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Processing and characterization of diamond nanocrystals for applications in biosensing

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Due to its unique physical properties (transparency, bio-compatibility, chemical inertness, availability of stable luminescent centers, etc.), artificial diamond is a promising material for applications in cellular biosensing. In particular, nanometer-sized diamond crystals offer unique opportunities for optical labeling and drug delivery in living cells, due to their low toxicity.

The samples in this thesis work are produced through either detonation or fragmentation of samples grown by HTHP synthesis, with particle size ranging between 5 nm and 1 µm. Thermal processing techniques are applied to graphitize the amorphous carbon component, which is then removed by a subsequent etching process.

The optical labeling properties of the nanocrystals are based on the Nitrogen-Vacancy defect, which can be introduced in the lattice by means of ion-beam-induced damaging. The samples were implanted with a 2MeV H+ ion broad beam at the accelerator facility of the INFN Legnaro National Laboratories.

The characterization of the structural modification on the nanoparticles was carried out through Diffuse Reflectance Infrared Fourier Transform and Raman spectroscopies during each step of the processing. SEM imaging provided an estimation on the size of the nanodiamonds.

Subsequently both cellular imaging and (possibly) drug delivery will be explored as a final goal of the activity.

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