## Description for the general public

The 3D printing is presently one of the most intensively developing technology worldwide. Especially huge technological progress has been observed for the last decade. It has resulted in many innovative solutions in various fields of science, technology, art and entertainment. From the scientific point of view the most spectacular progress has undoubtedly succeeded in medicine, in which the 3D printing was used for prototyping organs and implants as well as preparing tissues. An increasing significance of the 3D printing has been also found in materials engineering, for example in constructing advanced tools and prototypes for aircrafts and spacecrafts as well as in electrochemistry, where the printed parts of electrodes are studied as platforms with various functions (e.g. gas detectors, sensors). In catalysis the application of the 3D printing has been insignificant till now. The developed applications have concerned on the preparation of only few supports and catalysts using techniques which enabled obtaining simple construction (one or two shapes) of catalyst without using full potential guaranteed by the control of structure during designing. A poor resolution of resulting objects, a limited chemical composition of materials and a lack of any information on technological limitations (i.e. real resolution of printing, mechanical resistance) have been disadvantages of these techniques.

The aim of the submitted proposal is a development of innovative methods for the synthesis of catalysts by the high-resolution 3D printing. Two alternative routes based on the 3D printing will be proposed for the preparation of heterogeneous catalysts. In our research we are going to use fully the potential of presently available equipment for the high-resolution 3D printing, which is based on photopolymerization. First approach will be focused on casting, which will be tested as a possible method for the preparation of catalysts. In this method the printed polymer matrices will be applied as templates to tune up size and architecture of channels (pores) in synthesized catalytic materials. Our preliminary studies showed the utility of this technique in the synthesis of heterogeneous catalysts. The important advantage of this solution is a possibility of entirely unlimited construction of polymer template shape, and consequently the architecture of catalyst. Since the printed matrix is only template, which during the subsequent step of synthesis is burnt, the chemical composition of precursor can be changed in a wide range. In another synthesis method we will use the 3D printing directly to the preparation of supports and heterogeneous catalysts. Therefore, we will plan to develop a series of inks containing all needed components – support, binder, active phase and fillers, which after the removal of photocurable resin, will be transformed into a solid material with defined catalytic properties.

Our goal is to develop catalysts for oxidative coupling of methane (OCM) and combustion of volatile organic compounds (VOCs) synthesized using the 3D printing. Both mentioned processes demand very carefully prepared catalytic materials. First of all, the catalysts have to be characterized by high thermal stability due to high working temperatures (e.g. 1023-1123 K in OCM) and hot spots caused by strongly exothermic nature of both reactions. Furthermore, in the case of the catalytic VOCs combustion, the catalysts without diffusion limitations are desirable because they should work in end-pipe technologies. For the mentioned catalytic applications, the structural catalysts with good mass and energy transfer and low pressure drop seem to be ideal. It is expected that the proposed synthesis method based on the 3D printing should enable the optimization of catalyst architecture in order to intensify the catalytic processes.