Ultrasound study of magnetic Pickering emulsions

Emulsions are a mixture of two immiscible liquids in which one of the phases is dispersed in the other phase as droplets. This system is thermodynamically unstable so needs stabilization. Pickering emulsion is an emulsion stabilised by solid particles accumulated at the surface of droplets. This type of emulsion has received great research interest in recent years because they have generated and hold promise for a variety of practical applications in fields such as medicine, the food industry, the oil industry, and biofuel processing. Magnetic particles can also be used to stabilize emulation. The real-time characterisation especially under external stimuli is generally challenging. In this project, I propose a convenient method to control properties of Pickering emulsions using ultrasound technique. The benefit of acoustical measurements compared to other techniques is their ability to test the medium in a non-destructive way and neither requiring special sample preparation. The main objective of this research proposal is to use ultrasound for study the properties of magnetic Pickering emulsions, specially under external stimuli (magnetic and electric fields).

The general plan of the project comprises: synthesis of magnetic nanoparticles and their characteristics, fabrication of magnetic Pickering emulsion, determination of the emulsion structure on the basis of ultrasonic measurements and investigation of ultrasound theranostic properties of Pickering droplets. Theranostic procedure is based on the concept of combining both therapeutic and diagnostic functions into one nanoparticle or droplet. The primary approach is laboratory research at the Adam Mickiewicz University in Poznań, which will be supplemented by theoretical studies.

This research project offers a great opportunity for basic research to advance fundamental knowledge in different fields, including in the physics of droplets and capsules, responsive materials, and ultrasound. The progress in Pickering Emulsion field - the explanation of the mechanism of emulsion formation and their properties, and the demonstration of their various applications will be of interest to material engineers and applied physicists. The strength of the proposal lies in its originality and very low risk of failure owing to the promising results of our preliminary experiments.