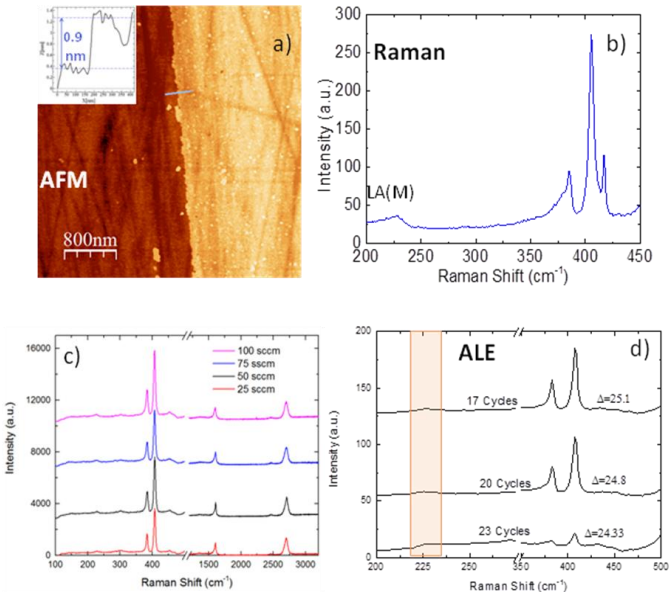

Figure 1: (a) AFM image (b) Raman Spectrum of CVD deposited MoS_2, (c) Raman spectra of graphene-MoS_2 heterostructures deposited under different process conditions, (d) Atomic layer etching of multilayer MoS_2 showing defect free layer by layer removal using remote plasma etch process.