

Politecnico di Milano, Department of Energy, Cesnef (Building 19), via Ponzio 34/3, Milan
Seminar Room 1° floor

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Mev-ion-beam Lithography in Diamond for Applications in Bio-sensing

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Diamond is a material with extreme physical properties: high mechanical and radiation hardness, chemical inertness, high carrier mobility, bio-compatibility, availability of a range of optically-active defects. Such unique features make this material extremely appealing for many different technological applications. Interestingly, the same properties that make diamond so attractive also determine a major challenge in their fabrication. MeV ion implantation is an effective tool in the micro-fabrication and functionalization of a vast range of materials, and in particular, it can be effectively adopted to engineer the electrical [1], optical [2] and structural [3] properties of diamond. The damage density can be controlled over a broad range by varying several implantation parameters, such as ion species and fluence, resulting in the formation of point defects, in the amorphization and eventually in the permanent graphitization of the pristine crystal upon thermal annealing when a critical damage threshold is reached. In this structural modification process, high spatial resolution in both lateral and depth dimensions is allowed respectively by the availability of focused ion beams and by the peculiar damage density profile of highly energetic ions in matter [1].

In the present contribution, an overview of our activity in the development of diamond-based devices by means of deep ion beam lithography will be given. In particular, the application of multi-electrode-array biosensors fabricated using a broad MeV He ion beam on a type-IIa monocrystalline diamond sample will be described [4] showing our last application for radiobiology study

References

- [1] F. Picollo et al., *New J Phys* 14 (2012) 053011 [2] J. Forneris et al., *NIMB*, 348 (2015) 187–190
[3] A. Battiato et al., *Acta Mater*, 116 (2016) 95 – 103 [4] G. Tomagra et al., *Carbon* 152 (2019) 424 -433

About the speaker:



F.P. was awarded a PhD in “Science and Technology of Materials and Nanosystems” in 2012. From 2012 to 2013, he held a Post-Doctoral fellowship at the Physics department of the University of Torino developing ion beam lithography of diamond. From 2014 to 2015 was awarded a grant for young scientist devoted to diamond nanofabrication for devices realization funded by the Italian Institute of Nuclear Physics (INFN). During 2016, F.P. held a Post-Doctoral fellowship at the Physics department of the University of Torino, devoted to the realization of biosensors employing the techniques previously developed. Since 2017, F.P. is a researcher of the University of Torino and PI of an INFN

biannual project (2017-2018) on ion beam fabrication of diamond for particles and biosignals detection. F.P. is coordinator of an experiment at INFN - National Laboratories of Legnaro, which guarantees the access to MeV ion beam facility.

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