Oxide-Assisted Chemical Vapour Deposition Growth of Hexagonal Boron Nitride and its Heterostructures with Metal Dichacogenides

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Abstract

Two-dimensional hexagonal boron nitride (h-BN) has attracted significant attention in recent years for its superior mechanical flexibility, chemical and temperature stability [1]. These fascinating properties make h-BN regarded as a good candidate for various applications in electronics and optoelectronics [2]. In addition, h-BN is also considered as a promising insulating substrate for graphene growth due to its atomically smooth surface and free from dangling bonds to construct van der Waals (vdW) heterostructures for electronic devices that exhibit unique characteristics and are unobtainable from single-component 2D materials [3]. Compared to traditional mechanical exfoliation, chemical vapour deposition (CVD) method possesses the advantages of scalable production and compatibility with current semiconductor processes. However, the quality of h-BN is much lower than that obtained from exfoliation approach due to the high density of domain boundaries. Here we demonstrate that the formation of an oxide layer on Cu substrates before h-BN growth can significantly reduce the initial nucleation density because of the substrate surface passivation. The domain size of h-BN can consequently be enhanced from 1 μm to 20 μm. Besides, the continuous h-BN films obtained from this new CVD method can act as insulating substrates for the direct growth of MoS_2 with smaller lattice strain and lower doping level compared to SiO_2 substrates.

References

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[2] Britnell, L., et al., Nano Lett., 12 (2012) 1707.
[3] Wang, M., et al., Adv. Mater., 25 (2013) 2746.

Figures

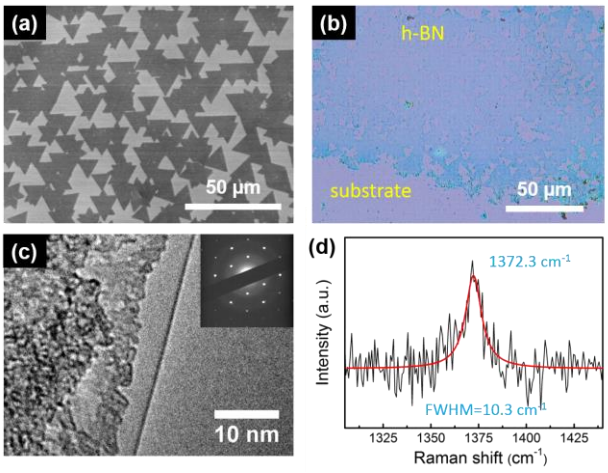

Figure 1: (a) SEM image of an oxide-assisted CVD-grown h-BN on Cu substrate. (b) OM image of h-BN transferred to SiO_2/Si substrate. (c) TEM image of h-BN on the folded edge with the SAED pattern shown in the inset. (d) Raman spectrum of h-BN on SiO_2/Si substrate.