



National University of Science and Technology
Politehnica Bucharest

HABILITATION THESIS

**" Advanced methods and new trends in electrodeposition
and corrosion protection at micro and nano level for
industrial and bio applications"**

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Abstract

The habilitation thesis entitled: "*Advanced methods and new trends in electrodeposition and corrosion protection at micro and nano level for industrial and bio applications*" represents the accumulation of knowledge through scientific research carried out during the professional evolution after the award of the Doctor title (October 2002), the evolution in the teaching and scientific career, respectively the main directions of development expected in the future.

The doctoral thesis marked the beginning of scientific research activities in the field of applied physical chemistry and electrochemistry, specifically focusing on corrosion studies of metallic materials in various environments, as well as anti-corrosion protection methods. Subsequently, the research carried out between 2002-2004 within a Marie Curie Industry Scholarship held at Ansaldo Fuel Cells S.p.A. Genoa, Italy, where I studied the improvement of technologies for metallic components intended for molten carbonate fuel cells, but also between 2010-2013 in a postdoctoral study program where my topic was Electrodeposition of nanostructured materials from ionic liquids based on choline chloride for their use in various fields (sensors, batteries, supercapacitors or photoelectrochemical solar cells), thus demonstrating the deepening and development of the field. After completing his doctoral studies, scientific research was continued with the development of applications in the field of corrosion parameter evaluation and metal protection against corrosion, synthesis and characterization of various nanomaterials for industrial applications, including semiconductors, thermoelectric materials, cathode materials for HER or batteries, materials used in the nuclear industry, characterization under severe conditions of materials used in the nuclear industry, but also testing in terms of corrosion resistance of some biomaterials, as well as performing treatments that would improve the resistance of these materials used mainly as stents or dental alloys.

The thesis is divided into two sections: Part I – includes essential scientific and professional achievements, and Part II provides a synthesis of progress in the teaching and scientific career, along with a plan for the development of the academic career.

The main objective of Part I – Scientific and professional activity – is focused on .

Chapter 1 “Electrodeposition of ionic liquids as an expression of trends towards sustainable development of materials used in the energy industry” presents a synthesis of the main original results obtained using green chemistry in the field of synthesis and characterization of specific thermoelectric materials such as BiTe, BiSeTe, BiSbTe, or of chalcogenides with semiconductor properties or used in photovoltaic cells such as PbTe, CdTe or CuTe. Thus, it was demonstrated that the use of ionic liquids in electrodeposition is a sustainable, versatile, and efficient method for manufacturing thermoelectric or semiconductor materials used in the energy industry. The main results obtained materialised in 12 ISI articles and one patent.

Chapter 2 “Factors influencing the electrodeposition of advanced coatings for the incorporation of drugs to prevent infections and improve human health” highlights the incorporation of the drug into the polymer matrix simultaneously with its electropolymerization due to the use of DES and NADES. Also in this chapter, the protective properties of the polymer coating are presented, and the kinetics of drug molecule release in a simulated physiological fluid are analysed, as well as the antibacterial effects. The results obtained are supported by 5 ISI articles.

Chapter 3 "Electrochemical parameters and models for corrosion processes of advanced materials for reducing the corrosion rate in types of equipment for nuclear reactors" presents a

synthesis of the original results regarding the electrochemical parameters characteristic of corrosion processes of advanced materials, to reduce the corrosion rate in equipment for nuclear reactors and have materialized in 14 ISI papers and a grant as UPB responsible.

Chapter 4 "Monitoring the corrosion rate of modern stent alloys and finding new strategies in response to the new EU regulations on the use of Co, Ni, Cr-based biomaterials in dentistry" presents a multidisciplinary approach that integrates electrochemistry, surface analysis, spectroscopy and histopathology, which allowed a comprehensive evaluation of the performance and safety of biomaterials used as stents or dental alloys, the results obtained being published in 10 ISI articles, as well as a grant as director.

The content of the above chapters proves that my research is only partially a continuation of the doctoral thesis, introducing modern original aspects of corrosion protection and a higher level of techniques used. Both the corrosion of state-of-the-art coatings on materials used in nuclear reactors, as well as polymer coatings acting as drug carriers with applications in the medical field, were analysed.

The scientific activity carried out in the period 2002-2025 was disseminated through the publication of 65 articles

In PART II, the professional development plan is presented, highlighting the evolution in the teaching and scientific research career, respectively the main development directions and the activities targeted in the coming period which, it is estimated, will lead to an increase in the visibility and impact of the scientific results of both the candidate and the entire research team.

The habilitation thesis concisely presents the candidate's academic development plan, emphasising the habilitation criteria stipulated by the methodology approved by UNSTPB, in particular the quantification of the objectives assumed by the candidate, which, although ambitious, are supported by the results obtained to date. The internationalisation of research will be an objective of the candidate, contributing to increasing the visibility of the individual and the team and of the National University of Science and Technology Politehnica Bucharest.