The scientific aim of this project is to determine the mechanism of formation of the aluminide coatings modified with palladium and zirconium or palladium and hafnium deposited on nickel and nickel superalloys substrates. This mechanism will explained by the characterization of the chemical and phase composition of coatings, their crystallographic structure and distribution of modificators. On the basis of the analysis of the literature data and results of experiments performed by the authors, there has been proposed the following hypothesis: simultaneous usage of two modificators (Pd+Zr or Pd + Hf) will slow down the rate of the aluminiun oxide growth and improve its adherence to the coated elements. This way the oxidation resistance of the coating will be improved.

Deposition of palladium layers on nickel and nickel superalloys substrates will be performed by the electrodeposition method. Deposition of hafnium or zirconium modified aluminide coatings on nickel and nickel superalloys with palladium layers will be performed by the chemical vapor deposition method (CVD). The BPX pro 3235 equipment manufactured by Ion Bond Company will be used. The microstructure of the cross-section of coatings and the elements, distribution will be investigated by an optical microscope Nikon Epiphot 300, a scanning electron microscope (SEM) Hitachi S-3400N and an energy dispersive spectroscope (EDS) and a transmission electron microscopy (TEM). The characteristic of the structure of pores and voids and the influence of dopands on the structure of the structure of defects and diffusion process will be analyzed by the Mössbauer spectroscopy and Positron annihilation lifetime spectroscopy (PALS). This techniques will be applied for the for the first time in the analysis of aluminide coatings. The oxidation resistacne of the coated samples will be determined at 1100 ^{0}C at the air atmosphere.

Turbine blades used in engine hot sections are made of nickel superalloys and are mainly degraded by high temperature oxidation and hot corrosion. The application diffusion coatings is an effective way to increase the oxidation resistance of the treated parts. This is obtained by the formation of a protecting surface of Al_2O_3. Protective aluminide coatings deposited on superalloys are degraded by the loss of Al due to oxidation of the coating surface to form aluminum oxide and by interdiffusion with the underlying substrate. It accelerates the rate of the oxide growth and results in the loss of the coating strength and deformation of the coating. The addition of small amount of noble metals (platinum or palladium) or reactive elements such as: hafnium, zirconium, yttrium and cerium has a beneficial effect on oxidation behavior. This beneficial effect includes an improvement of adhesion of alumina scales and reduction of oxide scale growth rate. The use of RE 'co-doping" has recently been emphasized as a strategy for optimizing the oxidation resistance of superalloys, conventional alloys and coatings. Different pairs of co-dopants were taken into consideration for instance: Y+Hf, La+Hf, Pt+Pd, Y+La, Dy+Hf, Hf+Zr, Hf+La or Y+La. The analyzed co-doped coatings exhibited lower oxidation rate than the corresponding single– dopped ones. The dopants ions (Hf+Zr and Y+La) segregated on oxide grain boundaries and acted as ionic clusters which have stronger interaction with Al ions than two individual ions, thus producing a synergistic effect. Pt+Pd modified aluminide coatings exhibit significantly higher β-NiAl phase stability as well as maintain more stable alumina oxide layer. The analysis of the literature data and the results of experiments performed by the authors of this project encourage to the further research in this area. The influence of single dopants on the microstructure and oxidation resistance of the coating have been widely investigated, but sinergisic effects of two dopants are hardly known. Therefore, the authors of this project plan to analyze synergistic effect of Pd+Hf and Pd+Zr and the role of this elements in the kinetics of the aluminide layer formation. The influence of single dopants Pd, Hf and Zr and their role in the coating formation have been investgated by many authors, including the authors of this project. Each of dopants significantly improved the oxidation resistance of the coatings, but the mechanism in which the dopant's atoms stabilize the β-NiAl are different. Palladium dissolves in the coating and stabilized the β-NiAl phase, whereas hafnium and zirconium are markers of the diffusion process. They form inclusions at the additive/interdiffusion layer interface.The synergistic effect of these two dopants has not been analyzed yet. Therefore, the scope of research proposed in this project, that is a thorough analysis of Pd+Hf and Pd+Zr modified coatings is a pioneering one. The research will be performed by means of many techniques, such as scanning electron microscopy, transmission electron microscopy (TEM), Mössbauer spectroscopy and Positron annihilation lifetime spectroscopy (PALS).