

Department of Engineering Materials and Biomaterials

Faculty of Mechanical Engineering

Silesian University of Technology

DOCTORAL DISSERTATION

“The influence of hybrid processes of surface microalloying on the structure and properties of surface layers of Ti and Ti alloy-based biomedical materials”

Oktawian Bialas, M.Sc., Eng.

Discipline: Materials Engineering

SUPERVISOR

Marcin Adamiak, DSc, Ph.D., Eng.

GLIWICE 2023

Abstract

In the dissertation presented here, a hybrid approach was used to obtain layers containing the Ti₃Au phase, enabling new potential biomedical applications for materials modified in this way. The process involved the use of both an electrochemical deposition techniques to deposit gold Au onto titanium Ti and Ti₁₃Zr₁₃Nb alloy, and subsequent laser microalloying to obtain a multilayer surface enriching the base material in Au. The obtained samples were then analysed in order to determine the composition and characteristics of the microstructure and functional properties.

In the course of the study, research techniques such as light microscopy, atomic force microscopy, scanning electron microscopy, transmission electron microscopy, backscattered electron diffraction, X-ray diffraction, contact roughness measurement methods, wettability measurement, corrosion studies including electroimpedance spectroscopy, as well as tribological studies, nanohardness studies and cytotoxicity studies were used. Empirical studies were preceded by numerical simulation of heat flow and nanoindentation.

The results of this study showed that the hybrid approach was effective in producing the Ti₃Au phase, and that the gold enriched materials produced by this original method had desirable properties such as high biocompatibility, corrosion resistance, and better tribological properties than the base materials used for this study. This research has the potential to contribute to the development of new materials for use in the field of biomedicine.