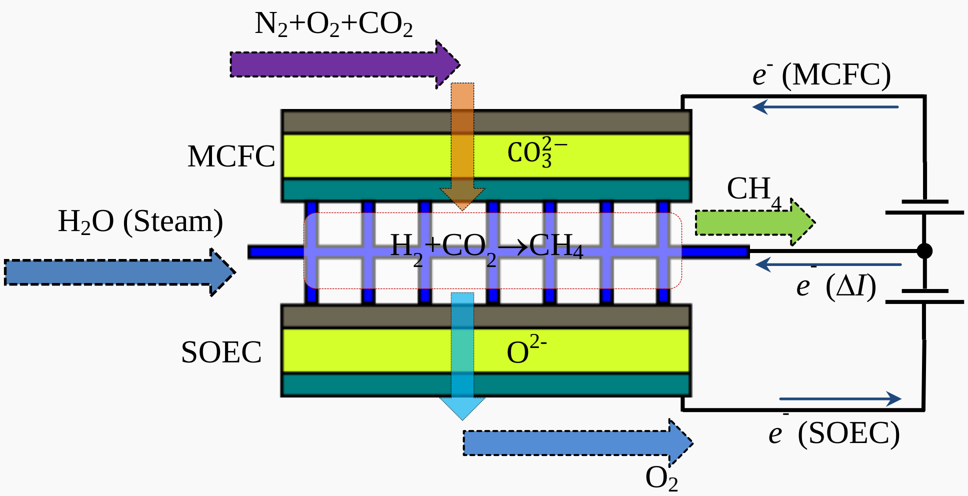
DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

The aim of the proposed project is the completion of experimental studies and mathematical modeling of electrochemical and transportation processes in high-temperature reactor, based on a combination of molten carbonate fuel cell (MCFC) and solid oxide electrolyser (SOE). If the common anodic compartment of MCFC is fed with steam, which is electrolyzed by SOE in situ, one can expect a chain of chemical transformation of carbon dioxide (which is always involved in ionic current trough MCFC).



Key hypothesis of the project is an assumption that carbon dioxide can be electrochemically activated on MCFC anode, and, being activated, it can easily be reduced with hydrogen, generated by SOE from steam. Hydrogenation of the CO_2 may lead to formation of the valuable products like methane. This is main objective of the project: experimental observation of the CO_2 hydrogenation. However, due to complex nature of the processes in such kind of reactors, experimental studies have to be coupled with strong modelling, which will resolve two main issues: keeping reactor on necessary level of balancing in heat, mass and charge transportation and separation of the various factors, which may impact on reactor performance.

Data analysis, based on elaborated models, will allow to make clear conclusions concerning chemical processes in reactor and prospective of further development in this direction. Necessary to note that described above process, electrochemical methanization of carbon dioxide, already studied, but implementation is based on SOE reactor, which should be fed with pre-mixed steam and purified CO_2. It is expected, that separation CO_2 in situ by MCFC supplemented by anticipated electrochemical activation will allow gain substantial benefits against head-on electrolysis.

In terms of the fundamental science and development of the knowledge considered project is an original study, which led to insight in to complex phenomena of electrochemical transformations coupled with non-isothermal gas diffusion and hydrodynamics.

In case of successful implementation project would form a basis for novel branch in “power-to-fuel” technologies, which become more and more prospective due to extensive expansion of solar and wind generation.