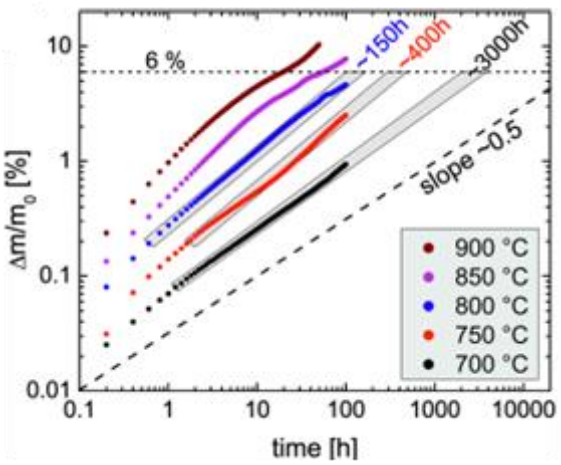
Lifetime extension of high chromium ferritic porous alloys by application of ultra-thin aluminium oxide coatings

Solid oxide cells (SOC) are gaining more and more interest in the scientific world as well as in the industry. They are often used as a backup power source, for example in hospitals. In a typical solid oxide cell system, advanced ceramic components like Ni-YSZ are used as support materials. Unfortunately, these materials are expensive and difficult to manufacture. To solve this problem metal-supported solid oxide cells have been extensively developed in recent years. The metallic supports are cheaper, easy to fabricate and provide sufficient electrical conductivity. In order to reduce the material cost the porous form of the alloys has been proposed as a support and interconnector material for solid oxide cell applications. In addition, the porous structure of the alloys ensures gas permeability within the material. The biggest problem for porous alloy application in SOC systems seems to be the corrosion process that leads to forming the oxide scale on the porous alloy`s surface. Then, a possible path for gas is blocked and an electrical current flow is limited. Thus, the lifetime of the device strongly depends on the lifetime of the porous alloy substrate. The solution to this problem can be a protective coating.

The aim of the project is extension of the lifetime of high chromium ferritic porous alloys by application of ultra-thin alumina coatings by at least 10 times (one order of magnitude) at high temperatures (> 600 °C). So far, the corrosion properties, as well as the electrical conductivity of the porous alloys, have been studied to a limited extent. The predicted lifetime of these materials is estimated as ~3000 h at 700 °C and only ~150 h at 800 °C. The novelty of the proposed research is the application of the atomic layer deposition (ALD) technique to obtain the ultra-thin protective coating on porous substrates and a detailed study of their corrosion kinetics and electrical conductivity of them.



The project will significantly increase the state-of-the-art knowledge in the field of coatings of porous alloys and their high-temperature corrosion. The new data about the electrical and gas permeability properties will provide new insight into the applications in SOC systems. The optimisation of the deposition process should improve the corrosion resistance of porous alloys and allow for elongation of their lifespan. Thus, a project will create an original way to fabricate cheaper and lighter solid oxide cells that can successfully replace ceramic-based systems.