

CVD synthesis of various polygonal-shaped h-BN single crystals

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Hexagonal boron nitride (h-BN), a structural analogue of graphene, is a wide bandgap 2D insulating layered material, consisting of alternating sp^2 -bonded boron and nitrogen atoms [1]. h-BN shows appealing properties such as thermally stable in air up to 800°C, chemical inertness, stable thermal conductivity, and superior elastic properties, and hence has drawn significant attention as a promising material in frontier applications [2]. Although chemical vapor deposition (CVD) technique has developed as the most scalable process to synthesize h-BN on transition metals, the formation of various polygonal-shaped single domain is unclear and are still limited to few microns in their edge length [3, 4]. In this research, we study the growth kinetics of h-BN crystals larger than 25µm via morphological transition.

For h-BN crystals synthesis, bare Cu foils were heated at 26 °C/min from room temperature to 1050 °C with 100 sccm Ar in horizontal tubular furnace. After annealing the Cu foil for 30 min with 100 sccm H_2 (Method-A) or 100 sccm Ar (Method-B), ammonia borate (AB) was evaporated with 100:2 mixtures of Ar and H_2 . To grow h-BN on Cu foil prepared by Methods A and B, 2 mg of AB was heated for various growth intervals, which are termed as Method- A_A , B_A , B_B , and B_C and the growth furnace was rapidly cooled down to room temperature within 30 min. As synthesized h-BN crystals were analyzed by optical microscopy (OM), Raman spectroscopy, FESEM, XPS, AFM, and EBSD.

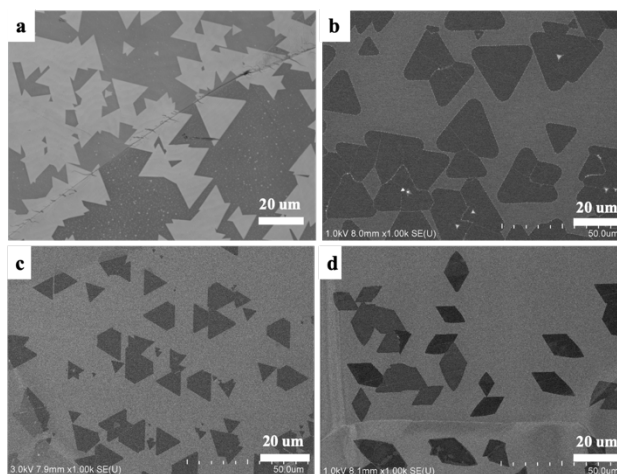


Figure 1. OM image of h-BN crystals synthesized by (a) Method- A_A , and FESEM images synthesized by (b) Method- B_A , (c) Method- B_B , and (d) Method- B_C .

Regular triangular shaped h-BN crystals (**Figure 1(a)**) grown in Method- A_A changed into truncated triangles (**Figure 1(b)**) obtained in Method- B_A . It should be noted that the ambient gas used for annealing of Cu foils affected the h-BN crystal shapes. On decreasing the heating rate of AB, pentagonal and diamond shaped h-BN crystals were synthesized with elapsed growth time (**Figure 1(c-d)**). Hence, various polygonal h-BN crystals were grown larger than 25µm in edge length by controlling the feedstocks supply rate.

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References

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