High Entropy alloys (HEA) are a new group of structural and functional materials. In their chemical composition there are five or more elements in the amount of 5-35 atomic %. The new concept proposed for designing materials without a dominant element creates new possibilities for obtaining alloys and metallic compounds with high mechanical properties.

The research predicted under the project concerns the use of the HEA concept of a completely new composite based on a Ti-Zr-Hf-X-X HEA containing M= Ti, Zr, Hf, Nb, Ta, Ru, Rh, Os, Ir, reinforced with complex nitrogen pernitrides compounds. This will be possible thanks to the development of a casting process using an innovative application of high pressure nitrogen and temperature, resulting in a supersaturated solid solution alloy with nano-precipitations of transition metals nitrides with general formula MxNy, M= Ti, Zr, Hf, Nb, Ta, Ru, Rh, Os, Ir. The material produced in this way will be extremely useful in a wide range of industrial applications due to its excellent mechanical properties, such as high strength, hardness and modulus of elasticity. What is more, the new alloy will be studied to explain phenomena occurring after crystallization by analyzing the microstructure of forming phases containing nitrogen depending on gas pressure and temperature used. New metallic-ceramic compounds based on transition metals and nitrogen will be characterized by properties that cannot be achieved by using other conventional manufacturing methods like casting or plastic deformation.

The potential use of new materials envisaged for the project depends on the effective and economical method of their production, which should be maximally optimized in terms of obtaining components without defects. The result of the research carried out under the project is also a process model, which in turn will allow the development of efficient technology for the production of high entropy titanium composites for applications in various branches of the industry.