The problem of nanodiamond visualization in biopharmaceutical research

Yakovlev R.Ju.

Pavlov Ryazan State Medical University, 390026, Ryazan, Russia
e-mail: yarules@yandex.ru

The problem of carbon nanoparticles diagnostics in biopharmaceutical research becomes more and more actual during the last years. But the complexity of control whether such particles are present and in what state *in vitro* and *in vivo* precludes us from using the standard physic-chemical methods. Therefore the search for new methods and techniques of carbon nanoparticles visualization and of widening their functions via development of new original approaches might be extremely important. This is very important for the research in nanotoxicology and biomedical applications including pharmacology research and drug delivery. The applications of nanodiamonds (ND) as nanocarriers in drug delivery systems necessitated finding the effective methods of their visualization. For the diagnostics of ND *in vitro* we used TEM. This allowed us to determine the average size of ND particles (5 nm) and the presence there of carbon atom layers (shells) with the diamond core in the center. It was possible to estimate the thickness and structural peculiarities of the ND shells depending on their chemical modification by HRTEM. In order to determine the chemical composition of ND surface and the presence to sp^2/sp^3 carbon atoms in near-surface layers of ND particles the XPS method was used. Raman spectra showed that ND have characteristic band of 1332 cm^{-1}. But creation of C_{diam}–N– bonds on the surface results in high fluorescence which is so higher than the peak of diamond phase that totally masks it. The further fluorescence research of ND with grafted drugs by Raman spectra might give us a powerful way to visualize such complexes. The radiochemical methods of carbon nanoparticles visualization are one of the most fast and accurate. We received ND with ^3H-label firmly fixed by covalent bond C_{diam}–^3H that allowed us to study their biodistribution *in vivo* in rats. The presence of heavy atoms in the grafted layer on the ND surface opens new diagnostic possibilities to determine ND *ex vivo* и *in vivo* by mass-spectrometry. Thus the long-term biodistribution of ND in rabbits was studied. The devised complex of physic-chemical methods of ND visualization allows us to effectively find ND in model systems, biological liquids, tissues and organs.