Supporting Information: Atomic Localization of Quantum Emitters in Multilayer Hexagonal Boron Nitride

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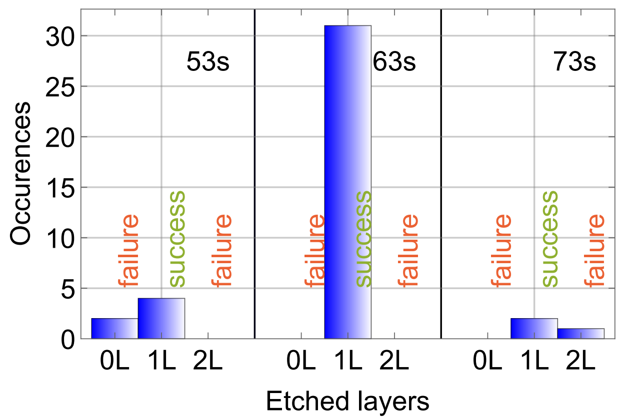

Figure S1: Histogram of single-layer etching failures and successes for various plasma etching times. A failure is if 0 or 2 layers have been etched, while in a successful process only 1 layer is etched.

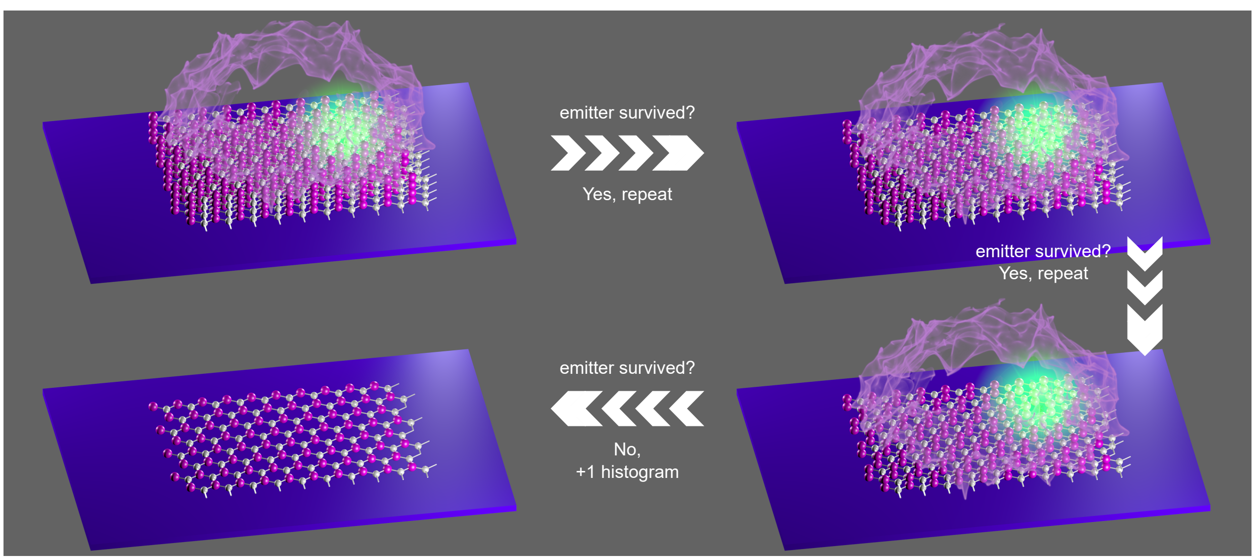

Figure S2: The process cycle shows the experimental procedure. An hBN crystal hosting a quantum emitter is treated with an oxygen plasma. After exactly one atomic layer is etched we verify if the emitter survived. If so, the plasma treatment is repeated, if not, we add a count in the corresponding layer bin in the histogram.

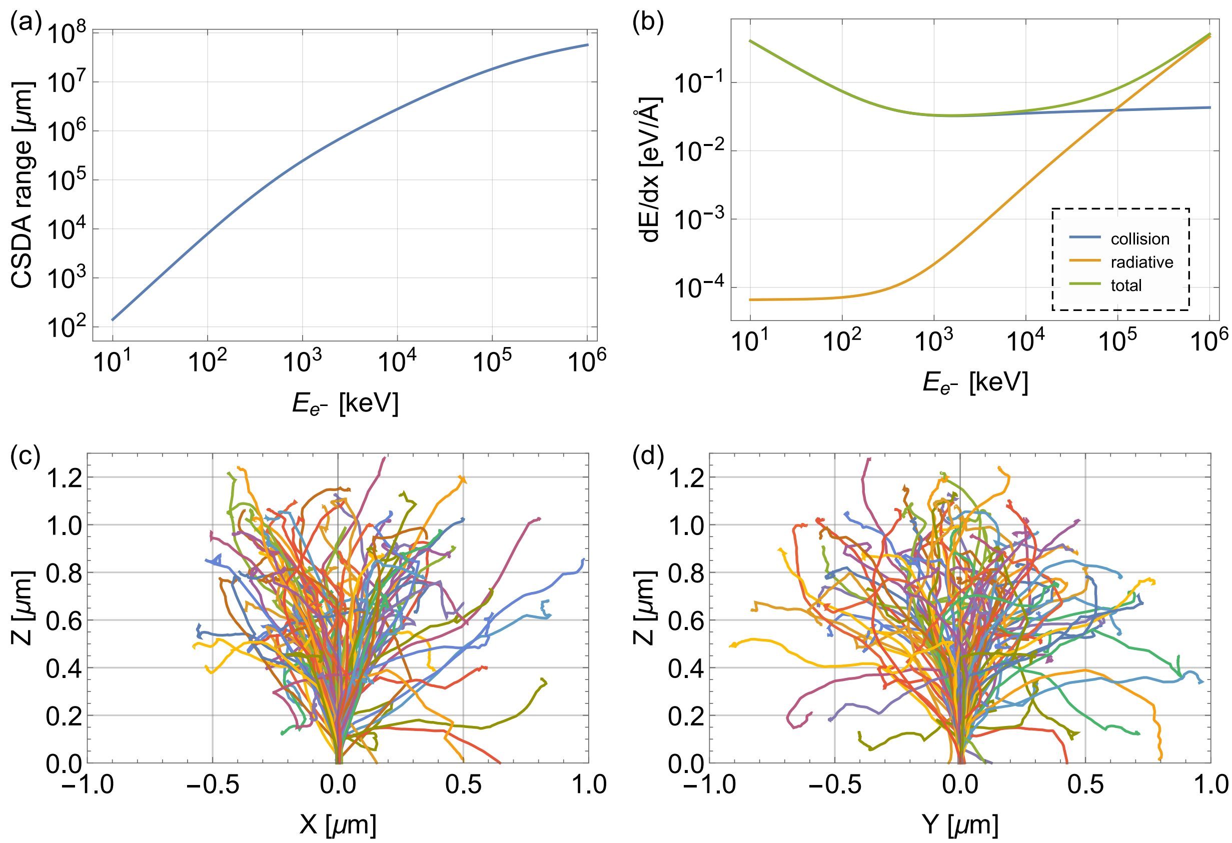

Figure S3: Simulations of electron interactions with hBN. (a) Projected range of electrons in hexagonal boron nitride in the continuous slowing down approximation (CSDA). (b) Stopping power of hBN for electrons. At low energies the total stopping power is dominated by collisions, while at high energies it is dominated by bremsstrahlung. The calculations of the range and stopping power have been performed using ESTAR.[1] (c, d) XZ- and YZ-projection of Monte Carlo trajectories of 10 keV (the same energy used in the experiments) electrons through hBN (101 trajectories, differently colored for clarity), simulated with CASINO.[2] This shows defects are created throughout the material. All simulations in (a-d) assume boron and nitrogen in a stoichiometric ratio of 1:1 and a material density of $2.1\,\mathrm{g\,cm^{-3}}$ as a target.

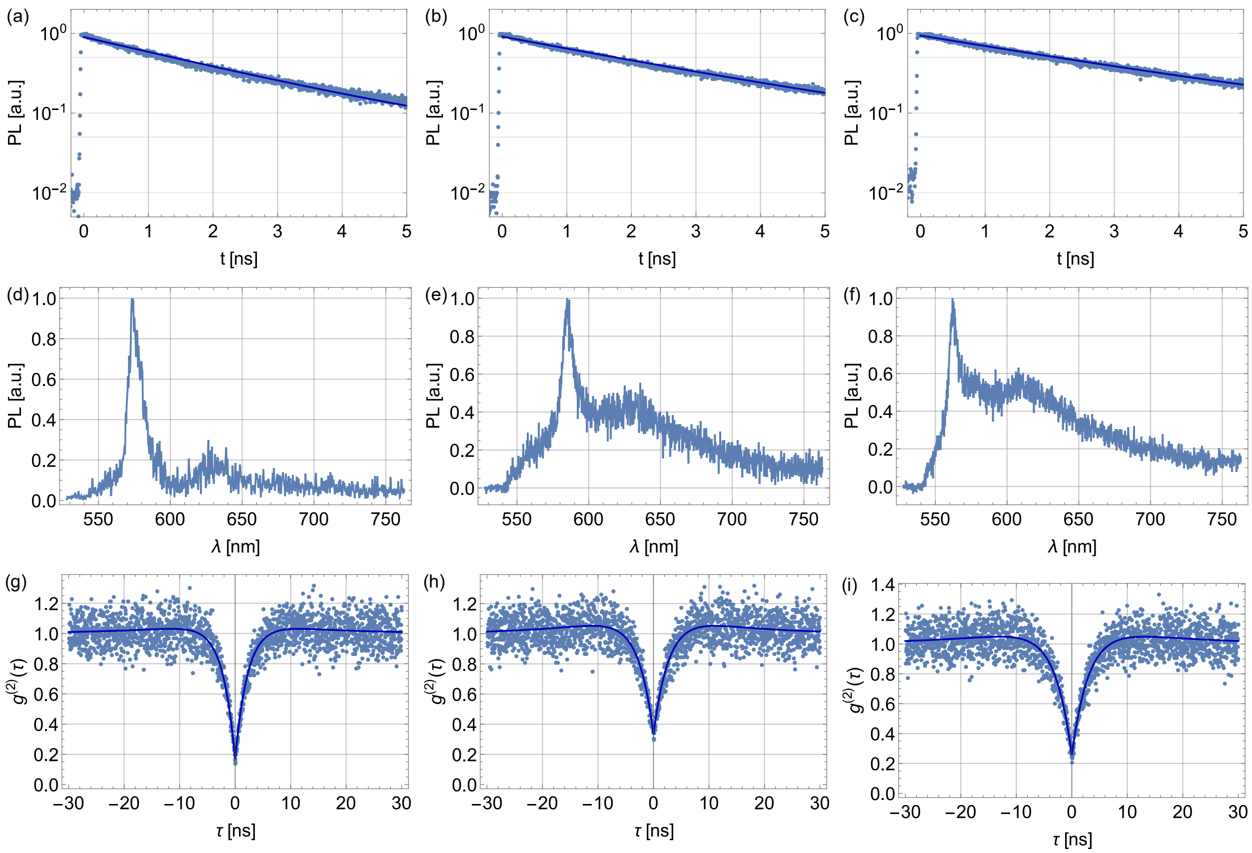

Figure S4: Photophysics of sample quantum emitters in multilayer hBN created with electron irradiation. The lifetimes in (a-c) are 2.223(6), 2.758(7), and 3.084(9) ns, respectively. This makes these emitters $3-6$ times slower compared to the plasma treated ones (see main text). The spectra are shown in (d-f). The Debye-Waller factor for emitters created by radiation damage are usually lower compared to the emitters created by the plasma treatment. The second-correlation function dips to 0.17(3), 0.33(3), and 0.25(7) at zero time delay, respectively (g-i).

References

1. Berger, M.; Coursey, J.; Zucker, M.; Chang, J. ESTAR, PSTAR, and ASTAR: Computer Programs for Calculating Stopping-Power and Range Tables for Electrons, Protons, and Helium Ions. http://physics.nist.gov/Star (National Institute of Standards and Technology, Gaithersburg, MD, 2005).

2. Drouin, D.; Couture, A. R.; Joly, D.; Tastet, X.; Aimez, V.; Gauvin, R. CASINO V2.42 - A Fast and Easy-to-use Modeling Tool for Scanning Electron Microscopy and Microanalysis Users. *Scanning* **2007**, *29*, 92–101.