For many years, zinc and its alloys have been used for cast details, anticorrosion protection, and soft, thin sheets. However, biodegradable metallic alloys' very fast development for bone-fixing plates and cardiovascular stents increased interest in Zn alloys once again. Nowadays, researchers have focused on developing biodegradable, high-strength, ductile Zn alloys. Chemical segregation during crystallization is one of the most frequent problems, which makes strengthening less effective.

This project presents two-stage fabrication technology of biodegradable zinc alloys, based on rapid solidification using melt spinning technique and subsequent consolidation using high-pressure torsion. Such a processing route allows to reduces chemical segregation in fabricated material significantly. Each of the planned stages was carefully selected to finally obtain a material characterized by ultrafine-grained microstructure with uniformly dispersed second-phase particles. In the first step, a melt spinning provides a crystallization in the twinkling of an eye, changing a homogenous liquid into a metastable solid with negligible segregation. Thin, melt-spun ribbons and wires are not the best load-bearing materials. Thus, a high-pressure torsion (a pressure 60.000 times higher pressure than atmospheric one) consolidation will be performed in the second step. It was an optimal choice considering effective consolidation at room temperature and severe plastic deformation, which further refines microstructure. A final effect of two-step fabrication will be high-strength, ultrafine-grained biodegradable zinc alloys.

Experiments planned in this project will focus on the effect of chemical composition and applied processing route on final microstructure and mechanical properties. Various advanced electron microscopy techniques will qualitatively and quantitatively characterize microstructure. The processing method's effectiveness will be evaluated based on hardness measurements and uniaxial tensile tests. A corrosion behavior of fabricated alloys will be tested in a simulated body fluid.

The proposed project presents possibilities of combined rapid solidification and high-pressure torsion of biodegradable zinc alloys for the first time. In the end, the project will expand scientific knowledge in the field of ultrafine-grained, biodegradable zinc alloys. On the broader spectrum, answering the question postulated in this project can help develop zinc-based biodegradable implants.