Heat and creep resistance of nickel superalloys is higher than other metallic materials and that is why blades and vanes of aircraft engines, that are subjected to intensive destruction which results from variable stresses, high temperature (above 1200 ^{o}C) and oxidative gases environment, are made of nickel superalloys. The most efficient way to improve the durability of engine blades is the use of protective coatings. In the aircraft turbine industry aluminum based diffusion coatings deposited by the CVD method are generally used. The NiAl phase in aluminide coatings improves the hot corrosion resistance of superalloys. The NiAl phase is the most stable of all phases in the Ni-Al system. It is creep resistant and has good adhesion to the substrate. Aluminide coatings do not fulfill the requirement of the long term oxidation resistance at high temperature. Modification of aluminide coatings is the most effective way to increase oxidation resistance of turbine blades. Pt-modified aluminide coatings improve the protection of nickel-based blades from oxidative gases even at the temperature above 1400 ºC. However platinum leads to formation of the $PtAl_2$ phase in the coating microstructure. Low ductility of $PtAl_2$ and large difference of thermal expansion coefficients between the substrate and platinum causes the coating degradation under the cyclic thermal stress. Some literature data indicate, that platinum could be substituted by rhodium, zirconium and hafnium. It has been proved that small addition of rhodium, hafnium or zirconium to the aluminide coating leads to about twice higher oxidation resistance. Until now, there is now data of the synergy of the simultaneous interaction of two elements (Rh+Zr or Rh+Hf) on the kinetic of the growth of aluminide coating deposited on nickel and nickel based superalloys. Therefore the scientific aim of this project is determination of the synergy of the simultaneous interaction of two elements (Rh+Zr or Rh+Hf) on the kinetic of the growth of aluminide coating deposited on nickel and nickel based superalloys. On the basis of the analysis of the literature data and results of experiments performed by the leader of this project, the following hypothesis has been proposed simultaneous usage of two modificators (Rh+Zr or Rh+Hf) will slow down the rate of the aluminiun oxide growth and improve its adherence to coated elements. This way the oxidation resistance of the coating will be improved.

There are two aspects of the pioneering nature of the project:
I. The analysis of synergistic effect of Rh+Hf and Rh+Zr and the role of this elements in the kinetic of the aluminide layer formation.
II. The characteristic of the influence of dopands on the kind and density of defects and diffusion process of aluminide coatings.
The project involves:
- deposition of the rhodium layer on nickel and nickel superalloys by the electrochemical method,
- deposition of the zirconium or hafnium modified aluminide coatings on nickel and superalloys with rhodium layer by the chemical vapour deposition method,
- analysis of the phase and chemical compositions and microstructure of the modified aluminide coatings,
- investigation of the kind and density of defects of the substrate and modified aluminide coatings by the Positron Annihilation Lifetime Spectroscopy (PALS),
- analysis of the oxidation resistance of modified aluminide coatings

The proposed research are placed in the area of the surface engineering and the obtained results will increase the knowledge of materials science. The economic effect of the research will be the increase of the exploitation time of aircraft engines The results of planned research will be published in domestic and international scientific journals (including journals from the JCR list) and will be presented on domestic and international scientific conferences. This project is a continuation and broadening of the research carried on by the leader of this project and it will be basis of habilitation's thesis of the leader of the project. Moreover, the results will be used for elaboration of the coatings' modification technology carried on in the Research and Development Laboratory for Aerospace Materials.