Synthesis and characterization of single photon emitters from carbon related defects in hexagonal boron nitride nanoflakes

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Single-photon emitters are an essential component in the emerging applications of quantum communication, quantum computing, and integrated quantum photonics. Hexagonal boron nitride (hBN) is of particular interest as a material with a wide bandgap, which allows it to host a wide range of visible to UV emitters and retain stability at room temperature. These emitters arise from spatially isolated defects which introduce mid-gap states which can be excited to act as emitting color centers. In this work, we investigate the properties of single photon emitters in hBN nanosheets, which have been generated by using commercially available hBN powders and inducing defects through 3 different methods including a method of chemical exfoliation. By alkali metal intercalation, hBN is chemically exfoliated in solution and then drop casted onto any substrate. In comparison to flakes annealed in methane, and intrinsic defects in the hBN we find that all these methods produce similar distributions of colour centres suggesting they have a common origin. DTF simulations show that these emitters in the range 650 nm could result from variations of a $C_{3B}C_N$ defect. We have found these single photon emitters are bright, active at room temperature, and are stable for months in atmosphere without bleaching or blinking. Through a Hanbury-Brown Twiss Interferometer we have characterized multiple emitters in the range of 570-650 nm with values $g^2(0)<0.2$ without background subtraction, indicating high quality emitters, and demonstrate some improvement at cryogenic temperatures. These findings help to provide insights into the importance of defects in hBN that are responsible for single photon emission, thus opening the possibility for tailoring these defects through chemical functionalization.