**Title:** **„The formation and properties of anodic oxide layers on titanium”**

**Author**: Magdalena Warczak

**Supervisor:** Iwona Flis-Kabulska, Ph.D, D.Sc., Eng.

## ABSTRACT

The purpose of the present PhD thesis was the investigation of anodic oxide films formed on titanium, and their characterization performed by using electrochemical and microscopic techniques. Electrochemical oxidation of titanium was carried out in various electrolytes, mainly in sulphuric acid solutions, and at different applied potential (from OCP to 100 V). This potential was significantly higher than that applied to traditional metals, such as Fe, Cu Ni, Ag, for which the upper limit of the anodization potential in aqueous solutions rarely exceeds 2 V versus standard hydrogen electrode (SHE).

The physical and chemical properties of titanium and its various applications were presented in the literature section. This section included also the mechanism of formation of anodic oxide films on titanium and their properties.

The results of research were presented in four chapters. The first chapter described the effect of fluoride ions on stability of oxide films on titanium and the process of activation of titanium electrode by monitoring of its potential. Electrochemical methods such as measurements of open circuit potential (OCP), chronoamperometry (CA) and electrochemical impedance spectroscopy (EIS) were used to characterize the process of the passive-active transition of titanium electrode. Changes of surface topography were recorded by optical microscopy, atomic force microscopy (AFM) and scanning electron microscopy (SEM).

The second chapter concerned electrochemical oxidation of titanium in sulphuric acid electrolytes. It presented curves of cyclic voltammetry typical for valve metals (*e.g.* Al, Ti, Nb, Zr, and Nb). EIS was used for better understanding of anodic oxide formation and for characterization of oxide films.

The last two chapters were devoted to some peculiarities observed during electrochemical oxidation of titanium such as: (a) regular current oscillations seen on voltammetric and chronoamperometric curves; and (b) anodic peak appearing on cathodic branch of cyclic voltammetry curves. These phenomena manifested instabilities of oxide films during anodization of titanium.