Among the environmentally-friendly technologies for energy conversion, the solid oxide fuel cells (SOFCs) and regenerative-mode running solid oxide electrolysis cells (SOECs) are ones of the biggest prominence, offering numerous advantages over conventional heat engines. Unfortunately, their widespread application is still limited by the high operating temperature, decrease of which is the ultimate goal of SOFCs' design. The performance of the fuel cell is dictated mainly by the transport properties of the electrolyte and electrodes, anode and cathode, respectively. However, the unit cell does not provide sufficient power output, therefore the cells are put together in stacks, connected through the interconnector parts, multiplying the voltage and power of the device. The interconnect can be considered as a key component of the SOFC, as its role covers multiple aspects of the fuel cell's operation: physical support to the stack, separation between the reducing (at anode) and oxidizing (at cathode) atmospheres of adjacent units, charge collecting, allowing redirecting the electronic current to the external receivers. As a result of such diverse responsibilities, the selection criteria for the interconnect materials are especially rigorous.

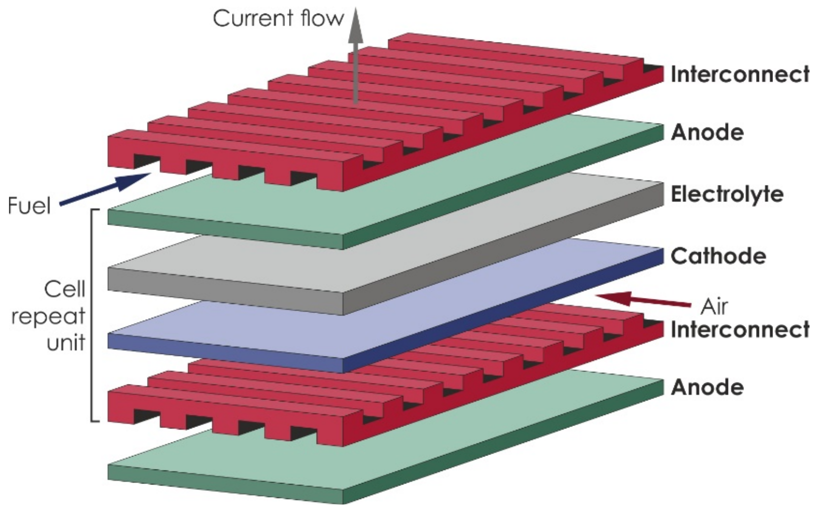

Fig. 1. *Schematic representation of planar-geometry SOFC.*

The application of metallic interconnects, enabled by the introduction of intermediate-temperature SOFCs (IT-SOFCs), while greatly reducing the cost of the devices, resulted in a number of previously unencountered problems, including continuous degradation of interconnect's performance due to the growth of the protective Cr_2O_3 scale on its surface, as well as the presence of Cr-poisoning effect, caused by the deposition of volatile Cr species on catalytically active areas of the electrode. Both these phenomena are considered as main longevity-limiting factors for state-of-the-art fuel cells. One of the possible solutions is the application of the protective-conductive coatings for interconnects. The main scientific goal of the proposed project is development of the next-generation of such materials, based on the application of the high entropy approach to their design, combined with an in-depth understanding of their working principles. The high entropy approach is based on utilizing multiple composing elements in near-equimolar ratios. As a result, the system is characterized by extremely high configurational entropy, which enhances the stability of so-called solid solution structures, and introduces a number of new properties, resulting from the synergistic effects. Furthermore, such an approach creates the unmatched capability for tailoring the properties of the materials.

The leading hypothesis of the project is that the application of the high entropy oxide (HEOx)-based protective-conducting coatings, benefiting from such features as enhanced stability due to entropic stabilization and reduced diffusion rates, will allow obtaining coatings of superior performance. To verify this hypothesis, an extensive and comprehensive study of the spinel- and perovskite-structured high entropy materials will be undertaken, covering different aspects of their operation under conditions close to those in the fuel cell, including the comprehensive elucidation of the corrosion-protective and Cr-poisoning-protective properties of the coatings.

The project will result in the first-ever evaluation of the HEOx materials as potential conductive-protecting coatings for SOFC applications, potentially allowing solving some of the most important issues limiting widespread application of this technology. The obtained results will allow for significant advancement with regard to the state-of-the-art, impacting both the development of HEOx and SOFC technology, widely regarded to be among the leading directions of studies in materials science. Furthermore, the results may provide much-needed breakthrough in the SOFC technology, being an important step towards the next-generation power grid.