„Preparation and study of micro-fabricated photonic structures for light amplification with the use of biological origin compounds”

Let’s imagine the future, just like from the realm of science fiction in which the human body implants are widespread and provide valuable information on the state of the organism, environmental changes, or meet theranostics functions, which means the combination of therapy and diagnostics. Implantation development would not be possible without the effects of material engineering in the form of non-toxic and biocompatible materials and photonics needed for the optical information obtain.

The development of fundamental research in materials research and physical phenomena are important because of their possible applications. This project focuses on both materials science, particularly biomaterials and physical phenomena. The combination of these two topics offers the great opportunities for research, in detail this project is devoted to the light amplification phenomenon in natural systems in order to achieve lasing action. However, this type of research is conducted in the world, but there is still a huge research potential due to the plurality of problems to solve and a relatively short period of increased interest in the subject.

The total novelty of this project is appliance of microfabrication technique working on the principle of two-photon polymerization to fabricate designed photonic systems. The combination of natural dyes and microfabricated structures allows both to control the matter according to our design, but also to utilize properties of natural compounds. Systems prepared in this manner gives the unique possibility of studying the phenomenon of light amplification with the control of a wide range of parameters.

The topic of light amplification is strongly associated with the construction and operation of coherent light sources – lasers. The phenomenon of light amplification occurring in a distribution of optical resonators is called random lasing. Studies conducted in a doped polymer and biological systems are designed to produce a biological random laser for the future biomedical applications. Part of the research in this project is also devoted to the phenomenon of random lasing and possible gaining control of this phenomenon.