Wide-field spectral super-resolution mapping of optically active defects in hBN

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Point defects can have significant impacts on the mechanical, electronic and optical properties of materials. The development of robust, multidimensional, high-throughput and large-scale characterization techniques of defects is thus crucial, from the establishment of integrated nanophotonic technologies to material growth optimization. Here, we demonstrate the potential of wide-field spectral single-molecule localization microscopy (spectral SMLM) for the determination of ensemble spectral properties, as well as characterization of spatial, spectral and temporal dynamics of single defects in CVD-grown and irradiated exfoliated hexagonal boron-nitride (hBN) materials. We characterize the heterogeneous spectral response of our samples, and identify at least two types of defects in CVD-grown materials, while irradiated exfoliated flakes show predominantly only one type of defect. We analyze the blinking kinetics and spectral emission for each type of defects, and discuss their implications with respect to the observed spectral heterogeneity of our samples. Our study shows the potential of wide-field spectral SMLM techniques in material science and paves the way towards quantitative multidimensional mapping of defect properties.

References

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[2] Feng, J., Radenovic, A. et al. (2018). Imaging of optically active defects with nanometer resolution. Nano letters, 18(3), 1739-1744.

Figure

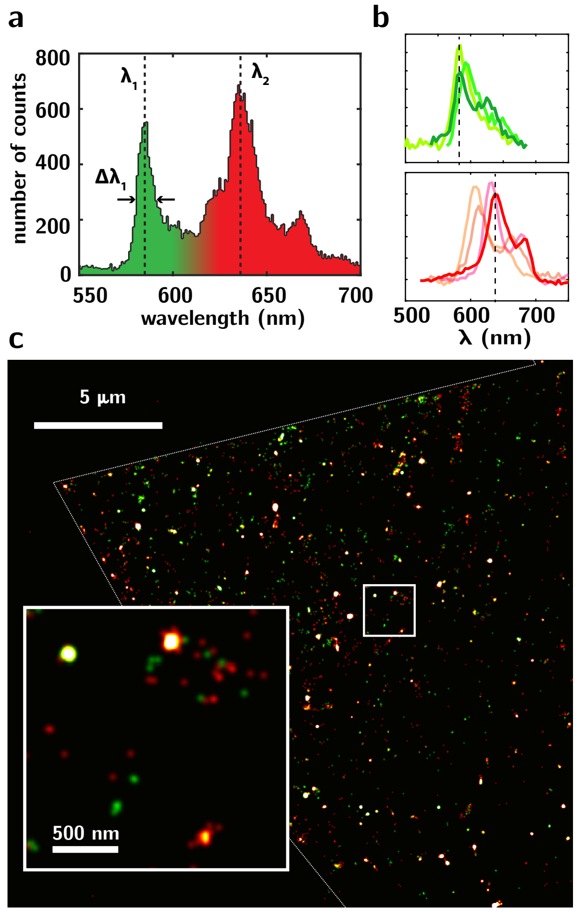

Figure 1: (a) Spectral distribution of center emission wavelengths for a CVD-grown hBN flake. A dual distribution is observed, corresponding to green and red emitters of respective center emission wavelength λ1 ≈ 585 nm and λ2 ≈ 640 nm. **(b)** Representative spectra for each type of emitters. **(c)** Spatial map with spectral contrast, showing the position of the two types of emitters throughout the flake.