Tuning the ultra-bright quantum emission from atomic defects in hexagonal Boron Nitride

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Two dimensional (2D) materials have begun to impact the field of semiconductor quantum optics through the demonstration of stable quantum emitters in both transition metal dichalcogenides [1] and hexagonal boron nitride (hBN) [2]. Single photon emitters (SPE) in hBN are associated with atom-like defects that confine electronic levels deep within the wide band gap. As recently reported, the emission energy of these emitters spans over a large spectral band [3], which presents a central problem for developing identical single photon sources. Furthermore, exfoliated hBN flakes show high background emission that reduces single photon purity. We propose a material processing based on ion irradiation and high temperature annealing that allows to reduce the broadband background emission and therefore to isolate individual defects, as shown in the photoluminescence map of Fig.1a. Our sample fabrication process sharply improves the single-photon purity with $g^{(2)}(0) = 0.077$, and brightness with emission rate exceeding 10^7counts/sec at saturation (see Fig.1b). To investigate the wide span of the emission energy, we transfer hBN films, after sample treatment, onto a bendable substrate that allows us to controllably apply strain, confirming also that quantum emitters persist this transfer process. Fig.1c plots the emission spectra of two SPEs for compressive, tensile and no strain. These emitters show different tuning coefficients up to 6 meV per strain unit. The strain control of the emission wavelength and the reduced multi-photon emission probability produce a tunable ultra-bright room-temperature single photon source with the advantages of 2D materials, including stretchability, heterogeneous device assembly and straightforward integration with photonic circuits [4].

Figures

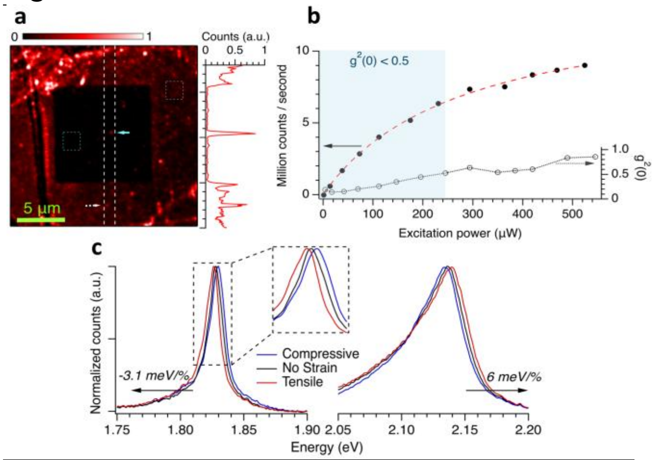

Figure 1: a-Confocal PL intensity map of the treated hBN flake. The 10x10 μm dark region shows a reduction of the background fluorescence due to ion irradiation. The blue arrow indicates an emitter with improved signal-to-background ratio. **b**- Saturation curve of the intensity emission (black dots) and autocorrelation function (open circles) as a function of the excitation power. **c**- Spectra of two different SPEs for compressive (blue), tensile (red) and no strain (black).

References

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