Nanodiamonds for drug delivery and other biomedical applications

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Abstract

Carbon nanomaterials hold tremendous potential in addressing the two major issues faced by our society: providing energy and improving healthcare. Nanodiamond powder produced by detonation synthesis is one of the most promising carbon nanomaterials for drug delivery and theranostics [1], [2]. Diamond particles have a ~4-5 nm stable core and a large surface area with tailorable surface chemistry. Nanodiamonds have unique optical, mechanical and thermal properties. These properties have recently started to attract much interest for different biomedical applications [3]. Rich surface chemistry, nontoxicity and good biocompatibility of diamond nanoparticles make them attractive in biomaterial applications [4].

The development of new methods for obtaining free nanodiamond particles opens up new possibility for targeted drug-delivery systems that overcome cell membranes, various biological markers, systems intended for determination of the concentration of bioactive agents in living organisms, and others applications [5]. For tissue engineering scaffolds, the non-toxic fluorescent nanodiamond introduced into biodegradable polymers provides increased strength, visual monitoring, and enhanced biomineralization [6].
Nanodiamond (ND) particles are increasingly being utilized as diagnostic, imaging, and therapeutic agents in biomedicine [7]. In the area of biomedical imaging and diagnostics, luminescent nanodiamond with NV centers, as well as chemically modified fluorescent nanodiamond, hold tremendous potential to replace toxic semiconductor quantum dots, thus bringing this exciting potential application one step closer to the clinics [8]. Before nanodiamonds could be applied, they have to undergo multistage purification, characterization and surface modification. Various approaches of surface modification and functionalization of nanodiamond allow to enhance and control drug adsorption for prolongation of drug action and chemical binding of the drugs for sustained drug release for their further use as a drug delivery platform. As for drug delivery, this study mainly focuses on adsorption of antibiotics that will be discussed in detail. We demonstrate results of physical−chemical study of the adsorption of doxorubicin, polymyxin B and rifampicin on nanodiamonds.

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