Hybrid particles, composed of two or more elements, are one of the most exciting research objects in materials science, due to their optical, catalytic and magnetic properties, which differ from the properties of single component particles. They can have many technological applications. Their properties depend on factors such as the size, chemical composition and shape of the particles, which are often determined by the method of synthesis.

To ensure high quality and desired properties, it is necessary to produce particles of a specific size, composition and morphology. In this context, there is a deep interest in developing a reliable method and exploring the possibility of producing hybrid particles with controlled composition and physical or chemical properties. It has already been proven that the synthesis method proposed in this project - laser melting in liquid - is an efficient and promising method for producing hybrid colloidal particles. This method allows the production of particles with a composite structure (e.g. core-shell particles) and alloys with a low expenditure of resources. This is possible because the synthesis uses easily available ingredients, such as metals or metal oxides in powder form and water or basic organic solvents. During laser irradiation no high temperatures, pressures or other modifications of the synthesis environment are used, also this method does not require the use of toxic chemicals, which makes it a highly ecological method of synthesis.

The mechanisms of formation of hybrid particles by laser melting in liquid are still not fully understood. During laser irradiation, many physical and chemical processes take place in the liquid, which affect the final parameters of the synthesised particles. So far, only some of these phenomena have been thoroughly investigated. Some of the parameters that most strongly influence the process of hybrid particle formation are the laser power, frequency, irradiation time and the choice of the solvent in which the nanoparticles are dispersed. Additionally, our previous studies show that one of the factors that has a huge impact on the produced particles is the agglomeration of nanoparticles during synthesis. Therefore, this project aims to observe the kinetics of agglomerate formation during the laser melting process and to investigate how the size and composition of hybrid particles generated by irradiation depend on the laser beam parameters and experimental conditions (laser frequency and solvent). We will also investigate the chemical reactions occurring during the process.

The results of these studies will facilitate the laser synthesis of hybrid particles with controlled size and composition and may provide promising materials for many applications.