Ion implantation for engineering and integration of diamond color centers

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Abstract: Ion implantation as a platform for engineering diamond color centers and enabling their integration into photonic microstructures and nanoscale device architectures.

Ion implantation is a versatile platform for engineering diamond-based quantum devices; however, controlled single- and multi-photon generation requires not only defect creation, but also defect recovery and optical activation.

Here, we demonstrate the engineering of color centers in diamond via broad-beam and focused ion implantation, achieving control over defect position and density. We realize GeV single-photon emitters [1], their integration into photonic microstructures for enhanced photon collection [2], and shallow NV centers for sensing applications [3].

Beyond defect creation, this platform enables the fabrication of photonic and nanoscale device architectures. Supported by structural and optical characterization, we exploit ion-beam-induced structural transformations, such as amorphization and graphitization upon thermal annealing, as functional tools for enabling diamond-based devices [4], and employ focused ion beam processing of thin diamond membranes tailored for scanning probe and nanothermometry applications.

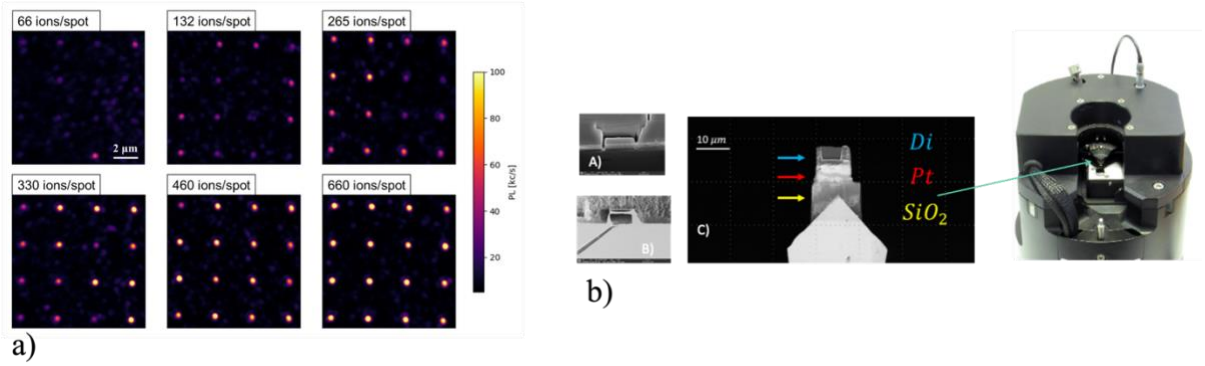

Fig. 1 (a) PL maps of implantation arrays of focused Ge ions at different ion spot doses. (b) 1 µm-thick diamond membrane fabricated by focused Xe ions and integrated into an AFM.

References

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