

In this project, the multi-layered biomaterials composed of bioactive glass coated on ultrafine-grained (100 - 1000 nm grain sizes) metallic substrates via laser cladding technique will be characterised. Such biomaterials are intended to be used as medical implants with superior mechanical properties (thanks to ultrafine-grained substrates) and bioactivity (thanks to bioactive glass coatings). Necessary experimental studies will be performed followed by development of the numerical models, which can support the design and processing of the implants. There are no studies of application of ultrafine-grained substrates in manufacturing of such new generation multi-layered biomaterials using laser cladding method. This is because, the methods for obtaining ultrafine-grained structures are not widely understood yet. Additionally, the laser equipment is relatively expensive, restricting the relevant studies to a few research centres worldwide. Authors of the project closely collaborate with the Manufacturing Technology Centre (MTC UK) in the United Kingdom, where the relevant multipurpose hybrid laser cladding system HSTM 1000 "RECLAIM" has recently been developed. Preliminary studies of the bioactive glass coatings on coarse-grained titanium alloy substrate, as a result of such collaborative work, have shown their feasibility and potential significance initiating the proposed research.

Extensive research of the obtained biomaterials will be performed including studies of microstructure evolution of bioactive glass, interface between glass and the ultrafine-grained substrate and also the microstructure near the substrate surface including heat affected zone. Furthermore, during the whole project, experimental research will be supported by the detailed computer analyses based on the finite element (FE) methodology.

Nowadays, increasing demand for biomedical devices urges the research for searching new biomaterials characterized by superior mechanical properties and high bioactivity. The implantable devices market in the USA is expected to be worth of US\$73.9 billion by the end of 2018, due to demographic factors, such as increasing geriatric population and high incidence of degenerative and chronic diseases. The implantable devices market is dominated by reconstructive joint replacements, spinal implants and dental implants. Worldwide, over 250 million people lack teeth and unofficially this number can exceed 1 billion. In the USA only, nearly one million teeth are implanted each year and the majority of dentists is qualified for the new field of implantology. Thus, the studies, which are going to be performed according to the proposed project, meet with the greatest worldwide interest and can contribute towards further improvement of the effective methods for the manufacturing of the modern biomedical devices.