DESCRIPTION FOR THE GENERAL PUBLIC

Catalytically active materials are widely used in various areas of chemical industry, environmental protection and energy conversion. Therefore, there is a need to develop new, low-cost and easy to produce materials that meet specific requirements. Recent scientific reports indicate that intermetallic phases characterized by a highly ordered crystal structure, exhibit catalytic properties not only in the form of nano-particles but also as bulk materials or powders.

The main goal of the project is to verify the possibility of using a conventional metallurgical method combined with rapid solidification technique for the preparation of catalytically active materials based on intermetallic phases. Selection of intermetallic phases will be based on the analysis of the phase diagrams and crystallographic criterion stating that the symmetry of the phase must satisfy the requirements of active sites existence, which in this case are transition metal atoms located in the ordered crystalline structure.

It is planned to examine two groups of materials: from Ni-X (X = In, Zn, Sn, Al) system with a high degree of ordering and the Al-X (X = Fe, Co, V, Cu) phases, which are approximants of quasicrystals (this compounds are built from clusters characteristic for quasicrystals). For the production of intermetallic phases, a melt spinning technique will be used to obtain a material in the form of 20-80 μm ribbons with refined microstructure (crystallite 1-2 μm). This will significantly increase the active surface compared to conventionally cast materials. It is also planned to produce a material in the form of single crystal (Bridgman method), which as a model system is essential for performing in-depth analysis of the relationship between surface properties, geometry and orientation of a given crystal and the preferred catalytic properties.

Obtained materials will be subject to full microstructure characteristic of the microstructure at each stage of their preparation. The influence of the parameters of rapid solidification and directional crystallization on the structure and morphology of the phases will be determined and the optimum conditions the optimum conditions of both processes will be selected. In the samples subjected to heat treatment particular attention will be paid to the degree of structural ordering, which plays a key role in the chemical processes taking place during catalysis. For this purpose, the following methods will be used: X-ray diffraction and advanced scanning and transmission electron microscopy. Selected samples will be tested for their catalytic properties.

The project assumes a comprehensive approach to the production of active catalytic materials based on intermetallic phases, including optimization of their manufacturing process and surface and heat treatment. One can therefore expect that the project will bring new and valuable information regarding the structure and physic-chemistry of intermetallic phases. It is worth emphasizing that the use of intermetallic phases in heterogeneous catalysis is a relatively new, dynamically developing field of study, of great importance for the development of efficient and competitive catalysts in the future