Magnesium alloys are characterized by one of the lowest densities among commercially applied structural metallic materials. Their most important property is high specific strength, comparable to these, exhibited by aluminium alloys and some kinds of steel. As a result, magnesium alloys are often applied in automotive and aerospace industries, where the weight savings are essential. Currently, the most often applied magnesium alloys are these, with aluminium addition (Mg-Al-X, X=Zn, Mn). However, their main disadvantage is weak thermal stability, which limits their application up to ~120°C. Majority of the structural elements in the transportation industry, such as engine housings, gearbox housings etc. are exposed to higher temperature. This disqualify magnesium alloys with aluminium addition for such applications. Thus, one of the most important directions of development of magnesium alloys is to increase their thermal stability. This has been achieved by replacing aluminium with rare earth elements (RE). These elements forms with magnesium thermally stable intermetallic phases. As a result, high mechanical properties of the alloys are kept up to ~250°C. Mg-RE alloys have found application inter alia in modern racing cars and in the defense industry.

Rare earth elements are extremely expensive and difficult to access. Due to, many researches are performed to develop creep resistant magnesium alloys without RE addition. So far, no satisfactory results have been obtained. One of the promising systems for such application is Mg-Bi. Intermetallic phases in such alloys are characterized by even higher thermal stability than the phases in Mg-RE systems. Moreover, Mg-Bi system is a classic system with limited solubility of bismuth in solid magnesium. This enables age hardening of the alloys, significantly increasing their mechanical properties. Strengthening phases formed in the Mg-Bi system may be precipitated in form of plates or laths on the prismatic planes of α-Mg crystal lattice. Researches revealed, that such particles bring the highest increment to the magnesium alloys strengthening. So far, phases with such morphology were found only in Mg-RE alloys. In conclusion, all above mentioned factors make Mg-Bi alloys a prospective alternative for magnesium alloys containing rare earth elements. Consequently, the results of the proposed research project may lead to future development of the magnesium alloys, being cheaper substitute for Mg-RE system.

For these reasons, the main objective of the project is description of the mechanisms of strengthening phases precipitation in the Mg-Bi and Mg-Bi-X (X=Zn, Mn, Ca) alloys. Secondary aims, realized in the project are following; Description of the precipitation sequence in the Mg-Bi and Mg-Bi-X (X=Zn, Mn, Ca) alloys; Analyses of the strengthening phases influence on the Mg-Bi and Mg-Bi-X (X=Zn, Mn, Ca) alloys mechanical properties; Description of the influence of the type and morphology of the phases on the Mg-Bi and Mg-Bi-X (X=Zn, Mn, Ca) alloys corrosion resistance. Performed researches will help to find out if the alloys from Mg-Bi system may be potential substitute for the Mg-RE alloys.

The investigations conducted within the project will include microstructural analyses both in the as-cast and heat treated Mg-Bi and Mg-Bi-X (X=Zn, Mn, Ca) alloys. This will lead to description of the precipitation mechanisms of the strengthening phases in these alloys. Basic investigations on the materials' properties, such as mechanical properties and corrosion resistance will be conducted. This will result in the description of the alloys' phase composition on their properties.