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Optimized Decomposition of Ammonia Borane for Controlled Synthesis of Hexagonal Boron Nitride Using Chemical Vapor Deposition

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Recently, hexagonal boron nitride (h-BN), which is III-V compound of boron and nitride by strong covalent sp2 bonds has gained great interests as a 2 dimensional insulating material since it has honeycomb structure with like graphene with very small lattice mismatch (1.7%). Unlike graphene that is semi-metallic, h-BN has large band gap up to 6 eV while providing outstanding properties such as high thermal conductivity, mechanical strength, and good chemical stability. Because of these excellent properties, hBN can potentially be used for variety of applications such as dielectric layer, deep UV optoelectronic device, and protective transparent substrate. Low pressure and atmospheric pressure chemical vapor deposition (LPCVD and APCVD) methods have been investigated to synthesize h-BN by using ammonia borane as a precursor. Ammonia borane decomposes to polyiminoborane (BHNH), hydrogen, and borazine. The produced borazine gas is a key material that is a used for the synthesis of h-BN, therefore controlling the condition of decomposed products from ammonia borane is very important. In this paper, we optimize the decomposition of ammonia borane by investigating temperature, amount of precursor, and other parameters to fabricate high quality monolayer h-BN. Synthesized h-BN is characterized by Raman spectroscopy and its absorbance is measured with UV spectrophotometer. Topological variations of the samples are analyzed by atomic force microscopy. Scanning electron microscopy and Scanning transmission Electron microscopy are used for imaging and analysis of structures and surface morphologies.

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