[III-18] [초청]

Growth of Hexagonal Boron Nitride Thin Films on Silicon Using a Single Source Precursors

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Boron nitride (BN) films have attracted a growing interest for a variety of technological applications due to their excellent characteristics, namely hardness, chemical inertness, and dielectrical behavior, etc. There are two crystalline phases of BN that are analogous to phases of carbon. Hexagonal boron nitride (*h*-BN) has a layered structure which is sp^2-bonded structure similar to that of graphite, and is the stable ordered phase at ambient conditions. Cubic boron nitride (*c*-BN) has a zinc blende structure with sp^3-bonding like as diamond, and is the metastable phase at ambient conditions. Among of their prototypes, especially the *c*-BN is an interesting material because it has almost the same hardness and thermal conductivity as diamond.

Conventionally, significant progress has been made in the experimental techniques for synthesizing BN films using various of the physical vapor deposition and chemical vapor deposition. But, the major disadvantage of *c*-BN films is that they are much more difficult to synthesize than *h*-BN films due to its narrow stability phase region, high compression stress, and problem of nitrogen source control. Recent studies of the metalorganic chemical vapor deposition (MOCVD) of III-V compound have established that a molecular level understanding of the deposition process is mandatory in controlling the selectivity parameters. This led to the concept of using a single source organometallic precursor, having the constituent elements in stoichiometric ratio, for MOCVD growth of the required binary compound.

In this study, therefore, we have been carried out the growth of *h*-BN thin films on silicon substrates using a single source precursors. Polycrystalline *h*-BN thin films were deposited on silicon in the temperature range of 600 - 900 °C from the organometallic precursors of Boron-Triethylamine complex, $(C_2H_5)_3N{:}BH_3$, and Tris(dimethylamino)Borane, $[CH_3)_2N]_3B$, by supersonic molecular jet and remote plasma assisted MOCVD. Hydrogen was used as carrier gas, and additional nitrogen was supplied by either ammonia through a nozzle, or nitrogen via a remote plasma. The as-grown films were characterized by Fourier transform infrared spectroscopy, x-ray pthotoelectron spectroscopy, Auger electron spectroscopy, x-ray diffraction, transmission electron diffraction, optical transmission, and atomic force microscopy.