The aim of the project is to develop and characterize the enhanced protective layer for commercially available ferritic steels with high chromium content, which can be used for the construction of interconnectors for Solid Oxide Cell (SOC) stacks. So far, in scientific research, R&D works and commercial solutions, mainly high-cost, specialized steel with a composition optimized for high-performance SOC operation at high temperatures (above 750°C) - Crofer® steel (German company VDM Metals) is used. The use of widely available, lower-cost steel will reduce the SOC manufacturing cost and minimize the risk associated with the limited amount of Crofer® steel on the market (one supplier), which will undoubtedly increase the market attractiveness of the SOC technology. However, the implementation of commercially available ferritic steels in SOC stacks as interconnectors is associated with a major research challenge on the part of materials, as well as chemical and process engineering. Protective coatings of both specialized and widely available steel are necessary for the proper operation of SOC stacks, due to poisoning of the cell's air electrode because of evaporation of chromium from steel at SOC operating temperatures. The role of the protective layers is to stop the diffusion of chromium from the steel surface and to limit the growth of chromium oxide scale with low electrical conductivity, which is formed on the surface of the interconnectors on the air side. The quality of the protective layer, understood through the prism of such properties as density, thermomechanical stability and electrical conductivity, affects the lifetime of the SOC stack and the rate of its degradation.

An important difference between the steels is also the method of production, which allows almost complete elimination of silicon in special steel, while in typical high-chromium ferritic steel, the amount of silicon is about 0.5-1 wt.%. Due to this fact, the use of cheaper steel is associated with the formation of non-conductive amorphous silicon oxide - the protective coatings developed as part of the project must additionally reduce this problem, e.g. through a small admixture of rare earth or alkaline earth elements that can capture silica, contributing to the formation of crystallized micrograins. In addition, due to the lack of admixture of typical steels with elements such as La or Ti, which support the formation of a dense, well-adhering scale on the steel surface, instead of intergrain oxidation inside the steel, it is necessary to propose a technique for depositing a protective layer that will not require high-temperature sintering. So far, the formation of the protective coating was most often associated with a two-stage sintering of oxide materials such as manganese-cobalt or manganese-copper spinel, i.e. reduction at ~1000°C and re-oxidation above 800°C. In addition, the project assumes the use of surface-functionalized electrospun micro- and nanofibers as a component of the protective layer of the interconnector, which could completely or partially replace the powder-based contact pastes, directly contributing to improving the efficiency of the system with SOC cells.

During the carried out research, it is planned to compare two types of steel representing the widely available ferritic steel: AISI 430 (1.4016) and AISI 441 (1.4509). Spinel $Mn_{1.5}Co_{1.5}O_4$ will be deposited as a reference coating. One of the key parameters to be tested will be Area Specific Resistance (ASR), measured both in a short time and during long-term exposure to simulated SOC operating conditions (1000 h), both in an oxidizing and double - oxidizing and reducing atmospheres, using specially prepared measuring station.

New coatings will be made on the basis of $(Mn,Fe,Cu)_3O_4$ spinels, in which electrospun fibers based on highly conductive perovskites (e.g. $La(Mn,Cu,Co)O_3$) will be incorporated. The kinetics of corrosion of steel with coatings will be investigated by thermogravimetric measurements of samples subjected to oxidation for 3000-5000 h. Samples after both tests will be subjected to a detailed *post mortem* analysis using SEM, EDS, TEM, XRD techniques to better understand the steel degradation processes and to understand the changes occurring at the protective layer - steel boundary. Materials with the best properties will eventually be used to make full-size interconnectors and to conduct tests of the SOC cell stack in reversible mode - both in the fuel cell mode (SOFC) and in the electrolysis mode (SOEC). A long-term test (approx. 1000 h) is planned to verify the applicability of the developed solutions.

The motivation to undertake the proposed research is the need for modern, low-emission technologies that efficiently generate and store energy, which could balance the power grid with renewable sources. The SOC technology is a very promising prospect that offers both support for energy production and hydrogen production as a form of energy storage or energy conversion for the synthesis of gaseous, liquid fuels or ammonia. At the same time, from the scientific side, there is a need to better understand the degradation mechanisms of ferritic steels at temperatures of 600-700°C in oxidizing and reducing atmospheres, and to determine the properties of materials that can form effective protective coatings intended for operation in similar conditions. The expected effect of the project is a significant advance in SOC technology, going beyond the current state of knowledge, as well as obtaining a new protective material and developing an effective technique for its deposition for SOC interconnectors based on commercially available ferritic steels.