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Controlled Growth and Atomic-scale Characterization of Two-dimensional Hexagonal Boron Nitride Crystals

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ABSTRACT

Two-dimensional (2D) hexagonal boron nitride (*h*-BN) is a fascinating material for variety of applications such as graphene-based devices, transparent/bendable electronics, and deep ultraviolet emitters. However, its technological applications are contingent upon tunable and scalable growth. Here, we demonstrate reproducible and tunable growth of high-quality *h*-BN crystals on Cu via chemical vapor deposition (CVD) through a precise control of the BN precursor's flow during growth. We present synthesis of both epitaxially-grown triangular flakes and large-area continuous films with tunable thickness ranging from monolayer to 11-layer thick. Using a combination of electron microscopy imaging, spectroscopy, and diffraction analysis, we thoroughly study morphology, thickness, chemistry, grain size, and atomic structure of the grown *h*-BN crystals. This study could pave the way for developing controlled and reproducible growth of high-quality *h*-BN crystals with tunable thickness and morphology.

Keywords: A1. Low dimensional structures, A1. Characterization, A1. Crystal structure, A3. Chemical vapor deposition processes, B1. Nitrides, B2. Dielectric materials

1. Introduction

Hexagonal boron nitride (*h*-BN) is a layered material with a hexagonal structure (a = 2.50 Å, c = 6.66 Å) [1] similar to graphite, but it is electronically insulating with an indirect band gap of ~5.95 eV [2]. *h*-BN crystals offer remarkable mechanical strength [3], chemical stability [4], and thermal conductivity [5] owing to their robust in-plane covalent bonds. All this fascinating properties make *h*-BN an interesting material for a