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Generation of luminescent defects in hBN by various irradiation methods

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Abstract: Hexagonal Boron Nitride (hBN) is a van der Waals (vdW) crystal with a very wide bandgap and often used as insulating layer for other vdW materials, like graphene. Luminescent centres in hBN have recently been gathering much attention because of their brightness and their excellent quantum properties at room temperature, which would make them competitive with state-of-the-art quantum emitters [1], like the N_V center in diamond.
Among the most studied luminescent centres in hBN, there is the charged Boron vacancy (V_B^-), which features a very broad photoluminescence (PL) spectrum centered around 850 nm, along with magnetic properties which have important applications in quantum sensing schemes [2].
In the present work, we use a Helium Ion Microscope (HIM) for irradiating hBN flakes, either on bare Si/SiO_2 substrate or stacked on thick Graphite flakes, to generate luminescent centres like the V_B^-. We perform in-depth PL characterization of these centres at different laser excitation wavelengths, power and polarization, and at cryogenic temperature, for different hBN thicknesses and for varying HIM irradiation fluences. Our results show that this technique can systematically produce high-quality luminescent emitters, in good agreement with literature [3], and allow us to have a good benchmark for further studies on V_B^- emitters in hBN.

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