Growth of hexagonal boron nitride/graphene bilayer heterostructure via epitaxial intercalation

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Moiré engineering has emerged as an attractive technology to tailor the physical properties of stacked van der Waals (vdW) materials where quantum control can take place. The recent demonstration of exotic quantum phenomena observed in man-made prototypes of stacked vdW devices has proved that the interlayer angle plays an essential role [1]. To extend the diversity of fundamental research and make progress towards practical applications, the development of a reliable and high-throughput synthesis approach for such stacked layers with desired interlayer angles is indispensable.

We previously reported the chemical vapor deposition (CVD) growth of uniform hexagonal boron nitride (hBN) film with high quality [2,3]. Here, we first grow the hBN as a top layer template, then epitaxially grow graphene underneath the hBN template, thereby achieving the growth of hBN/graphene bilayer heterostructures (Fig. 1a). The epitaxial intercalation of graphene under the hBN leads to convergence of the interlayer angles to less than 0.5°. (Fig. 1b). Moreover, the hBN acts as natural protection of graphene against fabrication contamination, as evident by the substantial enhancement of carrier mobility.

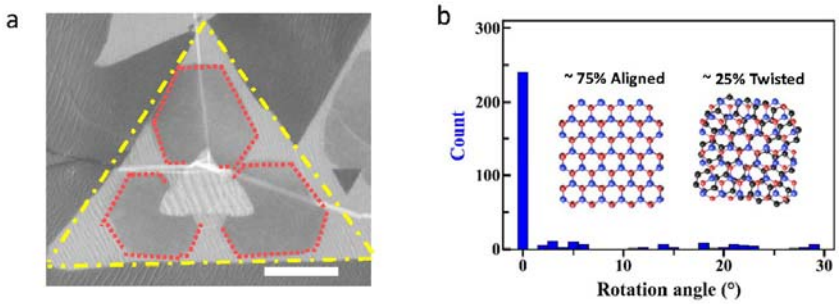

Fig. 1. (a) SEM image of hBN/graphene bilayer on the copper catalyst. The yellow lines mark the hBN triangle domain, and the red lines mark the graphene hexagons. The scale bar is 2 μm. (b) Selected area electron diffraction statistics of the interlayer angles between hBN and graphene in the hBN/graphene bilayers.

References

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[2] S. Wang et al. 2017 JSAP Autumn Meeting, 6a-C16-3.
[3] S. Wang et al. 2018 JSAP Autumn Meeting, 18a-224B-1.