The impact of carbon impurity concentration on the properties of single photon emitting defects in epitaxial hBN

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Hexagonal boron nitride (hBN) is a wide bandgap (~6 eV), two-dimensional material which is known to host many defects covering wide range from UV to NIR. Some of them act as single-photon sources working even at room temperature, making hBN a promising material in terms of quantum technologies. Much effort has been put into identification of these defects. Although up to now the exact nature of most of them is still unclear, the presence of carbon impurities seems to be crucial in terms of defect-related emission in UV and visible range [1, 2].

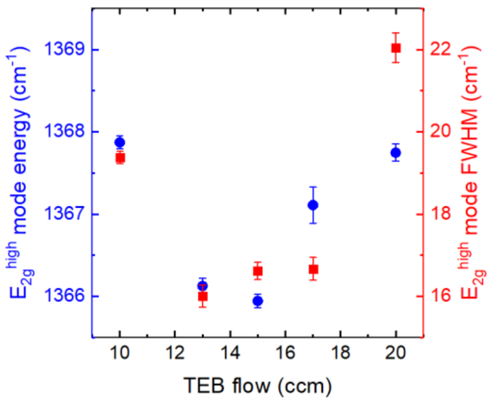

Fig. 1. Results of Raman measurements of the in-plane phonon mode in hBN grown with different TEB flows.

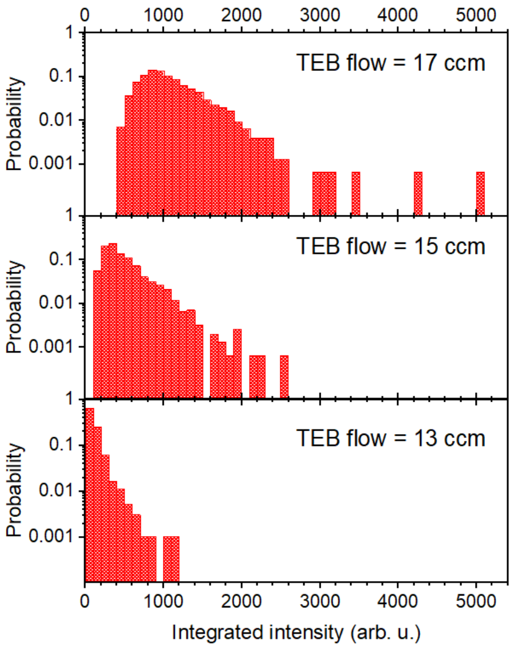

Fig. 2. Histograms of the total integrated PL intensity at room temperature in 2.20-2.32 eV range for hBN grown with different TEB flows.

In this work we study the influence of triethylboron (TEB) flow on the properties of our large-area MOVPE hBN grown on sapphire substrates [3,4]. The Raman data presented in Fig. 1 show that the highest quality of hBN, indicated by the lowest in-plane phonon FWHM values, is achieved only in a narrow range of TEB flows. Fig. 2 shows histograms of the total integrated photoluminescence (PL) intensity (2.20-2.32 eV) for hBN layers grown with different TEB flows. When the flow is too high, the total disrupting background PL signal is more intense. However, higher TEB flow should lead to higher concentration of desired carbon-related point defects which broadens the probability distribution of integrated luminescence [1]. We precisely study small changes of TEB flow to find the optimal growth conditions in terms of both high quality and creation of carbon-related point defects that can be used in quantum technologies.

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References:

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