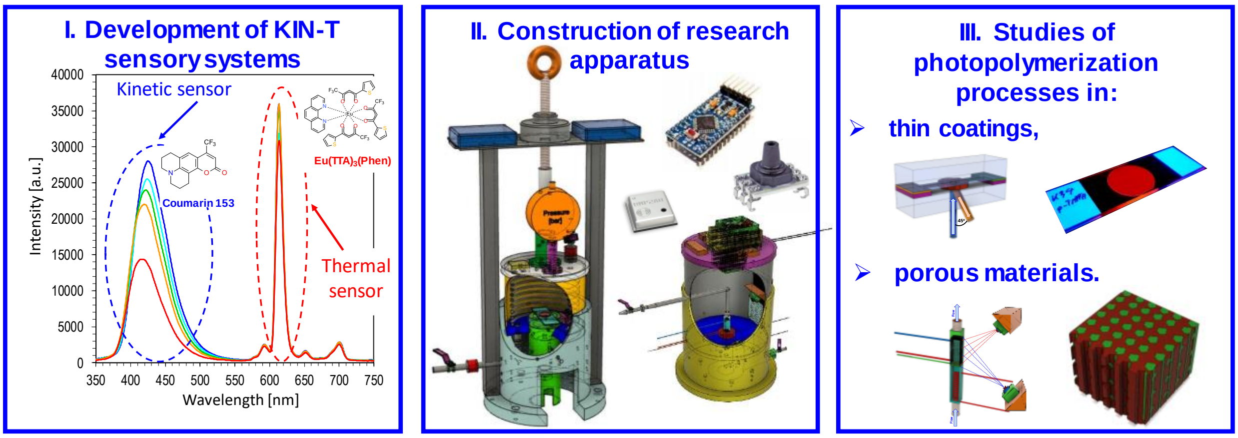
Kinetic-calorimetric studies of photopolymerization in thin porous layers using new two-component luminescent sensory systems.

The proposed project focuses on new two-component luminescent sensory systems dedicated to the kinetic-calorimetric measurements of photopolymerization reactions in thin porous films. The main research task of the project is to develop and test bi-component kinetic sensor – thermal sensor (KIN-T) system, dedicated to kinetic-calorimetric measurements of photopolymerization reactions in thin porous films, as well as study phenomena occurring during the photopolymerization of thin porous layers, which may cause the formation of structural defects in them. Porous polymeric materials are now increasingly used in many industries, in particular in the production of heterogeneous catalysts, filter systems, bone implants and smart functional materials. One of the most commonly used methods of producing hierarchical porous polymeric materials is 3D printing from photocurable resins. During the 3D printing process of porous structures, it is important to maintain a minimum temperature gradient and the reaction progress gradient within the entire layer of the printed material. This ensures that the desired porous structure is obtained, free from structural defects. This is why it is very important to monitor the distribution of parameters such as temperature and the degree of conversion in the entire volume of the printed material layer. Unfortunately, because porous materials are characterised by a complex spatial structure, it is very difficult to determine these parameters over the entire reaction volume. Therefore, the considered processes for the production of porous polymeric materials have not been thoroughly investigated so far in terms of the distribution of these parameters in subsequent layers of the produced material.



In response to the demand for kinetic and calorimetric studies of the production process of porous polymer materials, this project undertook the development of two-component sensory systems and carrying out kinetic-calorimetric studies of such processes. In the first stage of research, the work will focus on the development of **two-component luminescent sensory systems.** In the second stage of work, **two measuring systems for kinetic-calorimetric studies of photopolymerization reactions** will be designed and constructed. In the next stage of work, it is planned to **verify the possibility of the application of the developed sensory systems** for kinetic-calorimetric studies of photopolymerization reactions in thin porous polymer layers. Tests of sensory systems will be carried out for model radical photopolymerization reactions of acrylic monomers in thin polymer films. The validation of the proposed measurement method will be carried out using the DSC and Real Time FTIR techniques. The last, but not the least, stage of the research will focus on the **study of phenomena that may cause the formation of structural defects during the preparation of porous materials** such as local overheating of the porous structure, inconsistent degree of monomer conversion in the volume of the printed structure, as well as blocking and cross-linking of the photocurable resin trapped in the pores. Influence of process parameters of photopolymerization on the occurrence and intensity of the aforementioned phenomena will also be investigated.

The most important effects of this project will be the development of new two-component sensory systems for kinetic-calorimetric studies of photopolymerization reactions, as well as a thorough examination of the influence of process parameters and the structure of porous materials on the occurrence of phenomena causing the formation of structural defects in these materials during their production using photopolymerization. Due to the fact that the proposed measuring technique combines spatial sensory measurements with flow visualization, it can also contribute to the discovery of previously unknown phenomena occurring in porous materials under mass and heat flow conditions. Certainly, such discoveries show great potential cognitive value in the field of heterogeneous catalysis, filtration materials and chemical engineering.