DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

The continuously increasing demand for electric energy in Poland is mostly met by sources based on fossil fuels, i.e. natural gas and coal or petroleum, in case of vehicles. Currently used, conventional methods of energy conversion from the chemical energy accumulated in fossil fuels entails a risk of depletion of natural resources and, most importantly, increasing emission of exhaust gases, i.e. carbon dioxide, which is harmful for the environment. Mentioned environmental threats have increased interest in developing new, non-conventional, environmentally friendly and more efficient ways of energy generation and conversion. One of the possible research directions in this field are fuel cells, which could have a wide range of applications in industry, in particular in automotive industry and also for portable devices.

In general fuel cells allow for direct conversion of chemical energy to electrical energy with much higher efficiency than in case of classical combustion engines with almost no produced exhaust, hence, devices powered by such cells are environmentally friendly. However, production of fuel cells require using expensive materials what causes strong limitation of their massive commercialization.

The aim of this project is to obtain and characterize new materials, the use of which can lower the production and operation costs of one of fuel cell types - Solid Oxide Fuel Cells (SOFC). The key element of such a cell is electrolyte, a membrane which should be able to transport only oxide ions. Particularly important for efficient operation of solid oxide fuel cells is also proper selection of electrode materials, where oxidation and reduction processes of fuel take place. Electrode materials should show high conductivity, both ionic and electronic, and proper catalytic properties. It is necessary also to minimize undesired polarization effects on electrolyte – electrode interfaces, which are increasing overall resistance of the cell. Compounds obtained by doping of cerium oxide are currently considered as candidates not only for electrolyte but also for electrode in SOFC. In this project, cerium oxide doped with praseodymium system of general composition $Ce_{1-x}Pr_xO_{2-\delta}$ will be prepared and characterized. Research studies planned in the project are focused on characterization of electrical and structural properties of these materials . For this purpose various complementary experimental methods will be used but also new and advanced methods of data analysis will be applied and developed. One of the main project objectives is to determine structure – conductivity relation, especially mechanisms of ionic and electronic transport in studied compounds. Understanding how the crystal structure affects electrical properties can be helpful in future development of a new generation materials for SOFC.