The development of functional materials that determine progress in many fields of technology is closely linked with the use of single crystal materials. In aviation, among others, nickel-based superalloys are used to produce single-crystal turbine engines. Single-crystals of nickel-based superalloys are characterized by the two phase components in their microstructure: crystal of phase γ - matrix and γ '- secretion. The values of a lattice parameter γ and γ ' phases are similar and they are respectively $a_{0\gamma}$ = 0,352nm and $a_{0\gamma'}$ = 0,3561nm. High degree of coherence at the interface allows treatment of the structure of single crystal nickel-based superalloys. by the definition of the International Union of Crystallography.

Single crystals of nickel-based superalloys due to its good mechanical and thermal properties at high temperatures > 950°C are applied for the elements of hot parts of aircraft engines, among others, the blades of a 1st and a 2nd turbine stage and turbine vanes. Therefore they are particularly exposed to work in extremely difficult conditions, the impact of high load, high temperature and environment oxidizing gases. Nickel-based superalloys operating conditions favor the occurrence of the phenomenon of creep, which is the main factor causing damages. Complex design of an aircraft engine and the cost of manufacture and maintenance, as well as the need to ensure the safety of passengers require production of its components, with the highest quality and resistance to working conditions. Single crystals of nickel-based superalloys are critical elements and due to this their quality control, as well as the rate of crystal structure by X-ray diffraction methods are very important.

In the process of directional solidification one embryo may increase generating a single crystal characterized by a structure with a crystallographic orientation - usually about the direction [001]. This direction is parallel or slightly inclined to the direction of pull. The parameter that characterizes the perfection of the crystal structure of single crystal nickel-based superalloys is to determine the value of the tilt angle α - between the direction of withdrawal and the direction [001].

The aim of the researches undertaken in the project is to rate the crystal perfection of the crystal structure of single crystal of nickel-based superalloy. Determine the crystal perfection of the crystal structure at the macro and micro scale for the individual components of phase microstructure of single crystals is planned to. These studies will be conducted for both the single crystals in a condition directly after directional solidification as well as for impacts in terms of the temperature and the time.

X-ray diffraction methods will be used. The Department of Materials Science in Rzeszów University of Technology in cooperation with the Institute of Materials Science University of Silesia developed a modified method of Laue enabling an assessment of crystal perfection of the crystal structure of single crystals with the complex shape and large size. The basis of this method was to change the structure of X-ray diffractometer. Developed was the basis for the extension of new research techniques including diffraction in microregions. The research will be lead with the use of specialized diffractometers made to assess the structure of crystal perfection of single crystals nickel-based superalloys.

Implementation of the planned project of research tasks will determine the value of the tilt angle α in microregions of the main components of phase microstructure of single crystal nickel-based superalloys. Terms of variables: the time and the temperature will allow an rate of changes in the value of tilt angle α.