Substrate-induced variances in morphological properties of MoS_2 grown by CVD

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MoS_2 has been intensively researched for the last years [1]. CVD growth of this material, however, is still not fully studied and understood. For example, the potential of graphene as an industrial-scale growth platform for all-CVD MoS_2 heterostructures has yet to be unveiled [2]. In this work, we show the growth of MoS_2 on both SiO_2 and epitaxial graphene and indicate the differences between the morphological properties of the as-grown layers. Specifically, we observed that by modifying the growth condition we are able to achieve different shapes of MoS_2 crystals on SiO_2, however, the MoS_2 growth on graphene is extraordinarily stable and only triangles have been produced. Moreover, we present two methods of increasing the MoS_2 grains size, namely KCl-assisted and a novel Mo-assisted. Due to these modifications, we have obtained the largest reported MoS_2 grains on graphene, that is over 1 µm (Fig. 1). In addition, also a continuous layer over hundreds of micrometres on both substrates can be grown (Fig. 1). Strain-doping decomposition showed a significant change in the structural characteristics of graphene after MoS_2 growth (Fig. 2). The stability of MoS_2 growth on graphene and the ability to form a continuous layer indicate the industrial potential of graphene as a growth platform.

References

[1] Z. Cai, B. Liu, X. Zou, H.-M. Cheng, Chemical Reviews 13 (2018), 6091-6133
[2] J. Shi, M. Liu, J. Wen, X. Ren et al., Advanced Materials 44 (2015), 7086-7092

Figures

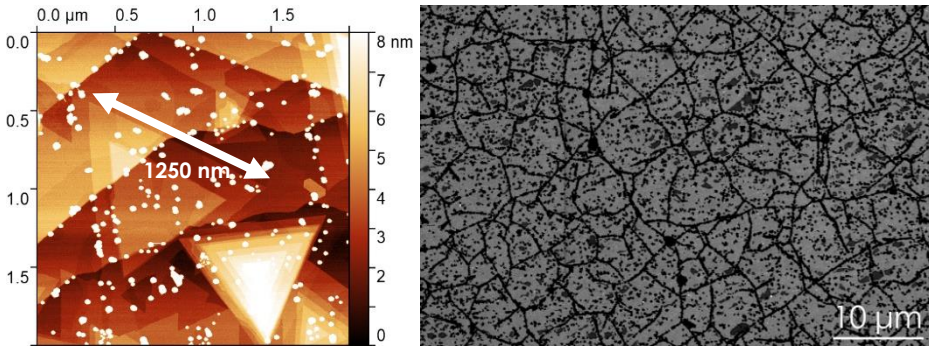

Figure 1: Large MoS_2 grains (left) and continuous MoS_2 layer (right) on graphene/sapphire.

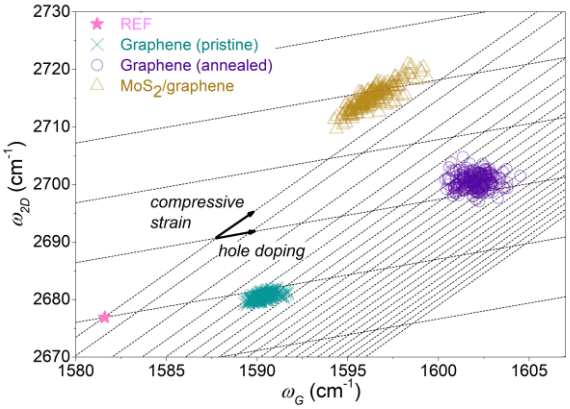

Figure 2: Doping-strain correlation in pristine graphene, annealed graphene and graphene with MoS_2 layer grown on top.