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P31 - Ion-beam-fabrication of buried graphitic electrodes for the excitation of electroluminescent NV centers in diamond

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Focused MeV ion beams with micrometric resolution are suitable tools for the direct writing of conductive graphitic channels buried in an insulating diamond bulk. Their effectiveness has been shown for the fabrication of multi-electrode ionizing radiation detectors [1] and cellular biosensors [2].
In this work we investigate such fabrication method for the electrical excitation of color centers in diamond, aiming at the development of quantum technologies based on single-photon sources [3].
Differently from optically stimulated light emission from color centers in diamond, the electroluminescence requires a fairly high current flowing in the diamond subgap states between the electrodes. With this purpose, buried graphitic electrode pairs with a spacing of less than 10 μm were fabricated in the bulk of a single-crystal diamond sample using a 6 MeV C microbeam.
The electrical characterization of the structures showed low currents at low applied bias voltage, due to residual radiation associated with the fabrication process; a significant current increase was observed above an an effective voltage threshold of several tens of volts.
The light emission from the sample was imaged both in electroluminescence and photoluminescence regime using a confocal microscopy setup, in order to identify the active regions of the device and to investigate the role of the residual vacancy density in the diamond sample due to ion irradiation.
A bright electroluminescent emission from native neutrally-charged nitrogen-vacancy centers (NV0) was observed; the presence of light emission associated with residual vacancy clusters associated with radiation damage (A-band) was not observed in electroluminescence regime, indicating a potential application of the electrodes fabrication method for the electrical control of isolated single-photon sources.
[1] J. Forneris et al. Nucl. Instr. Meth. B 306 (2013) 181
[2] F. Picollo et al. Adv. Mater 25 (2012) 4696
[3] N. Mizuochi et al., Nature Photonics 6 (2012) 299

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