Single photon emitters in hexagonal boron nitride for scalable quantum photonics

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In the context of photonic quantum information science, hexagonal boron nitride (hBN) has recently emerged as a very promising material. The bidimensional character of hBN makes it attractive for the realisation of compact heterostructures and integrated photonic devices. Moreover, this wide-gap material has been recently shown to host single photon emitters (SPEs) with appealing optical properties in the red and near infrared regions [1]. However, these deep defects suffer from the wide distribution of their emission wavelength and, in most cases, a random spatial location [2,3]. These limitations hinder the scalability of the system for applications.

Here we demonstrate a new approach towards deterministic positioning of SPEs with similar emission wavelengths, based on irradiation with an electron beam [4]. The SPEs are locally activated in exfoliated hBN flakes using a focused electron beam and subsequently characterised using microphotoluminescence (fig. 1). They exhibit narrow linewidth at low temperature (below the ~ 100 µeV resolution of the spectrometer) and a drastically reduced ensemble distribution of their emission wavelength (Δλ < 1 nm). Individual emitters display low $g^2$(0) as well as high and stable count rates. Moreover, emission is observed up to room temperature.

Our results suggest new avenues towards top-down realisation of integrated quantum optical devices based on indistinguishable single photon sources in hBN.

References

Fig. 1: hBN flake with eight irradiation sites and corresponding confocal map and spectra, displaying reduced statistical dispersion of the emission wavelength.