Deep-ultraviolet spectroscopy in hexagonal boron nitride: from bulk to monolayer

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Hexagonal boron nitride (hBN) is an ultrawide bandgap semiconductor with a large range of basic applications relying on its low dielectric constant, high thermal conductivity, and chemical inertness. The growth of high-quality crystals in 2004 has revealed that hBN is also a promising material for light-emitting devices in the deep-ultraviolet domain, as illustrated by the demonstration of lasing at 215 nm by accelerated electron excitation [1], and also the operation of field emitter display-type devices in the deep-ultraviolet [2]. With a honeycomb structure similar to graphene, bulk hBN has gained tremendous attention as an exceptional substrate for graphene with an atomically smooth surface, and more generally, as a fundamental building block of Van der Waals heterostructures [3].

I will discuss here our results on the optoelectronic properties of hBN from bulk to monolayer. I will first focus on bulk hBN, which is an indirect bandgap semiconductor with exceptional properties [4]. I will present our recent measurements revealing the giant light-matter interaction in bulk hBN [5]. I will then address monolayer hBN. In samples epitaxially grown on graphite by high-temperature MBE, the reflectivity minimum is found in resonance with the emission of atomically-thin hBN, thus demonstrating the direct bandgap of monolayer hBN [6]. These results are further confirmed by recent experiments by means of hyperspectral imaging in the deep-ultraviolet in monolayer hBN exfoliated from a bulk crystal [7].

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