Zinc and its alloys are characterized by good corrosion resistance and due to that, they are successfully used as anticorrosive steel coatings. In fact, low mechanical properties limit usage of zinc as a construction material. A common method for improving zinc's strength is a small addition of other elements like copper, lithium, magnesium, manganese, and silver. Newly-created alloys present much higher mechanical properties than pure zinc. Additional hot plastic deformation processes like rolling or extrusion produce fine-grained microstructure which increases strength or ductility but rarely both at once. Application of unconventional plastic forming methods is considered as a way to obtain optimal mechanical properties of zinc alloys. Severe Plastic Deformation (SPD) methods such as High-Pressure Torsion (HPT) and Equal Channel Angular Pressing (ECAP) induce very intensive grain refinement without change of shape and dimensions. In most conventional constructive materials SPD processing causes a significant increase in strength, much higher than classic plastic forming. It is consistent with basic grain refinement strengthening Hall-Petch relation comparing reduction of grain size with an increase in strength.

Initial investigation and literature review show that low melting temperature of pure zinc (approx. 693 K) causes the negative effect of grain refinement on strength of zinc alloys. Below particular critical grain size in zinc alloys main strengthening mechanism that is twinning is not observed, and additionally, creep deformation significantly increases at room temperature (room temperature equals 0.41 absolute melting temperature of zinc). All these phenomena result in mechanical properties decrease up to 60 % while elongation increases by over 500 %. The complexity of the deformation phenomena of low-alloyed, fine-grained zinc alloys is still not well investigated and known. Without a good understanding of observed deformation processes it is very difficult to optimize the thermo-mechanical processing of these alloys, moreover, the numerical models cannot be used to simulate plastic flow without reliably quantitative results.

The aim of the project is an analysis of deformation mechanisms in low-alloyed binary zinc alloy with 0.5 at. % addition of copper processed via equal channel angular pressing. This alloy presents very high elongation to failure approx. 500 % although the superplastic flow requirements were not meet. During the investigation, a scanning electron microscopy (SEM) and an electron back-scattered diffraction (EBSD) combined with in-situ tensile testing will be used. These methods allow to see deformation in micro- and nano-scale and also identify the grains' crystallographic orientation. Quantitative analysis of particular deformation mechanisms will show which one plays a major role.

Obtained results will allow performing quantitative evaluation of the phenomenon responsible for Zn-0.5Cu alloy deformation and will help indicate the reason for disproportion between model superplastic flow and observed during the initial investigation. Moreover, quantitative results could be easily implemented into numerical models describing the deformation of low-alloyed, fine-grained zinc alloys.