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Controlled Growth of Amorphous Boron Nitride and Hexagonal Boron Nitride Using PECVD

To practically apply 2D materials to current Si semiconducting industry, they should be grown directly on Si substrates below 700 ^{o}C, desirably below 400 ^{o}C. Unfortunately, it has not been realized yet. Rather, amorphous boron nitride (a-BN) would be a promising material to meet such requirements. Since, however, a-BN has been rarely studied, its structure and property as well as reproducible growth method have not been properly elucidated. In this report, we report growth of very thin films of amorphous BN (a-BN) and nanocrystalline h-BN (nc-BN) on Si and SiO_2 substrates by using plasma enhanced chemical vapor deposition to decrease growth temperature below 700 ^{o}C. The growth of nc-BN and a-BN at such low temperature was possible due to precise control of borazine gas flow. TEM, XPS, Raman, FTIR, UV/Vis, and NEXAS studies confirmed that a-BN consists of sp^2-hybridized B and N atoms. Furthermore, metal diffusion of a-BN, nc-BN, and TiN as a reference to Si wafer was investigated. The barrier performance against metal diffusion decreases in following sequence: a-BN > nc-BN > TiN.

References

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Figures

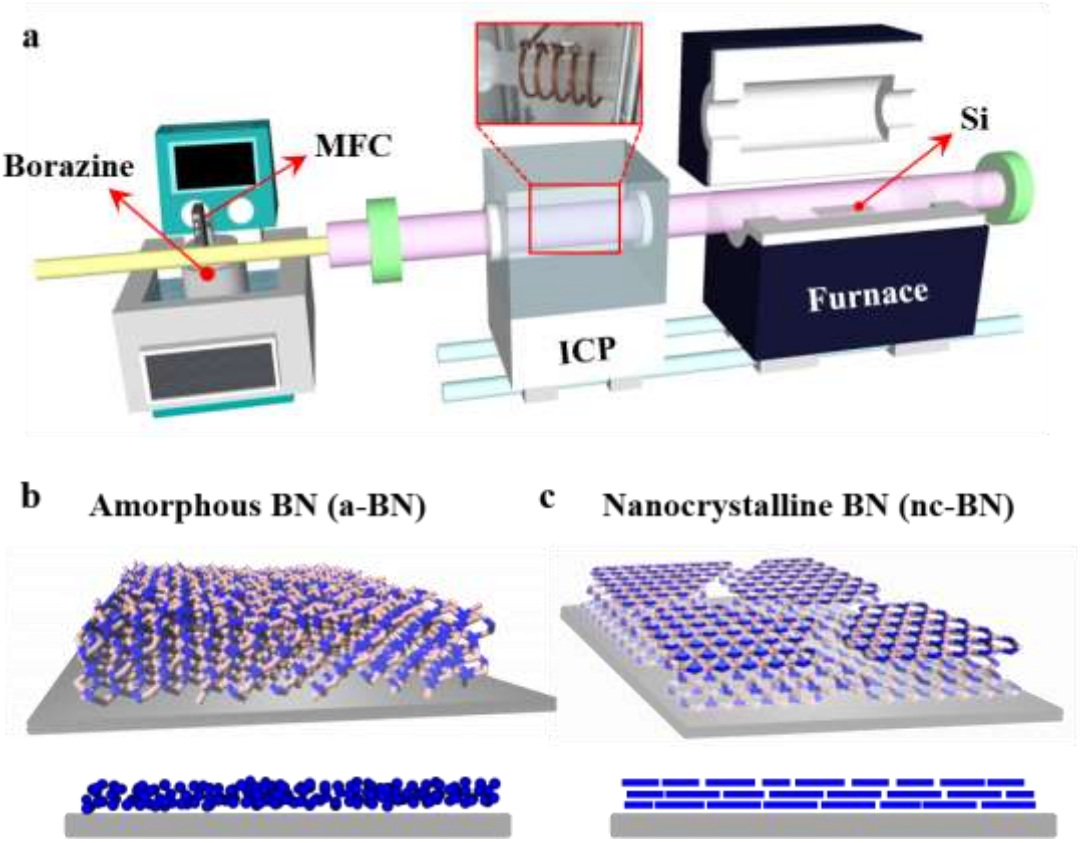

Figure 1: (a) Illustration of a ICP-CVD system with controllability of borazine flow rate. (b) and (c) Illustration of a-BN and nc-BN structures grown at 400 and 700 ^{o}C, respectively.