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Natural and synthetic nanodiamonds: from stars to laboratories

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The methodologies recently settled for production of nanostructured forms of crystalline sp3-Carbon have opened a new scenario in the field of innovative materials. Owing to their remarkable structural features, the superior physico-chemical properties and the total biocompatibility, diamond nanostructures have emerged as promising alternative materials for biomedical applications, in primis, for drug delivery or fabrication of scaffold for tissue engineering. Moreover, a topic of great interest is the use of fluorescent nanodiamond particles for biological tagging and imaging applications [1]. The nanocrystalline forms of diamond are widely applied in many other technological fields, due to their chemical, thermal and mechanical inertness.

The potential impact of nanodiamonds on science and technology is enormous and only in the last years the consequences on our lives began to be perceived. It is intriguing, however, to note that some of these nanostructures are natural occurrences.

Natural nanodiamonds are found in: meteorites (the nanodiamonds recovered from meteorites are considered “messengers from the stars” because they carry out traces of chemical and physical processes in interstellar media [2]), as mineral inclusions in terrestrial rocks (for example in zircon minerals from Jack Hills, Western Australia) and as very old fragments of the Earth’s crust [3]

All these materials have closely related properties and are found in a variety of shapes, such as nanoparticles, nanowires, needle-like, platelets. The synthetic diamond nanocrystals obtained by processes carried out under far-from- equilibrium conditions (CVD, PECVD techniques) are found to mimic the same shapes of the natural nanodiamonds. In addition, plasma-induced post-synthesis processing are also able to produce a variety of exciting nanostructures similar to those designed in nature and with the crystallographic features of the diamond Fd3m s.g.

Some examples of nanocrystalline diamonds engineered in our labs will be illustrated and their present and foreseen applications in several advanced technological areas will be discussed.

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