INTRODUCTION

Today the new materials, chemical and electrochemical catalysis, sensorics, medicine, modern industry and scientific and technological progress can not be imagined without nanotechnologies. Therefore, the level of development of the latter is one of the main criteria for economic success of the country. Hence, there has been a rapid growth in the number of publications devoted to a wide range of studies in the field of nanosystems and nanotechnologies, in particular, the review articles and monographs which summarize achievements in certain areas or branches.

The proposed monograph is an attempt to generalize the state of affairs in the field of electrosynthesis of nanomaterials, covering all the links in the sequence "*parameters of synthesis – composition/structure – properties – the field of application*", in the modern context of nanoscience. The main attention is paid to the establishment of correlations in the first triad, which are decisive. At the same time, the attention is accentuated on the possibilities of electrochemical methods for controlled formation of the geometry of nanoparticles, the structure of materials, etc. Based on the sources, which were published mainly during the last decade, there are analyzed those areas of chemical material science, where electrochemistry has achieved the greatest success, namely: the synthesis of metal nanoparticles and nanostructures, nanocomposite coatings, metal/polymer composites in the four chapters of the monograph .

In the first *Chapter* (authors – O. Kuntyi, O. Dobrovetska), the achievements in the electrodeposition of metallic nanoparticles on the surfaces of different nature (matrix and non-matrix synthesis), as well as electrochemical synthesis of colloid solutions of nanoparticles of metals, are analyzed. The types of nanomaterials are classified and their comparative characteristics are given, the electrolysis conditions are systematized, the dependences of the geometry of the nanoparticles on the composition of the electrolyte, and the modes/types of polarization of the electrodes are shown. The levers of influence on the content of the component in the resulting precipitate are analyzed for the binary metal systems. It has been shown that a significant number of researchers use

the pulsed mode of electrodeposition as an effective influence factor on the controlled formation of nanoparticles in shape, size and composition (for binary systems), namely during non-matrices deposition of metal nanoparticles on substrates of different nature. The emphasis is also placed on the influence of non-aqueous media, in particular organic aprotic solvents, on the process of nucleation and growth of a metal sediment. The features of the synthesis of metal nanoparticles by electrolysis and microplasma method in solutions of surfactants are described, their advantages over chemical methods, in particular concerning controllability of processes and "green technologies", are substantiated.

In *Chapter 2* (author – G. Zozulia), the broad possibilities of the galvanic substitution method in electrochemistry of nanomaterials are revealed. The main directions of application of this method, namely for the synthesis of nanostructures, surface modifications of both metals and semiconductors, are considered based on the electrochemical mechanism of the process. The role of the medium of aprotic solvents in the controlled formation of the geometry of the metal sediment particles during the surface modification by the galvanic substitution method was also noted, as well as on numerous examples from literature, the efficiency of deposition of nanostructurized metal sediments by this method on the silicon substrates was demonstrated. The problems of galvanic substitution process, exactly the spontaneous nucleation and growth of nanoclusters, are revealed and ways of their solution are indicated. The promise of this method for the synthesis of nanostructures, especially hollow, frameous and porous, is shown.

Chapter 3 (author – O. Kuntyi) covers a relatively new direction in electrochemistry, exactly the deposition of nanostructurized metal coatings and nanocomposites, which possesses unique mechanical, chemical and physico-chemical properties. The composition of electrolytes and electrodeposition modes of monometallic coatings, binary and ternary alloys are described. The dependence of grain size of sediments on the conditions of electrodeposition is shown, and the dimensional effect is shown in relation to mechanical properties and corrosion resistance of monometallic coatings. The attention accented on

the influence of the factor of "other" metal in reducing the size of grains of sediments, improving their mechanical and physico-chemical characteristics, corrosion resistance and catalytic properties is made in the case of binary and ternary alloys. It is shown that the introduction into metallic electrochemical coatings of nanoparticles of carbides, silicides, oxides or carbon nanomaterials (as the second phase) significantly increases their mechanical characteristics and corrosion resistance due to the decreasing of the size of the grains of metal matrix and the defects of the coating structure.

Chapter 4 (authors – M. Yatsyshyn, O. Reshetnyak) is devoted to the electrochemical synthesis of nanostructurized polyaniline and its composites with particles of both noble (Ru, Ro, Pd, Ag, Pt, Au) and active (Al, Fe, Co, Ni, Cu, Sn, Pb) metals. The main attention is paid to the features of the electrochemical production of polyaniline on the electrodes of different nature (Al, Fe, Co, Ni, Cu, graphite, glass carbons, ITO glass, etc.) in potentiodynamic, potentiostatic and galvanostatic conditions. It is shown that the selection of the monomer (aniline) concentration, nature of doping acid, conditions of electrochemical synthesis (range and rate of the potential scanning) etc. allows to control the thickness of the polyaniline film, its degree of oxidation and the morphology of the deposited particles. In most cases, polyaniline films are constructed of nanofibers and nanowires of up to 100–150 nm in length, which serve as conductive carrier matrices during electrochemical reduction of metals from the solutions of its precursors. Metal particles reduced on polyaniline substrates have, preferably, a spherical shape and a size from 5 to 150 nm. The efficiency of electrodes modified by thin metal-polyaniline nanocomposite films as electrocatalysts of oxidation of methanol, carbon (II), etc. was analyzed. It has been shown that in many cases the nanoparticles of metals, such as platinum or palladium, can be protected from poisoning by deposited films of one or several metals, which is often accompanied by an increasing in their catalytic activity. Such platforms can serve as sensitive elements of sensoric devices in many cases.