Epitaxial boron nitride – universal platform for quantum optoelectronics

Andrzej Wysmolek

Faculty of Physics, University of Warsaw, Pasteura 5, 02-093 Warsaw, Poland

Due to its wide bandgap, hexagonal boron nitride (hBN) can host defect centers that emit light in a very wide spectral range - from infrared to ultraviolet. Part of these defects act as single photon emitters even at room temperature [1, 2]. Thus, hBN is considered as a promising, universal platform for quantum optoelectronics.

Using Metal-Organic Chemical Vapor Epitaxy (MOVPE) it is possible to optimize defect emission in the desired spectral range [3]. Interestingly, in some cases quantum light emission from defects in hBN has to be stimulated by local deformation [4]. Such deformation can be achieved on wafer-scale epitaxial BN [5] using bubbles created by electron irradiation [6]. Photoluminescence (PL) mapping allows for a statistical analysis of changes in defect-related emission caused by the presence of bubbles in various spectral ranges. The possibility of creating bubbles in precisely selected areas make hBN bubbles a promising tool to deterministically locate and activate single photon emission in epitaxial hBN on demand.

Another important topic related to quantum light technology based on epitaxial hBN is the fabrication of Distributed Bragg Reflectors (DBR). They can be produced using stacks of undoped boron nitride layers with high refractive index contrast resulting from a controlled variation of the porosity of the individual BN layers grown by MOCVD [7]. The fabricated DBRs are very promising candidates for future applications, which could allow to build a cavity-based all-BN single-photon source.

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