

## Nanodiamonds as a platform for biomedical application

Recent developments in nanoscience dramatically transform our classical understanding of chemistry, biology, physics, and molecular interactions, show us new approaches to design delivery systems and bioactive compounds for nanomedicine.

For the last years, various carbon nanostructures were studied in nanomedicine for biomedical applications. They were tested as a potential treatment, as well as a carrier for bioactive molecules. In our studies, we focus on nanodiamonds (NDs). A powder made of ca. 5nm diamond particles with large accessible surface and tailorable surface chemistry delivers extraordinary optical, mechanical, electronic, and thermal properties on the nanoscale. Inert and biocompatible NDs could be applied in nanomedicine and biotechnology to improve the therapeutic value of various drugs. The coating of drugs on NDs could increase their bioavailability, solubility, retention time, efficacy, tolerability, and drug therapeutic index. However, one of the most important factors is the size of the applied nanosystem, which should allow it to pass through the cell membrane.

In the current research, we focused on designing the most beneficial method of the preparation of drug-coated biocompatible NDs, as the drug delivery system for medical applications. The pre-treated detonated NDs bear functional groups (carboxylic groups, etc.) on their surface. This allows us to perform coating using traditional methods of organic synthesis. Selected bioactive compounds will be synthesized and purified, followed by attaching/coating on NDs' surface. The biodegradability of the surface linkers and functional fragments is to be studied by means of the CBT method. The modified NDs and their formulations are to be characterized by different techniques (ssNMR, FTIR, DLS, SEM) and tested in the collaborator's biomedical laboratories. The obtained results will allow us to select the most beneficial method of obtaining the drug-coated NDs that can be further functionalized for biomedical applications.

As trainee students, you have a chance to take part in every stage of our research. You ought to make a synthesis of bioactive compounds in our synthetic lab, isolate and purify the desired product, first with my help and then independently. Using the synthetic techniques already developed in our lab, you are expected to work on the surface functionalization of the NDs with bioactive moieties. At the final stage, you are welcome to participate in the comprehensive characterization of the final product.



Figure 1. Our research group

Our research team (group leader Dr. Yevgen Karpichev) is a part of the Tallinn University of Technology (TalTech), a leading Estonian institution in innovative education. We have established a strong collaboration with the research teams worldwide and already enjoy hosting the students from Ukraine, France, and Algeria.

If you are eager to do real science, ready to work in a multinational team and want to get hands-on experience in multidisciplinary research combining organic synthesis with nanochemistry, you are welcome to apply for Baltic Science Network Mobility Programme for Research Internships!

Best regards,

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