DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH) (State the objective of the project, describe the research to be carried out, and present reasons for choosing the research topic - max. 1 standard type-written page)

Materials with various properties and fabrication techniques allowing their further processing and applications have been accompanying humans throughout history. Nowadays, studies of unconventional materials in the context of their development, characterization and machining is of particular interest to scientific and industrial communities. This need is strictly connected with continuous industrial progress, improvement of quality of life and environmental protection. Development of new materials is of key importance when talking about civilization advancement and knowledge economy. The innovative materials are being applied in numerous technological products and solutions. The research proponed in this project aims at performing a comprehensive characterization of Gum Metal which is a new multifunctional class of β-Ti alloy. It was developed in the Toyota Central R&D Laboratory (CRDL) at the beginning of the 21st century. Since then, Gum Metal has attracted remarkable attention due to its exceptional properties, i.e. low elastic modulus, high strength, wide range of nonlinear elastic deformation and excellent cold workability, as well as its constant mechanical response and low coefficient of thermal expansion in a wide range of temperature combined with relatively low density. Gum Metal is highly applicable; so far it is used in automotive, aerospace, biomedical, precision, optical and robotic industries. An ongoing research on the alloy promises to apply it as a material for a new generation of implants. Bone-like elastic modulus of Gum Metal combined with high biocompatibility and easy processing makes it a good candidate for artificial bones.

The research is aimed at characterization of Gum Metal polycrystalline and monocrystalline under compression. The alloy will be subjected to compressive loading on a testing machine with various loading programs in predefined directions. Differences in mechanical responses, called mechanical anisotropy, of the alloy subjected to compression in various directions will be tested by destructive and nondestructive techniques. The research will cover structural observations, investigation of thermomechanical couplings and analysis of temperature, displacement and strain distributions as well as mathematical model of mechanical behavior of Gum Metal under compression.

The experimental results obtained in the project will contribute to better understanding of Gum Metal underlying mechanisms of its deformation process leading to failure phenomena. The model based on experimentally determined parameters of the alloy will serve as a tool to predict mechanical behavior of parts made of Gum Metal at the stage of design and simulations.

Results on compression of Gum Metal have been seldom reported in the relevant literature. The research, proponed in this project, is aimed at their broadening. Systematical and interdisciplinary investigation combing the fields of mechanics and materials science is planned. It will embrace structural characterization in cooperation with the Institute of Materials Science of Silesian University as well as destructive and nondestructive methods characterizing Gum Metal subjected to compression. Gum Metal polycrystal and single crystals with various growth orientations, provided by Fukuoka University, will be tested. The nondestructive techniques, planned for the Gum Metal investigation, have not been reported to be used so far. The experimental results will be completed by a mathematical model of the mechanical response of Gum Metal under compression. In the corresponding literature the models are based only on the initial mechanical characterization of Gum Metal under tension. The interdisciplinary investigation described above will promote the exchange of knowledge and experience between the research centers specialized in the fields of mechanics and materials science as well as the international collaboration.