Chemical vapor deposition growth of hexagonal boron nitride/graphene vertical heterostructure

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Recently, we have reported chemical vapor deposition (CVD) growth of hexagonal boron nitride (hBN)/graphene vertical heterostructure by epitaxial intercalation [1]. As shown in Fig. 1, we first grow hBN on Cu catalyst as a top layer template, then apply hydrogen annealing to detach the hBN from the catalyst surface, finally grow graphene at the interface between hBN and catalyst [2]. Here, to further elucidate the growth mechanism, we investigate the heterostructure formation under different annealing conditions. We have found that hydrogen annealing is the key to achieving vertical growth of high-quality hBN/graphene heterostructure. When the hBN is synthesized, the hBN edge tends to bond with the Cu surface, presenting a metal-passivated state. In a hydrogen-rich environment, the passivated edge could be terminated by H atoms, and detached from the Cu surface to enable a vertical growth of hBN/graphene heterostructure. In an argon-rich environment, etching could happen at the edge and consequently result in both lateral and vertical growth of graphene from the etched edge.

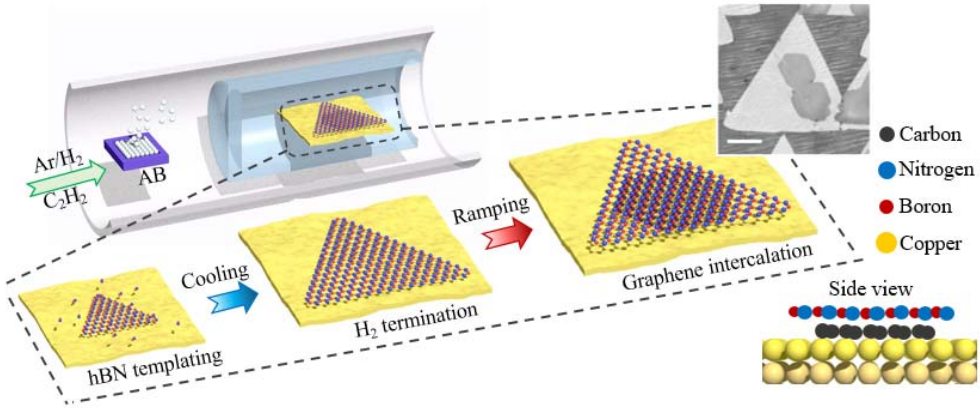

Fig. 1. Schematic of CVD growth process of hBN/graphene heterostructure. The scale bar in SEM image is 2 μm.

References

[1] S. Wang et al. 2021 JSAP Spring Meeting, 17p-Z12-8.

[2] S. Wang et al. ACS Nano 2021, 15, 14384.