Epitaxial Hexagonal Boron Nitride – Growth, Properties and Applications

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Hexagonal boron nitride (h-BN) is a two-dimensional (2D) material and a member of the III-nitride family that has recently attracted great interest due to its versatile range of applications. One of the most prominent examples is the use of h-BN as a substrate for other 2D materials. The lack of dangling bonds, the atomically flat surface and the homogenous dielectric environment lead to a significant improvement of the electrical and optical properties of adjacent 2D materials and render h-BN the prototype 2D-insulator for van der Waals (vdW) heterostructures that consist of stacks of many different 2D materials.

However, most of the work on vdW heterostructures is so far based on exfoliated flakes of h-BN. It is clear that the bottleneck for industrial applications of 2D materials will be the possibility to fabricate high-quality large-area layers.

In the first part of my presentation I will address this issue and show results on the growth of epitaxial h-BN on sapphire by metalorganic vapour-phase epitaxy (MOVPE) [1-4], which is currently regarded as one of the most promising growth techniques. I will show that the growth of a 2D material on a conventional substrate at high temperatures followed by a cool down to room temperature will lead to wrinkle formation [1,5], which can be used to assess the quality of the grown layer.

In the second part, I will focus on the properties of h-BN in general and of our epitaxial h-BN in particular, with a detailed characterization and discussion of the properties.

The last part will be dedicated to applications of our MOVPE-grown h-BN ranging from large-area growth of vdW heterostructures [6], single photon emitting defects [7], photonic applications like the growth of Bragg mirrors [8] to hydrogen generation and storage applications [1].

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