

Preface

This book highlights the most recent advances in nanoscience from leading researchers in Ukraine, Europe, and beyond. It features contributions from participants of the 4th International Research and Practice Conference “Nanotechnology and Nanomaterials” (NANO-2016), held in Lviv, Ukraine, on August 24–27, 2016. This event was organized jointly by the Institute of Physics of the National Academy of Sciences of Ukraine, Ivan Franko National University of Lviv (Ukraine), University of Tartu (Estonia), University of Turin (Italy), and Pierre and Marie Curie University (France). Internationally recognized experts from a wide range of universities and research institutes shared their knowledge and key results in the areas of nanocomposites and nanomaterials, nanostructured surfaces, microscopy of nano-objects, nano-optics, nanophotonics, nanoplasmonics, nanochemistry, nanobiotechnology, and surface-enhanced spectroscopy.

Today, nanotechnology has become one of the most actively developing and promising fields of science. Nanotechnology research has already resulted in numerous productive results that can be applied in various areas of human activity from science and electronics to medicine and pharmacology. The aim of this book is to highlight the latest developments from different areas of nanotechnology and to excite new interest in this field. The book chapters cover such important topics as nanocomposites, nanostructured interfaces and surfaces, nanochemistry, nano-optics, nanoplasmonics, and enhanced vibrational spectroscopy.

The book is divided into five sections: Part I, *Nanoscale Physics*; Part II, *Nano-optics and Photonics*; Part III, *Nanostructured Interfaces and Surfaces*; Part IV, *Nanochemistry and Biotechnology*; and Part V, *Nanocomposites and Nanomaterials*.

Part I: Nanoscale Physics

In Chap. 1 (Fitio), the possibilities of a new method for solving the one-dimensional stationary Schrödinger equation in the frequency domain for different functions of potential energy have been analyzed. In Chap. 2 (Frolova), the effects of

ultrasonic synthesis on the basic properties of CoFe_2O_4 nanoparticles are studied. In Chap. 3 (Dawid and Gburski), the structural and dynamical properties of an argon-krypton binary mixture confined between graphite slabs have been investigated and a molecular dynamics simulation has been made. In Chap. 4 (Gburski), three cholesterol-fullerene binary clusters varying in the number of fullerenes have been investigated. Chapter 5 (Grinevich) presents thermogravimetric studies of two different precursor complexes of tin dioxide. In Chap. 6 (Gudyma), modeling problems of spin crossover nanocrystals have been investigated. In Chap. 7 (Kaniukov), PET track membrane parameters have been comprehensively studied at the various formation stages. Chapter 8 (Korostil) investigates features of the current spin-orbit-induced magnetic dynamics in multilayer nanostructures with nonmagnetic heavy metal layers possessing a strong spin-orbit interaction. Chapter 9 (Luzanov) reviews the old and new tools for the interpretation of orbitals and excited states of nanodiamonds with defects. In Chap. 10 (Pokutnyi), the theory of excitonic quasimolecules (formed of spatially separated electrons and holes) in a nanosystem that consists of semiconductor quantum dots synthesized in a borosilicate glass matrix is presented. In Chap. 11 (Savka), the authors carried out molecular dynamics simulations to investigate the process of formation of ZnO nanoclusters from the gas phase. Chapter 12 (Sulymenko) presents an investigation of global coupling of microwave phase-locking of weakly coupled spin-torque nanoo oscillators. Chapter 13 (Suprun) presents the calculation of the current density in the complete absence of violations of electrostatic equilibrium at a nonzero temperature. In Chap. 14 (Vasylyuk), the authors investigate the mechanisms of nanoconductivity in polyene polymers. Chapter 15 (Kizilova) focuses on complex flows of immiscible microfluids and nanofluids with velocity slip boundary conditions.

Part II: Nano-optics and Photonics

Chapter 16 (Bulavinets) reviews modern methods for improving the quality of digital interferograms, including methods for eliminating zero order and filtering the resulting hologram phase map. In Chap. 17 (Dawid) the interaction-induced absorption spectrum of confined Ar-Xe mixture has been observed. Chapter 18 (Glushko) focuses on electromagnetic modes inside the island-kind 2D photonic crystal resonator. In Chap. 19 (Shopa), dynamic light scattering with nanoparticles has been studied. The effect of soft X-rays with photon energy $W = 8 \text{ keV}$ on the kinetics of decay photovoltage in solar silicon crystals is studied in Chap. 20 (Steblenko). In Chap. 21 (Hryn), two-dimensional photonic crystals formed by ordering of nanoparticles of different nature in the polymeric matrix are studied. The authors of Chap. 22 (Tatarchuk) present an overview of the preparation, crystal structure, and applications of SFs used in technology for the design of new materials and devices. In Chap. 23 (Kaladkevich), MAX phase-based compacts obtained by shock wave are studied. The authors of Chap. 24 (Wisz) present standard silicon photovoltaic devices improved by ZnO film obtained by pulsed laser deposition at

different temperatures of silicon and ITO/glass substrates using second harmonic of YAG:Nd³⁺ laser. In Chap. 25 (Potera), the results of research on the effect of the transmission spectrum of copper oxide films on glass substrate versus conditions of growth and heating in air are presented.

Part III: Nanostructured Interfaces and Surfaces

In Chap. 26 (Honcharov), the structural, catalytic, and thermal properties of stainless steel with a nanoscale metal surface layer are studied. The authors of Chap. 27 (Kharchenko) present studies on the formation of nano-sized patterns in surface layers based on local changes in the surface layer temperature. The effect of the Fermi velocity on the conductivity of the graphene-superconductive graphene junction is investigated in Chap. 28 (Korol). In Chap. 29 (Nedolya), the possibility of carbon atoms' drift to the surface of an FCC iron nanocluster through tetrahedral interstice is investigated. Chapter 30 (Savkina) presents the results of the formation of nanoscale patterns on the surface of a ternary compound. In Chap. 31 (Tarasov), a detailed theory of the scattering of plasmon-polariton waves by a segment of the metal-dielectric (vacuum) interface with randomly distributed surface impedance is developed. In Chap. 32 (Wiśniewska), the authors investigate the influence of solution pH on the nanostructure of the adsorption layer of selected ionic polyamino acids and their copolymers at the solid-liquid interface. The authors of Chap. 33 (Bazela) investigate the poly- and nanocrystalline TbMnO₃ samples crystallized in the orthorhombically distorted perovskite structure. In Chap. 34 (Gab), the dispersion kinetics of palladium and platinum nanofilms of 100 nm thickness deposited onto oxide substrate (quartz glass, leucosapphire, ZrO₂ ceramic) and annealed in a vacuum at 1000–1600 °C are studied. In Chap. 35 (Chrzanowska), the properties of the twist bend phase of liquid crystals obtained on the basis of the Landau de Gennes theory are presented. The authors of Chap. 36 (Klym) investigate the influence of inner free-volume structure on the functional properties of chalcogenide GeSe₂-Ga₂Se₃ and GeS₂-Ga₂S₃-CsCl glasses as well as oxide Cu_{0.4}Co_{0.4}Ni_{0.4}Mn_{1.8}O₄ and MgO-Al₂O₃ ceramics.

Part IV: Nanochemistry and Biotechnology

In Chap. 37 (Barbash), the possibility of obtaining nanocellulose from organosolv straw pulp is studied. The authors of Chap. 38 (Sakhnenko) investigate the nanoscale oxide PEO coatings forming from diphosphate electrolytes. The authors of Chap. 39 (Kucherenko) have developed an amperometric biosensor based on a bienzyme system (GOx/HEX) for ATP determination and investigate three different methods of GOx/HEX immobilization on the surface of working electrodes. The authors of Chap. 40 (Kuschevskaya) have synthesized nanodispersed iron powders by

means of thermal decomposition of iron citrate salt $\text{Fe}_3\{\text{C}_3\text{H}_5(\text{O})(\text{COO})_3\}_2$ in a protective hydrocarbon mixture atmosphere in temperatures of 250–500 °C. The authors of Chap. 41 (Maizelis) propose electrochemical methods of Cu/(Ni-Cu) and nickel-copper oxide multilayer coating formation in pyrophosphate-ammonium electrolyte. Chapter 42 (Marchenko) presents the development of a creatinine-sensitive biosensor consisting of pH-sensitive field-effect transistor (pH FET) and creatinine deiminase (CD) immobilized with various types of zeolites, in particular, silicalite, zeolites beta (BEA) and nanobeta, and BEA zeolites, modified with gold nanoparticles and ions. The authors of Chap. 43 (Kutsevol) synthesize and characterize branched nanostructured copolymers dextran-g-polyacrylamide (D-g-PAA) in uncharged and anionic form and test them in flocculation in comparison with linear PAA. The authors of Chap. 44 (Raczyński) present the results of molecular dynamics simulations of the dynamics of small cholesterol systems. A quantum chemical study of water molecule adsorption on nitrogen-doped titania thin films is presented in Chap. 45 (Smirnova). In Chap. 46 (Stetsko), the authors present research on the effects of chemical vapor deposition of elements on the structure of nanocomposite layers. In Chap. 47 (Vasylyv), the authors investigate the effect of the quantity of water vapor in hydrogenous atmospheres on reducing ability of the YSZ-NiO fuel cell anode material. Chapter 48 (Borysova) focuses on sol-gel synthesis and conductivity of $\text{NaLn}_9(\text{SiO}_4)_6\text{O}_2$.

Part V: Nanocomposites and Nanomaterials

Chapter 49 (Demchenko) is devoted to the structure, morphology, and properties of copper-containing polymer nanocomposites. In Chap. 50 (Derhachov), the possibility of opal infiltration with high-temperature melted $\text{Bi}_{12}\text{SiO}_{20}$, Bi_2TeO_5 , and $\text{NaBi}(\text{MO}_4)_2$ is examined and the obtained composite is characterized. Chapter 51 (Dzyazko) focuses on improvement of antifouling stability of polymer membranes. Chapter 52 (Gab) presents a chemicometallurgical method for obtaining of tungsten-based nanopowders. Chapter 53 (Guglya) covers the methods of production, the structure formation mechanism, and the properties of nano-porous thin film VN_x hydrogen absorbents. The authors of Chap. 54 (Makarchuk) have created and studied magnetic nanocomposite sorbents on bases of saponite, palygorskite, and spondyle clay. Chapter 55 (Nawrocki) is devoted to measurements of electrical conductance in nanostructures and their use in nanotechnology. The authors of Chap. 56 (Nosach) present a study of nano-particulate structures with glucose-derived char and compacted fumed silica in gaseous and aqueous media. In Chap. 57 (Panko), nano- and microdisperse structures are investigated in processes of metamorphism, reduction sintering, and component separation of iron-oxide-silicate materials. Chapter 58 (Pinchuk-Rugal) focuses on the electron radiation effect on polyvinylchloride (PVC) nanocomposites with multi-walled carbon nanotubes. Chapter 59 (Prokopov) presents the results of studies of resistivity, thermopower, and Hall phenomenon in fine crystalline pyrolytic anisotropic graphite intercalated

compounds with bromine and iodine chloride in the temperature range of phase transformation in intercalate layers. In Chap. 60 (Raczyński), the authors study the system of cholesterol molecules placed between two parallel graphene sheets using molecular dynamics (MD). Chapter 61 (Revo) presents the structural features, strength, and microhardness of nanocomposites obtained from Fe, Cu, and carbon nanotubes. In Chap. 62 (Shevchenko), the authors investigate the influence of radio-frequency electromagnetic radiation on the magnetic properties of a magneto-mechano-chemically synthesized antitumor nanocomplex. Chapter 63 (Tchervinka) is focused on continuum modeling of nanoelements. In Chap. 64 (Vyshnevskaya), a range of methods for obtaining poly(diphenylamine)-Ag NP nanocomposites are studied and the resulting hybrid materials characterized using SEM, TEM, AFM, and IR spectroscopy. The semiconducting and optical properties of compact graphene-like nanoparticles of molybdenum disulfide are investigated in Chap. 65 (Len). The electromagnetic and microwave absorbing properties of nanocarbon-epoxy Laritte 285 composites filled with GNPs and MWCNTs, as well as ternary CMs filled with GNPs and MWCNTs simultaneously, are studied as a function of frequency and filler weight content in Chap. 66 (Melnichenko).

Summing up, in this volume you can see many surveys of the latest advances in the field of nanotechnology that point the way to exciting future investigations and applications. The book demonstrates some of the latest research in nano-optics, nanoplasmonics, nanochemistry, and nanophotonics and their applications that concern a very interesting and exciting area of modern science that has already attracted the attention of thousands of scientists, engineers, and young researchers.

Kiev, Ukraine

Olena Fesenko
Leonid Yatsenko

Nanophysics, Nanomaterials, Interface Studies, and
Applications

Selected Proceedings of the 4th International
Conference Nanotechnology and Nanomaterials
(NANO2016), August 24-27, 2016, Lviv, Ukraine

Fesenko, O.; Yatsenko, L. (Eds.)

2017, XXXII, 880 p. 427 illus., 203 illus. in color.,

Hardcover

ISBN: 978-3-319-56244-5