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

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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 SiO_2 and Al_2O_3 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.

Figures

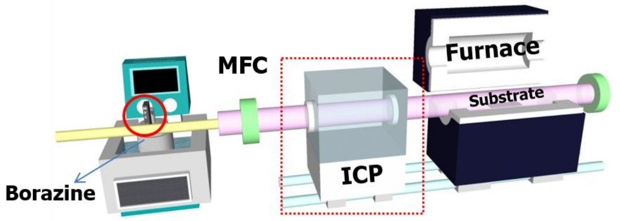

Figure 1: Schematic diagram of Plasma enhanced chemical vapour deposition system.

References

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