The aim of the project is determination of the influence of long-term annealing and creep at high temperature on transformations of precipitates in additively manufactured nickel-based superalloy IN 625.

Additive manufacturing is a family of innovative technologies, so-called 3D printing, successfully used for manufacturing of parts, also made of metal alloys, including nickel-based superalloys designed for operation at high temperature.

Despite the large interest in the additively manufactured IN625, changes in the microstructure of this material after long-term annealing and creep have not yet been thoroughly investigated. To fill this gap the comprehensive research is proposed within this project.

The especially interesting problem is to investigate the influence of chemical elements segregation, resulting from rapid crystallization of successively overlapped thin layers of melted powder on formation of precipitates and their transformations during long-term annealing. Research interest is also focused on the understanding of the effect of precipitates on the creep resistance of additively manufactured IN625.

Achieving of the project objectives requires comprehensive research including microstructural characterization, thermodynamic calculations and modeling of the phase distribution.

Electron microscopy investigations will allow to characterize changes in the microstructure caused by the high temperature exposure. Thermodynamic calculations will lead to the determination of equilibrium phases possible to exist in dendritic and interdendritic areas of additively manufactured IN625 superalloy subjected to high temperature annealing and creep. Based on the results of microstructural characterization and thermodynamic calculation a two-dimensional model of the phase distribution, quantitatively consistent with the experimental distribution will be proposed.

The innovative studies within the project will allow to gain knowledge about the changes in the microstructure of additively manufactured IN625 under the influence of high temperature and external load. The achieved results can be applied in the domestic automotive, aerospace and energy industries to replace traditional production technologies of some parts with additive manufacturing processes.