Currently used alloys resistant against oxygen at high temperatures, mainly from the so-called *alumina-* or *chromia formers* group, are not equally resistant against the aggressive influence of sulphur. In oxidizing atmospheres the high resistance of these alloys ensures the growth of a protective products' layer during oxidation called a scale, which contains Al_2O_3 or Cr_2O_3, respectively. However, in sulphur vapour-containing atmosphere these alloys undergo rapid degradation, because, inter alia, both Al_2S_3 and chromium sulphide demonstrate insufficient protective properties. Conversely, refractory metals that exhibit very good resistance against sulphidation degrade very quickly in the presence of oxygen, mostly due to the formation of porous scales or volatile oxides. A serious attempt to create materials resistant against both oxidation and sulphidation was made 30 years ago. It involved designing two-component amorphous alloys consisting of aluminium and refractory metals. These materials distinguished themselves with their excellent sulphidation resistance. However, they also demonstrated just satisfactory oxidation resistance and only at temperatures up to 900ºC, and thus, did not find any practical application. It should be emphasized that due to the wide variety of aggressive gas atmospheres commonly found in several branches of industry, a single universal metallic material, which ensures corrosion protection under all conditions, has still not been discovered. Initial experimental results obtained by our team indicate, however, that thanks to the development of a new group of materials, i.e. high-entropy alloys, it is now possible to select a composition that allows for resistance against both oxygen and sulphur, as well as water vapour and chlorine, to a degree comparable to that of the best currently applied allows, the compositions of which are dependent on the different aggressive gas atmospheres. The goal of this project is to develop high-entropy alloy compositions based on refractory elements with the addition of aluminium that are resistance against the aggressive influence of oxygen, sulphur, water vapour, and chlorine up to 1000ºC. There is a rational foundation for assuming that these alloys will not only exhibit very high scaling-resistance in atmospheres consisting of a single gas, but also in their multicomponent mixtures. In the framework of this project, scaling-resistance will be assessed in isothermal conditions by means of thermogravimetric analysis and under thermal shocks. Regardless of the steps taking to achieve the above-mentioned main goal, the mechanism responsible for the good corrosion resistance of the materials in various reactive atmospheres will be identified during project realization. The possibility of their application at temperatures up to 1400ºC in oxygen-containing atmospheres will also be verified. A positive result from realizing this stage will become an important indicator in favour of performing further studies in the future that aim to widen the selected alloys' range of applicability. Furthermore, an attempt will be made to select alloy compositions that will not result in brittle materials. Success in this endeavour would enable application of the materials as more than just protective coatings.

Due to the significant complexity of the planned studies, project realization has been divided into five stages. In the final stage, all the results will be comprehensively interpreted and partial conclusions made during realization of the previous research tasks will be analysed. At this stage of project realization, eventual complementary investigations will also be performed in order to systematize the state of knowledge that was already achieved. Final conclusions will be formulated that pertain not only to the scaling-resistance of the refractory metal-based high-entropy alloys selected for the studies that were subjected to various hot reactive atmospheres, but also the process of obtaining these alloys by melting in an electric arc furnace. Additionally, ideas for further development of the alloys investigated in this project will be proposed.

It should be highlighted that successful realization of the proposed project can have a significant impact on the development of a novel, currently non-existent, group of scaling-resistant materials with a potentially wide range of applications in several branches of industry, in equipment that requires the usage of highly aggressive hot gas atmospheres. It would also undoubtedly be a milestone in the search for materials that exhibit universal resistance against high-temperature corrosion.