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Abstract

Emergence of boron nitride (BN), one of the III-nitrides in the last decade has opened up new avenues for research in growth front, exploration of exotic physical properties and novel device designs. This cutting-edge 2-dimensional (2D) material has allowed us to tailor, combine and create heterostructures bringing up new and exciting unknown phenomenon. However, this material and its heterostructures exploration are still in its infancy due to inherent difficulties in growth and understanding of related mechanism in its evolution. Further research and development in this area is highly desired to take advantage of this disruptive material system and its heterostructures to the fullest. In this context, this Habilitation manuscript summarizes my research on advanced growth technologies using BN such as quasi van der Waals epitaxy, van der Waals epitaxy, remote epitaxy, selective area epitaxy and nanoheteroepitaxy of this material in combination with other interesting materials such as conventional III-nitrides and other 2D materials. These growth technologies have led to realization of 2D-3D, 2D-2D 2D-1D and 2D-0D mixed dimensional heterostructures that allows us to have considerable leverage over its fundamental characteristics and exciting functionalities. The impact of these advanced growth technologies on the III-nitride material system physical properties, the progress and its perspectives will be discussed.