Edge Controlled Growth of Hexagonal Boron Nitride Crystals by Atmospheric Chemical Vapor Deposition

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Hexagonal boron nitride (h-BN), a structural analogue of graphene, is a wide band gap 2D insulator consisting of alternating sp^2 –boned boron and nitrogen atoms [1]. Hetero-structures of 2D materials, such as graphene and transition metal dichalcogenides, sandwiched between h-BN layers to realize exceptional properties and excellent performance drew the significant attention [2]. Chemical vapor deposition (CVD) technique is adopted to grow large area h-BN on various transition metals. However, due to the complexity in growth mechanism, single domain size of h-BN is still limited to few micro meter [3]. Here we tackled the edge controlled crystal growth of h-BN.

For h-BN crystals synthesis, bare Cu foil was loaded into the horizontal growth furnace and heated at 10.5 °C/min from room temperature to 1050 °C with 100 sccm Ar. After annealing the Cu foil for 30min with Ar: H_2=100:17 sccm, h-BN source AB was evaporated for 62 min with Ar: H_2=100:2 sccm. Subsequently, the growth furnace was rapidly cooled down to room temperature within 30 min. As synthesized h-BN crystals were analyzed by optical microscopy, SEM, XPS, TEM.

N-terminated regular h-BN single crystals with edge length 10-25µm (**Figure 1 a - c**) were synthesized by atmospheric pressure CVD (AP-CVD) technique with stepwise heating of Ammonia borane (AB; H_3BNH_3), whereas the truncated triangular h-BN crystals of identical size (**Figure 1 d, e**) were synthesized by constant temperature heated AB without changing other condition. Thus, by controlling the growth condition, edge controlled growth of h-BN was readily achieved.

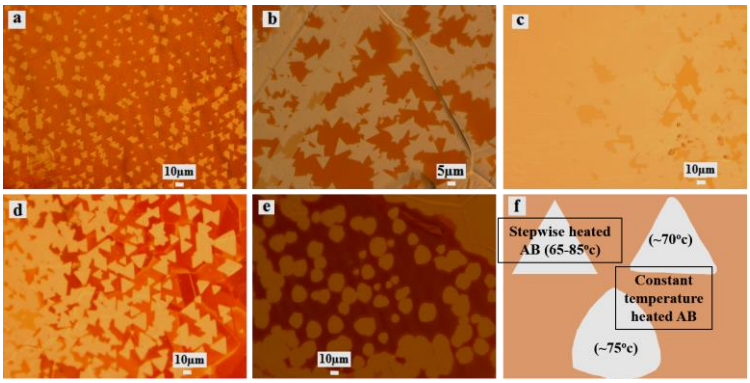

Fig. 1. Optical microscope images of h-BN crystals with **(a-c)** stepwise heating and **(d), (e)** constant temperature heating of AB, and **(f)** schematics representation of observed crystal shapes.

References

[1] K. K. Kim, et al., Nano Lett., 12, 161 (2012).
[2] F. Withers et al., Nat. Mater., 14, 301 (2015).
[3] Tay, R. Yet al. Nanoscale 8, 2434 (2016).