Titanium alloys are one of the most popular materials used in medicine. They are applied in the hard tissue implants as hip or dental implants, screws, nails, etc. There might be some medical issues related to the use of the commercially available materials as Ti6Al4V. The presence of aluminum and vanadium may cause medical disorders as neurological disorders (Alzheimer disease, etc.). Because of that fact, a lot of researchers try to find their replacement. Ti-Nb-Zr and Ti-Mo alloys are one of these substitutes. It's due to the fact of their chemical composition and phase (β-type titanium alloys). The β-structure allows to make the Young modulus much lower. It's minimized the risk of mechanical unfit between the bone tissue and the implant. The problems of bones resorption and loosening of the implants because of stress-shielding effect are significantly reduced.

New perspectives appear with ultrafine grained and nanostructured materials, which exhibit better mechanical and physico-chemical properties in comparison to their microcrystalline counterparts. Current goals in the development of new Ti-based biomaterials are: (i) to avoid potentially toxic elements, such as vanadium, to further improve biocompatibility; (ii) to produce titanium alloys with a high fatigue strength. β-titanium alloys partially fulfill these requirements .

While titanium and titanium-based alloys have excellent mechanical properties and are generally well tolerated in a physiological environment, they have negligible capacity for osteointegration. Two approaches have been made to improve the osteointegration: a scaffold approach and surface modification approach. In the surface modification approach, the surface of the Ti surgical substrates can be modified by electrochemical and hydrothermal treatments to make the surface bioactive.

In this project the mechanical alloying process followed by the hot pressing and pulse plasma sintering will be applied for the preparation of the ultrafine grained β- and pseudo β-type Ti based alloys with niobium and zirconium (Ti-Nb-Zr) as well as with molybdenium (Ti-Mo). Microcrystalline alloys will be produced by arc melting method. The production process of sintered bulk and porous β Ti type materials (Ti-Nb-Zr and Ti-Mo) without and with addition of hydrogen ammonium carbonate will be studied in details. Metallic and NH4HCO3 powders with specified grain size mixed in different ratios will be used. Influence of technological parameters on shape, size and distribution of pores in scaffolds will be investigated by the macro- and microscopic observations. Mechanical testing will be done. Modification of surface layer by electrochemical and hydrothermal treatment methods will be studied for a better biocompatibility of the materials. Evaluation of surface of the synthesize materials - porosity, roughness parameters, chemical composition, surface energy, corrosion behaviour will be avaluated. Biocompatibility studies will be carried, too. Yet, to the authors knowledge, there are no research regarding the addition of Nb and Zr and Mo up to 35 at.% into titanium and the inluence of the ultrafine grain microstructure and microstructure treatmentson physico-chemical, mechanical as well as in vitro biocompatibilityto have appeared till now.

Beta-type based biomedical scaffolds can have positive influence on both society and economy advancement. Biomaterials with ultra fine grains based on titanium will be a new group of biomaterials, which better mechanical and corrosion properties. Consequently it can provide savings in health care system and accelerate recovery time for patients. Development of porous structures will provides even better integration of implant with tissue and close its mechanical properties to tissues. Developed β Ti-type scaffolds and production methods will let for their future biomedical application and will contribute to lower costs of implants and increasing their accessibility for society. Development of modern solutions in this field and propagation of tests results on scientific journals and conferences will contribute to encourage domestic producers and investors to develop and implement domestic implants.