Abstract

The habilitation thesis entitled "**Deposition and remelting methods of corrosion and wear resistant coatings**" presents a synthesis of the main research results obtained by the candidate during the years 2005-2019 in the field of Materials Science and Engineering. The work approaches as the main direction of the research, the processing and characterization of the functional layers resistant to corrosion and wear by using modern techniques specific to surface engineering.

The thesis is structured in two parts and three distinct chapters, the first part being regarding the main scientific, professional and academic contributions, and the second part, presenting the evolution of the career and the perspectives of personal development.

Chapter 1 of the paper presents the main problems that arise in the components of the installations and equipment that work in the industrial field. During operation, they are subjected to corrosion and wear phenomena that can lead to their premature degradation. These are manifested in the surface layers where the demands are more intense and complex compared to the core parts. The factors of influence, the mechanisms of degradation and the main forms of wear and corrosion are presented. The chapter ends with the modalities of materials selection that are subject to such operating conditions.

Chapter II summarizes the scientific contributions that have been made in the field of coating deposition on the active parts of the products and components in order to improve the functional characteristics and increase their operating life. Various deposition techniques (thermal spraying, laser cladding and weld deposition) and different categories of coatings that have been successfully used in the industrial field are addressed. The first part of this chapter defines the system surface layer-substrate-deposition process as a term of system and specifies the demands that must be met by the materials used to obtain such of system. The material and the specific technology selection for the surface coatings is always based on obtaining a complete set of requirements imposed on the components according to the provided operating conditions. It is highlighted the role of the coating deposition in increasing of performance exploitation of the industrial components. It is presented the principle and the technologies of thermal spraying that are the most used nowadays and the own scientific contributions in the field of coating deposition by these methods. A first presented category of thermally sprayed layers is represented by MCrAlY coatings. These are a family of materials that have good corrosion resistance properties that are used in applications that operate at high temperatures, including in the energy field by thermal barrier coatings systems. They have begun to become more and more important regarding the protection against oxidation and high temperature corrosion of the turbine blades from energy industry. Another category of materials which is presented it refers to the cermet-coatings (WC-CoCr, WC-CrC-Ni). From structural point of view, they consist of a ceramic material dispersed in a metallic binder having good wear, erosion and corrosion resistance properties. Depending on the chemical composition and the relationship between the two phases, metallic and ceramic, they can also provide a high temperature resistance, a certain electrical resistivity and conductivity, dielectric permittivity, etc.

The last presented category of materials is that of the NiCrBSi self-fluxing coatings deposited by laser cladding. The obtained experimental results showed that the deposition parameters influence the dilution of the coating with the substrate and implicitly their exploitation properties. The chapter ends with a systematic presentation of information related to the judicious selection of appropriate methods and technologies to coat the surfaces depending on the operating conditions severity.

Chapter III presents the scientific contributions regarding the effect of surface irradiation with concentrated energy sources on the microstructural and morphological characteristics of the thermally sprayed coatings. These materials, depending on the deposition process and the granulation of the depositing feedstock, have a non-homogeneous structure, with a certain degree of internal oxidation and porosity which can sometimes produce phenomena of spallation and delamination of the coating from the substrate. By using local treatments, the surface layer can be completely or partially remelted. Due to the very short thermal cycles, the melting and solidification are done very quickly so that fine structures can be obtained compared to those obtained from the casting processes. In general, the purpose of applying these treatments is to improve surface characteristics by increasing wear, erosion and corrosion resistance. There are also presented the results of the research and the scientific contributions obtained in the field of laser and electron beam remelting of thermally sprayed coatings (CoNiCrAlY, WC-Co, Al8Si20BN, Al_2O_3-TiO_2). By varying and optimizing the treatment parameters, it has been obtained a refining, densification and homogenization of the coatings structure and implicitly improved wear and corrosion resistance properties. It has also been shown that heating using the WIG process is a simple, flexible and inexpensive method that can be used for metallic surfaces remelting in order to improve the surface characteristics.

In the last part of the habilitation thesis, the plans for the evolution and development of the professional career are presented. The research directions will be aimed by continuing the researches in the field of coating and surface treatments by developing mathematical models to simulate the distribution of the temperature field during the deposition or remelting of the coatings surface, the use of "eco-friendly" materials for the coating that has a small impact on the environment, optimizing the properties of the sprayed coatings by applying other surface treatments such as: flame heating or electromagnetic induction and not least broadening the application field of coating deposition and making the technology transfer with the industry.