h-BN bubbles – a step towards deterministic activation of single photon emission

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Hexagonal boron nitride (h-BN) is a wide bandgap (~6 eV) two-dimensional semiconductor which can be easily integrated with other materials. Point defects hosted by h-BN were found to act as single photon emitters even at the room temperature [1]. Therefore, h-BN is regarded as a promising material in terms of quantum optoelectronics. However, it was shown that single photon emission needs to be activated e.g. by annealing or by bending the material [2]. We address this issue by the deterministic creation of h-BN bubbles. Via electron irradiation [3] of our MOVPE material grown on sapphire substrates [4], we initialize the radiolysis of interfacial water. This leads to the creation of stable hydrogen-filled h-BN bubbles (Fig. 1a).

Here, we discuss the optical properties of the obtained h-BN bubbles. To study the impact of created deformation on defect-related emission in different spectral ranges, we performed photoluminescence (PL) measurements using different excitation wavelengths. PL mapping measurements show that bubbles enhance the total light emission (Fig. 1b) and prove that they can activate additional spectral lines impossible to observe on flat h-BN (Fig. 1c), which are candidates for single-photon emitters. Since bubbles are non uniform, they create a inhomogeneous strain distribution that can shift the energy. Therefore they can also tune the energy of emitted light. The key point is that bubbles are created only in irradiated precisely selected locations. Therefore, h-BN bubbles seem to be a useful tool to deterministically locate and activate quantum emitters on demand.

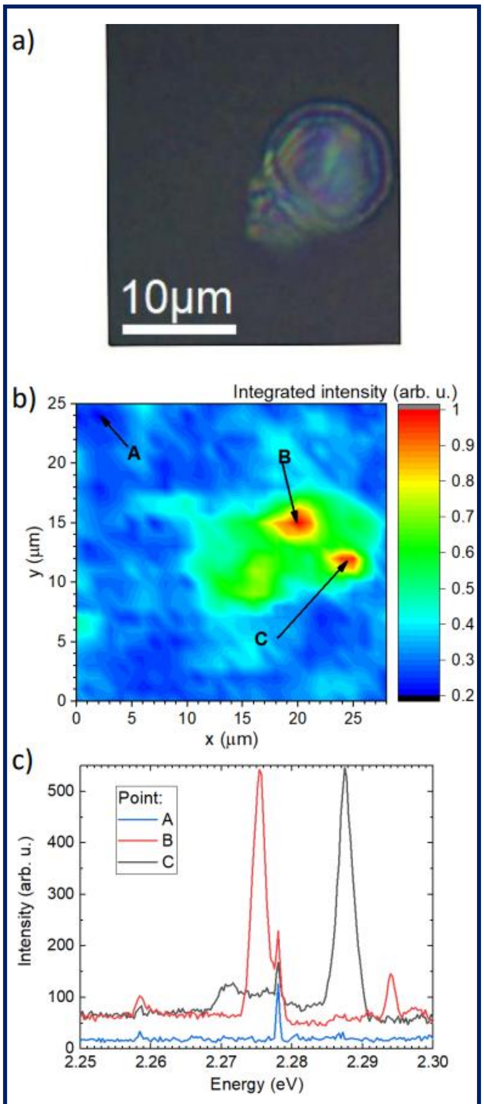

Fig. 1. PL measurements of one single h-BN bubble with 532 nm laser excitation at 4.2 K: a) Optical image of the h-BN bubble, b) total integrated intensity (2.06-2.30 eV), c) results for specific points marked at b).

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References:

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