Ti-based alloys exhibit low density, excellent corrosion resistance and very high tensile strength and toughness over a wide temperature range. The high strength-to-weight ratio of the titanium alloys allows them to replace steel in many applications requiring high strength and fracture toughness. They play an important role as materials for aircrafts, spacecrafts, medical devices, implants, sport cars etc. The structure and properties of titanium alloys can be tailored by using the combination of thermal and mechanical treatments.

Severe plastic deformation (SPD) belongs to the principally novel technologies for thermo-mechanical treatment of materials. The deformation of a material during SPD takes place in a confined space in such a way that a material can be deformed up to very high strains without its failure. It has been shown recently that SPD not only leads to the strong grain refinement and material strengthening but also can drive the unusual phase transformations. In other words, the phases before and after SPD are different. However, the phase transformations driven by SPD are different from those driven by the conventional thermal and mechanical treatments. To be able to predict and explain such phase transformations is a challenge for materials science. One can use such SPD-driven phase transformations in order to improve the properties of Ti-based alloys.

The thermal and mechanical treatments of Ti-based alloys are especially effective because titanium has different allotropic modifications at low (alpha-phase) and high (beta-phase) temperatures. In addition, Ti possesses also a high pressure omega-phase. Therefore, we will study influence of SPD (in the high pressure torsion mode) on the phase transformations in the titanium-based alloys. We suppose that SPD can promote (or suppress) the formation of not only high-temperature but also of the high-pressure phase(s).

We will study the fundamentals of omega phase formation in three Ti alloys with beta-stabilizers like Nb, Ni, Co during processing by high pressure torsion. Upon that the influence of sample conditions (alloying, initial microstructure and phase composition) and processing conditions (pressure, temperature, strain and strain rate) on the the alpha to omega phase transformation will be analysed. These investigations will allow to tailor and improve the properties of Ti-based alloys which are broadly used in various advanced industries.