Low Temperature Growth of Hexagonal Boron Nitride on Various Substrates Using Plasma-Enhanced Chemical Vapor Deposition

Seokmo Hong (1), Kyung Yeol Ma (2), Seong In Yoon (2) and Hyeon Suk Shin (1)
(1) Department of Chemistry, Ulsan National Institute of Science and Technology , 50, UNIST-gil, Eonyang-eup, Ulju-gun, Ulsan, KOREA
(2) Department of Energy and Chemical Engineering, Ulsan National Institute of Science and Technology , 50, UNIST-gil, Eonyang-eup, Ulju-gun, Ulsan, KOREA

Shin@unist.ac.kr

Hexagonal boron nitride (h-BN) is a two-dimensional insulator with a large bandgap (~ 6 eV), which can be used as a good candidate for dielectric layer or insulating barrier in nanoelectronics.[1] Such high-quality h-BN sheets were typically grown in the large scale by using thermal chemical vapor deposition (Thermal CVD) system. In case of thermal CVD, growth at elevated temperatures (1,100–1,400 °C) gives rise to relatively high-quality h-BN films.[2-3] However, such a process is cost-ineffective because of large energy consumption and could also hinder the application of h-BN in electronic devices owing to potential thermal degradation; it imposes further limitations on the choice of substrates. To avoid limitation caused by high growth temperature, a Plasma-Enhanced CVD is one of promising methodology. The PECVD approach enables h-BN growth at a lower temperature with better control of film uniformity owing to the presence of energetic and reactive species generated in the plasma region. Nevertheless, the growth of h-BN in the low temperature remains challenging. In this study, we demonstrate the low-temperature growth of h-BN by using inductively-coupled plasma CVD (ICP-CVD) that is kind of PECVD. The growth of h-BN was performed on various substrates such as SiO2 and Al2O3 non-metal as well as Cu and Pt metal substrate at 700°C. We performed various measurements such as Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), X-ray Photoelectron Spectroscopy (XPS) to determine the h-BN quality. Therefore, investigating low-temperature growth of h-BN may represent a significant step towards large-scale, low-cost production of h-BN thin film for versatile applications at the industrial level.

References