Synthesis of nano- and microplastics labeled with up-converting nanoparticles for its visualization and monitoring in biological materials

The project aims to obtain nano- and microplastics labeled with up-converting nanoparticles as model systems for environmental pollution studies and analysis. The possibilities of monitoring the transfer and migration of nano- and microplastics on selected biological systems such as plants, simple aquatic organisms such as daphnia, and cells will also be tested. Anti-Stokes emission allows for the more precise imaging of what is happening with nano- and microplastics in biological material than is possible with other research techniques.

Pollution by nano- and microparticles of plastics is now becoming one of the world's main problems, next to global warming. The danger of nanoplastics, in particular, is considered by many scientists as underestimated and poorly studied. There is a belief in the scientific community that it is urgent to undertake systematic and extensive research on the formation, migration, and environmental effects of nano- and microplastics. Microplastic is considered plastic particles with sizes greater than 1 μm to 1 mm, while nanoplastic is considered smaller than 1 μm. This project will research these two ranges as potentially the most significant and highest suspected environmental impacts.

Nano- and micro-plastics are currently one of the most intensively studied environmental threats. More and more recent scientific discoveries present a rather pessimistic picture of a world polluted at many levels by residues from the decomposition of plastics: from the sea depths to the Antarctic glaciers. Monitoring the transfer of nano- and microplastics is an emerging field. Much available research and analytical techniques do not bring sufficiently good results to fully estimate where and how nano- and microplastics are formed and migrate in the natural environment. This is due to the specificity of plastics, which, being organic materials, are difficult to detect, or their detection is error-prone.

As part of the project, the up-conversion phenomenon will be used to detect and monitor nano- and microplastics. It is an emission, usually visible light, under the influence of near-infrared radiation. It is an innovative solution that will allow the observation of only and exclusively the emission from the labeled nano- and microplastics, without any autofluorescence of biological material or material forming plastic particles. In this way, the detection limit will be significantly improved. Thanks to high-resolution fluorescence microscopy, it will be possible to detect even single nano- and microparticles of plastic, which is impossible to do with any other research technique.