# *New porous titanium based alloys for medical application with improved corrosion resistance prepared by mechanical alloying method*

In recent years, the increasing interest in new titanium alloys with biocompatible elements has been observed. This particular attention, of the medical community and also engineers who work with biomaterials, results from the increasing demand for long-term implants. The researches on designing the material for implants, which could optimally match to the bone in terms of its structure, properties and biocompatility are still ongoing. The intention of the researches is to eliminate the harmful Vanadium and Aluminium, which are used most frequently in the alloys for implants. The other important goal is to improve the implants mechanical match to the bone, and the corrosion resistance of the material. The common method of producing these materials is the arc-melting, but to obtain the porous material or composites by this method is extremely difficult. Having regard to the really interesting properties of the porous materials, it seems that the mechanical alloying method is more appropriate for biomaterials production. This method allows to obtain alloys from initial materials, which significantly different in terms of melting temperatures or density. Additionally, it is possible to obtain new titanium alloys with a specified degree of porosity, and with the strictly defined sizes and shapes of the pores by mechanical alloying, which uses the variable parameters of the process (e.g. a speed of milling, a ratio of balls to the material) or the easily removable space holders. The materials intended for long-lasting bone implants are preferred to contain the interconnected pores with a size from several dozen $\mu m^2$ to several hundred $\mu m^2$. It is important because such porosity allows the osteoblast and body fluids to penetrate into the implant. Such connection greatly improves osseointegration of the implant with a bone. Powder metallurgy also allows to obtain materials with a gradient porosity. Controlling the porosity in the produced materials can simultaneously improve the osseointegration and the bone-implant connection, and it can also influence on the mechanical match in order to prevent a premature failure of an implant.

The aim of the project is to determine the influence of parameters of mechanical alloying and the space holders presence on the structure and porosity of titanium-based alloys with vital elements (eg. Nb, Zr, Ta and Sn). Moreover, the possibility of producing materials with the desired phase composition and the porous structure (with specified sizes, shape and distribution of the pores) by mechanical alloying will be estimated. The additional aim is to determine the possibility of manufacturing the materials with gradient porosity. The obtained material will be wildly characterized with the emphasis put on the influence of a porosity degree on structure and properties. The priority of the research will be the tests of corrosion resistance. The results will be compared to the corrosion resistance of materials currently used for long-lasting implants.

A significant part of the project is to define the influence of the technologies producing the material on the size and distribution of the pores in titanium-based alloys with vital elements. This project also covers the characterization of the obtained material in terms of structure and porosity. Moreover, the influence of microstructure, and the phase and the chemical compositions on the properties of the material will be determined in the light of a potential biomedical application. The structural analysis of the material will be performed by using the X-ray diffraction (XRD), transmission electron microscopy (TEM), and scanning electron microscopy (SEM). The microstructure and the porosity of the material will be assessed by the stereological method. The mechanical properties and the corrosion resistance of the obtained material will be studied. The results of the research will be compared with the parameters of the material, which is currently used as implants.