EDUCATION IN A COMPETITIVE AND GLOBALIZING WORLD

New Trends in
Physics
Education Research
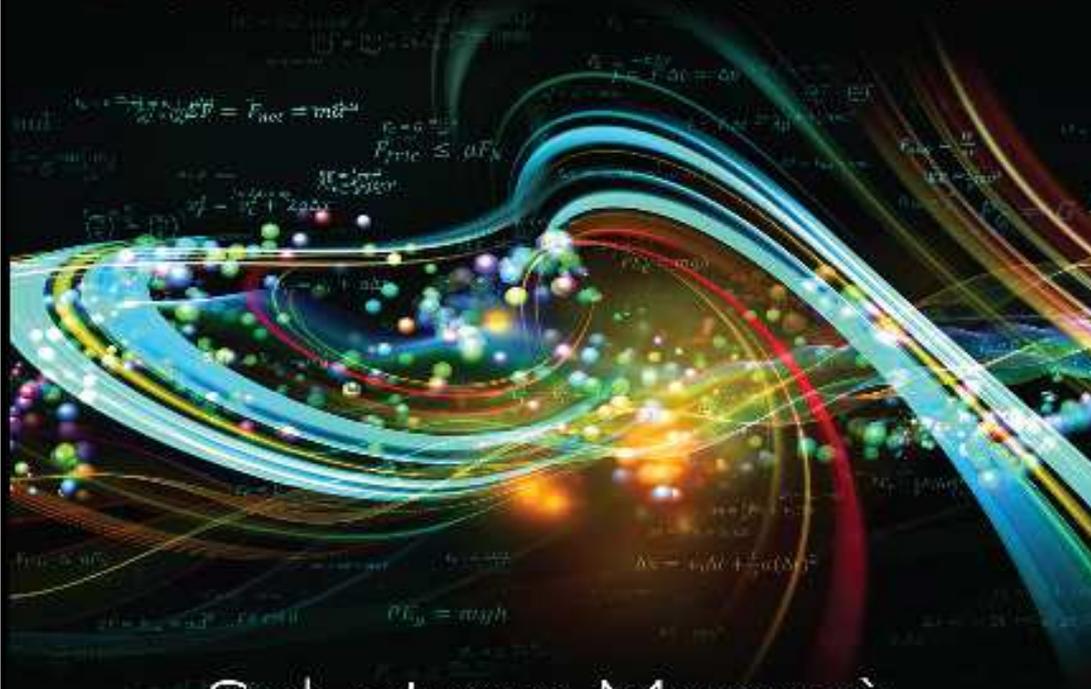
Salvatore Magazù

Editor

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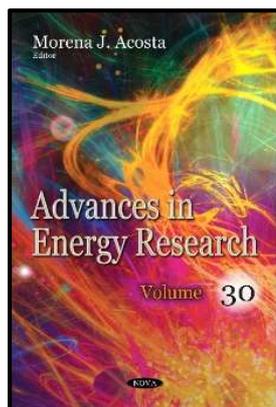
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Advances in Energy Research Series

Advances in Energy Research
Volume 30
Edited by Morena J. Acosta

In this compilation, the authors first present a study in which computational design is performed, using empirical data, to fit physical models to extract transport and material parameters (which are then used in 1D continuum and 3D particle models of charge transport) to validate against empirical measurement and each other prior to use in extrapolation studies.

Next, the book aims to discuss and illustrate the key trends behind the current international and European Union energy and climate policy. The authors provide insights into current dynamics, enabling a better understanding of future developments and indicating that unless a global effort to reduce greenhouse gas emissions is made, emissions will continue to rise.

The authors also present a computer algorithm based on type-1 fuzzy logic control strategies to manage the flow of energy in stand-alone PV/Wind/Battery hybrid systems. The solar and wind energies were combined together to increase system's efficiency and batteries were used to ensure the availability of power on demand and improve the dynamic behavior of the system. Both traditional and state-of-the-art proteomics techniques used for quantification of corn stover hydrolyzing enzymes are presented in the following chapter. The quantitative expression of cellulolytic and hemicellulolytic enzymes secreted by different microbes during corn stover hydrolysis is discussed, and an attempt is made to link the substrate complexity and quantitative composition of lignocellulolytic enzymes produced by microbes.

Later, an algorithm based on artificial neural network (ANN) and data envelopment analysis (DEA) is proposed for analyzing and assessing industrial sectors for energy potential. For illustrative purposes, energy use in the South African industrial sector between 1993 and 2025 was presented as a case study.

HB 9781536142143 £217.99 September 2018 Nova Science Publishers 165 pages
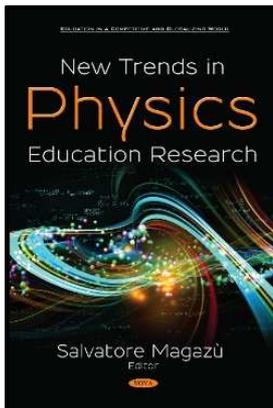
New Trends in Physics Education Research

Edited by Salvatore Magazù

Those who operate in physics education frequently ask research operators for suggestions, reference models, updated content and answers for their professional work. So far, the sector has not achieved significant advances specifically in terms of both content updates and methodology approaches.

In the special issue, titled New Trends in Physics Education Research, the authors, in addition to presenting some new topics in physics education, take into account the greater relevance that in recent years the Evidence Based Education has taken place.

In this framework, the main points of issue include: 1) Dealing with new trends in teaching and learning processes in physics; highlighting new mathematics content for physics courses; 3) giving evidence of the key role played by laboratory activities in physics training courses; and 4) stressing the importance of interdisciplinary approaches as well as scientific culture, communication and dissemination.

Physics teaching involves several fields and different disciplines (such as mathematics, philosophy, laboratory activities, etc.) where the same arguments are often explained without clarifying that often there is a close correlation between disciplines.

HB 9781536138931 £200.00 July 2018 Nova Science Publishers 293 pages

Energy Policies, Politics and Prices Series
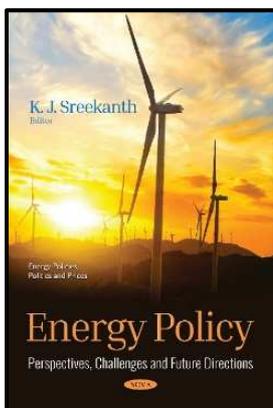
Energy Policy
Perspectives, Challenges and Future Directions

Edited by K. J. Sreekanth

Sustainable development is triggering a re-assessment of innovation and technological change in all fields, and energy is no exception. A key challenge of energy sustainability is to examine the range of credible potential pathways of combined social, environmental and technological systems under conditions of uncertainty, stagger, personal preferences and complication. Conventional energy resources – essentially fossil fuels – are becoming limited because of the swift increase in energy demand. This disparity in energy demand and supply has placed enormous coercion not only on consumer prices, but also on the natural world; this requires mankind to look for sustainable energy resources.

Sreekanth. K. J., PhD begins this book by first describing the energy efficiency and emission reduction characteristics of the road transportation sector in Chapter One. Chapter Two proposes the costs of renewable energy promotion and benefits through an analysis of the European case by Margarita Ortega Izquierdo and Pablo Del Río. Next, Chapter Three, by Jiang Yu and Zheng Fang, presents a review on residential electricity price policies in China. In Chapter Four, Fotouh Al-Ragom discusses the behavior change approach with a metric to promote and sustain energy efficiency. The Nigerian electricity market and its future is explained in Chapter Five by Karen Maguire and Kolawole Olaniyi. The institutionalization of the common gas market in the context of institutional evolution of the Eurasian economic union by Elena Shadrina is explained in Chapter Six.

PB 9781536137446 £82.99 June 2018 Nova Science Publishers 168 pages
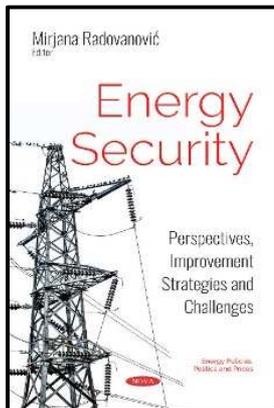
Energy Security
Perspectives, Improvement Strategies and Challenges
Edited by Mirjana Radovanović

Energy security is one of the greatest challenges of the modern world. The situation is further complicated by the fact that energy security can be viewed from different points of view, which are often contradictory and with no consensus on what energy security is and how it is measured, monitored or foreseen. This book presents the most important aspects of energy security, including its role as an element of national security and a factor of geopolitical stability. Many factors affect energy security (and vice versa) in different ways. This book discusses the most important: the impact of political changes, military operations, organizations (EU and NATO), and social movements on energy security. Special emphasis is given to energy infrastructure, as one of the major preconditions that will – along with geopolitical changes – have the greatest impact on energy security in the future. The book presents energy security specificities and challenges in the case of EU countries, the Russian Federation, the United States and China. It also provides an example of small countries that do not have their own energy resources, and therefore need to ensure their secure energy and political future in a rapidly changing world. The book is primarily intended for the academic community, decision-makers, energy sector companies and security services around the world.

HB 9781536135084 £139.99 April 2018 Nova Science Publishers 230 pages

Energy Science, Engineering and Technology Series
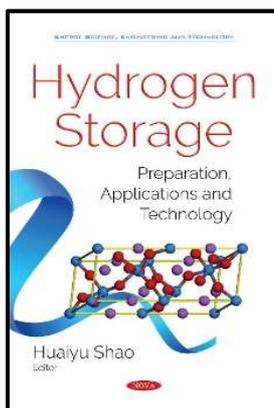
Hydrogen Storage
Preparation, Applications and Technology
Edited by Huaiyu Shao

Are you ready for a society driven by hydrogen energy?

The fact is, no matter if you are ready or not, a hydrogen energy-based society has arrived. Hydrogen as an energy carrier is clean, cheap, inexhaustible, carbon-free, and high in energy and power density, which is perfectly beneficial for mankind to achieve the long-sought goal of a sustainable world.

However, hydrogen exists as a gas at normal temperature and pressure conditions, and its energy density is quite low in a normal gaseous state. Thus, the storing of hydrogen becomes critical and actually, a convenient, high-density and low-cost hydrogen storage system is the key to enabling technology for the wide realization of a hydrogen energy-based society. However, finding this proper solution is challenging since many factors should be considered, such as high capacity, good cycle ability, fast kinetics and proper thermodynamics.

In this exciting book on hydrogen storage, the worldwide active scientists endeavor to share with you:

• How they adopt new ideas on the synthesis, measurement and characterization techniques to advance the research on current studied materials;
• How they explore new materials for cutting-edge hydrogen storage development;
• How they think up new approaches for the next-generation design and development of future hydrogen storage systems, and;
• How they see the possible future directions of hydrogen storage technology and a hydrogen energy-based society.

HB 9781536142204 £169.99 September 2018 Nova Science Publishers 285 pages
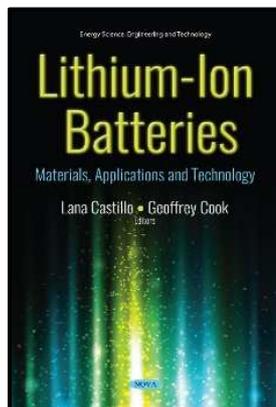
Lithium-Ion Batteries
Materials, Applications and Technology

Edited by Lana Castillo, Geoffrey Cook

This compilation begins by discussing Sn, Sb and Ge-based anodes. Various approaches for alleviating volume changes corresponding to each kind of anode are presented in regards to the last 20 years. Sn, Sb and Ge-based alloy-type anodes have attracted considerable research interest as promising candidates for next-generation LIBs due to their high theoretical capacities, suitable operating voltages and natural abundances. Next, the authors discuss the synthesis and application of Titanium dioxide (TiO_2) based lithium-ion battery anodes. TiO_2 has attracted considerable attention as a promising alternative lithium-ion battery anode. The evolution of studies on synthetic methods, performance improvement, and the size tuning strategy are thoroughly addressed. Following this, the book focuses on clarifying the mechanisms of lithium dendrite growth, the issues related to lithium dendrites, and the recent advances for technical solutions. To power electric vehicles, a minimum energy density of 300 Wh/kg is required. State-of-the-art LIBs are dominating portable electronics but can only enable an energy density of 100-220 Wh/kg in practice to date. In this regard, metallic lithium is highly regarded as promising next-generation anodes, ascribed to its extremely high theoretical capacity of 3860 mAh/g versus 372 mAh/g of the commercial graphite anodes. Recent progress in the development of Si/Gn nanocomposite anodes for lithium-ion batteries is also studied. The synthetic routes and electrochemical performance of these nanomaterials and the underlying reaction mechanisms are systematically described. The authors maintain that more research efforts are needed for the widespread applications of such composite anodes in the future of lithium-ion batteries. Afterwards, the advanced ab initio atomistic thermodynamics approach for electrode materials in LIBs is formulated, which enables the resolution of the interfacial structure of an LIB electrode material in an electrochemical environment under (constrained) reaction conditions. This universal approach is outlined, using state-of-the-art electrode materials in LIBs, such as LTO or lithium cobaltite (LCO, $LiCoO_2$) as examples.

HB 9781536134971 £139.99 April 2018 Nova Science Publishers 223 pages

Green Research, Developments and Programs
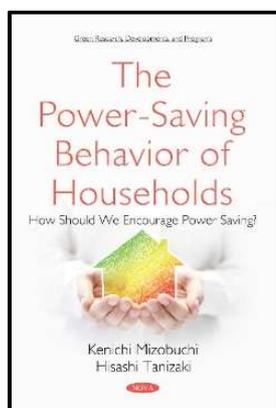
The Power-Saving Behavior of Households
How Should We Encourage Power Saving?

Kenichi Mizobuchi, Hisashi Tanizaki

This book is about the empirical analysis of household electricity saving behavior. In particular, we focus on effective methods to promote energy saving behavior and the effectiveness of energy-saving equipment. After the Great East Japan Earthquake of 2011, 52 of Japan's nuclear power plants temporarily stopped. Prior to the Fukushima accident, about 25% of Japan's total electricity supply amount depended on nuclear power. Therefore, the resulting power shortage has become a serious problem, especially in summer and winter. In this document, the authors focus on several policy instruments that encourage energy saving behavior such as economic incentive (increase in electricity price and compensation), public electricity saving request, comparative feedback, social norms, and verify their effect. Furthermore, the authors will conduct a quantitative economic analysis based on these data sets using randomly obtained data as well as summary data announced after 2011 Great East Japan Earthquake. The authors then examine how households respond to policy measures to save electricity. The result of this book is to clarify to what extent the power saving policy targeted at homes was effective, and it is useful for considering what kind of policy measures (including a mixed policy) should be adopted according to future goals. The authors especially recommend this book to researchers and environmental energy policy-makers, but also target readers interested in Japan's energy saving issues.

PB 9781536131734 £82.99 April 2018 Nova Science Publishers 124 pages
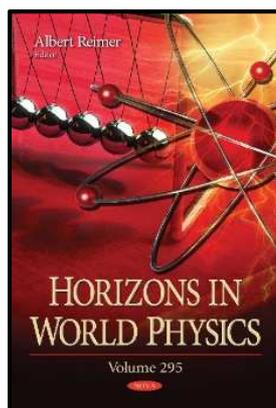
Horizons in World Physics
Volume 295
Edited by Albert Reimer

Horizons in World Physics. Volume 295 provides a detailed description of major fundamental problems of physics associated with inconsistencies of major postulates and concepts used in classical, relativistic, quantum and particle physics. The authors examine conceptual difficulties of classical dynamics, afterwards introducing notions such as energy, momentum and collision. Difficulties related to the introduction of electrodynamics based on hydrodynamic principles are described. Next, a study is presented wherein an attempt was made to explain the fundamental light properties (diffraction, photoelectric effect, pressure, refraction, dispersion and reflection). The photon flow was considered as a directed flow of so-called elementary particles (EP) passing strongly determined channels between the atomic nuclei with different concentrations of FOP. A preceding study gives an explanation for the ordinary and dark energy density of the cosmos. The authors present a connection between quantum entanglement and the absence of almost 95.5% of the energy supposed to be contained in the cosmos, taking the view that our current mathematical knowledge and general theories are in position to explain ordinary energy, dark matter and pure dark energy both qualitatively and quantitatively. A subsequent chapter investigates nonlinear propagation of ultrashort intense laser pulses through underdense plasma, presenting a paraxial theory of self-focusing of intense laser pulses due to expulsion of plasma electrons produced by the extreme ponderomotive force of a focused laser pulse. The authors address the way nanoporous materials applications in biology and medicine have been widely researched in recent years, presenting the numerical model and experimental data for imbibition. This model simulates the motion of the front of the liquid, two-dimensionally imbibing the inhomogeneous nanoporous medium with altering porosity and pore size.

HB 9781536132182 £217.99 March 2018 Nova Science Publishers 229 pages
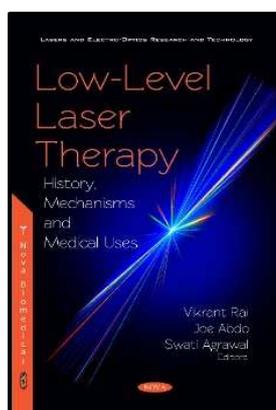
Low-Level Laser Therapy
History, Mechanisms and Medical Uses
Edited by Vikrant Rai

In this book, the authors have provided the latest and most in-depth information on one of clinical medicine's most useful tools: Low-Level Laser Therapy (LLLT). Written by over a dozen experts from five continents, from Jerusalem to Johannesburg and San Diego to Sao Paolo, the breadth of knowledge provided herein expands not only the globe, but many medical fields. LLLT is an inexpensive, easily employed therapeutic strategy that has validated clinical utility in dermatology, oncology, dentistry, veterinary field, wound healing and many other medical arenas. This book provides the most up-to-date information on recent clinical trials as well as catalogs the optimal therapeutic settings for a myriad of disease states. In the past, biochemical mechanisms associated with LLLT therapy have not been well-described; however, this book provides comprehensive and simple biochemical processes pieced together from theories provided by the most recent and reputable publications. The mechanisms involved in the numerous diseases covered by each chapter are also included herein. Low-Level Laser Therapy: History, Mechanisms, and Clinical Uses captures the incredible dynamic usefulness of this simple technology while also listing the therapeutic settings that have been deemed the most effective for dozens of medical ailments. Whether you are a student of medicine or a clinical practitioner, this book will serve as a helpful guide on how LLLT could play a role in the care you or your team provides on a daily basis.

HB 9781536132267 £199.99 April 2018 Nova Science Publishers 366 pages
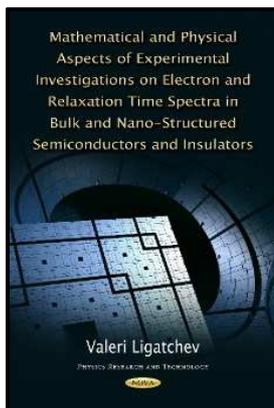
Mathematical & Physical Aspects of Experimental Investigations on Electron & Relaxation Time Spectra in Bulk & Nano-Structured Semiconductors & Insulators

Valeri Ligatchev

This book summarizes important outcomes of a quarter century of developments in advanced mathematical approaches and their implementations for deconvolution. The analysis of electron and relaxation time spectra obtained from the results of appropriate physical experiments fulfilled on real samples of bulk amorphous/crystalline semiconductors and insulators as well as on nano-structured materials and devices are also discussed. The second chapter of this book depicts key features of many well-known traditional and some modern techniques for experimental investigations of electron density and time relaxation spectra in such semiconductors and insulators. as Additionally, there is an emphasis on archetypal problems related to the analysis and interpretation of the results of those experimental techniques. Some generic (though crucially important in the context of this book) physical and mathematical aspects of the polarization and relaxation processes in solids, well-known one-dimensional direct and inverse integral transforms, linear integral equations of the first and second kinds, "ill-posed" mathematical problems and specific mathematical approaches to solution(s) of those are discussed in the third, fourth and fifth chapters, respectively. A majority of the aforementioned mathematical approaches are essentially based on the so-called "regularization" concept, pioneered by famous Russian mathematicians (A. N. Tikhonov, M. M. Lavrentiev, V. K. Ivanov, V. Ya. Arsenin and their co-workers) in the second half of the twentieth century. Mathematical aspects of the regularization concept are discussed (to some extent) in the fifth chapter of the book in comparison to the similar aspects of the traditional "modelling" approach with multiple references on appropriate "original" articles and books. Thanks to distinctive features of the regularization concept, it endures a protracted history (which nowadays well exceeds 5 decades), becomes the dominant strategy for the solution of various "inverse problems", and is widely used in many types of modern applications and computational packages. In particular, the regularization algorithms are incorporated into Mathematica, Matlab, Python and Octave packages.

This generic "regularization" concept had been successfully implemented by the author of this book during the development and practical realization (programming) of several essentially different regularization algorithms (described in detail in the sixth chapter of the book) for unambiguous investigations and the analysis of results of appropriated physical experiments, fulfilled over a period from 1984 to 2009, both in Russia and in Singapore. Furthermore, actual results of such experimental investigations are discussed in the seventh chapter following closely appropriate original publications, and in comparison with their counterparts obtained by traditional (e.g., "modelling") approaches. As it is also demonstrated in the seventh chapter with the relevant examples and detailed discussion(s), the implementation of the aforementioned "regularization" algorithms allows one to identify (and interpret thereafter) new important features of the intra-gap and near-band-gap electronic spectra of the amorphous and polycrystalline semiconductors and insulators. The relaxation time spectra of those materials, which are usually unattainable via the implementation of the "modelling" approach is also analyzed.

HB 9781536125665 £199.99 January 2018 Nova Science Publishers 362 pages
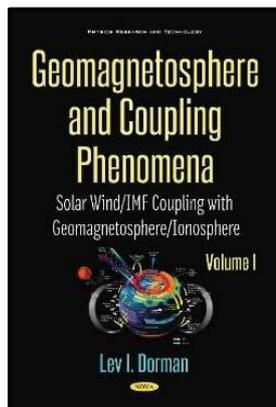
Geomagnetosphere and Coupling Phenomena
Solar Wind/IMF Coupling with Geomagnetosphere/Ionosphere
**Volume I**

Lev I. Dorman

The present review book by Prof., Dr. Lev I. Dorman, *Plasmas and Energetic Processes in Geomagnetosphere* reflects the development of the geomagnetosphere's research and applications for the last few decades. The importance and actuality of geomagnetosphere research are based on the following three factors:

1. The geomagnetosphere is the nearest giant natural laboratory, where it is possible via satellites and ground measurements to investigate in detail many different plasmas and energetic processes in space, which are caused by an interaction of high kinetic energy solar wind plasmas and its perturbations (Interplanetary Coronal Mass Ejections - ICMEs, Interplanetary Shock Waves – ISWs, Interplanetary Interaction Regions – IIR), including those frozen in the Interplanetary Magnetic Fields (IMF) with the rotated main geomagnetic field. This interaction leads to the dynamic transformation of magnetic fields in the geomagnetosphere, generation and trapping of high energy particles (which are known as Magnetospheric Cosmic Rays – MCR), and the generation of many types of instabilities and electromagnetic radiations. These processes are in principle similar to processes in magnetospheres of other planets and their moons, in the atmosphere of the sun and other stars, in interplanetary and in interstellar space, and in many different astrophysical objects. This research is an important basis for fundamental space and astrophysical science.

2. Today, technology, economics, navigation, TV, Internet, radio connections, military aspects, and the life of people on our planet are strongly connected to the work of many satellites moving inside the geomagnetosphere. Different processes and MCR in the geomagnetosphere influence the satellites' work and often lead to satellite malfunctions up to fully destroying their electronics; satellites essentially "die" in these cases. The described research can be considered as a basis for developing methods of forecasting dangerous situations for satellites in different orbits and to decrease the risk of satellite malfunctions and loss.

3. The interaction of ICME, ISW, and IIR with the geomagnetosphere leads to the generation of big magnetic storms accompanied with a Forbush decrease and precursory effects in Galactic Cosmic Ray (GCR) intensity. These magnetic storms are dangerous not only to satellites, but also to the Earth's surface in terms of technology, radio connections, car accidents, and human health (e.g., increasing the frequency of infarct myocardial and brain strokes). Investigations of causes of magnetic storms can help to develop methods of forecasting and decreasing the level of magnetic storm hazards. Therefore, the other practical application of this research is connected with the problem of space weather and space climate influence on the technology, radio connections, navigation, transportation, and people's health on the Earth, which is independent of altitude and geomagnetic latitude.
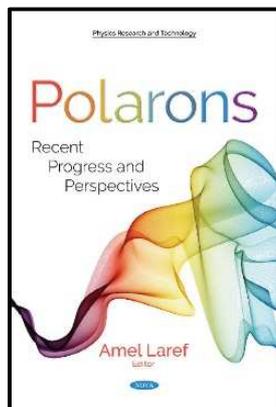
Polarons
Recent Progress and Perspectives
Edited by Amel Laref

This book presents recent research results on the illustrious verge of polaron science, which is broadly applied in condensed matter physics, solid state physics, and chemistry fields. It covers the modern progress of the polaron effect in various classes of materials. This book provides a thorough overview of the recent advancements in the polarons arena, and presents several active forms of guidance of scrutiny developed by well-known researchers. It describes interesting topics related to the new physical phenomena, experimental results, and applications of polarons. The scope includes both theoretical models and experimental works on different aspects of polarons, manifesting in conducting polymers, functionalized nanowires, glasses and their nanocomposites, organic semiconductors, semiconducting nanostructures, manganites, ferrites, transition metal oxides, high-temperature superconductors, colossal magnetoresistance oxides, and magnetic semiconductors. A collective of authoritative research articles provide recent achievements of theoretical models and experimental realizations of polaron properties in solid state physics and chemistry. They involve substantial research varying from single polaron phenomena to multi-polarons problems in advanced materials. This book will be beneficial as a reference to support an inclusive perspective of the polaron phenomena in advanced materials and will be of prodigious significance to a broad range of researchers in condensed matter physics and material sciences.

HB 9781536139358 £269.99 September 2018 Nova Science Publishers 613 pages
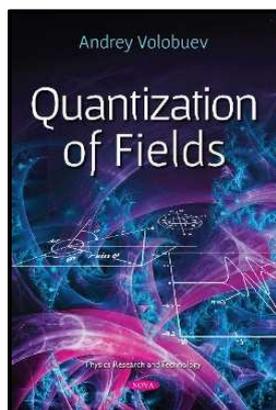
Quantization of Fields
Andrey Nikolaevich Volobuev

In the book *Quantization of Fields*, the problems of electromagnetic and gravitational fields quantization are examined. Quantization of an electromagnetic field is carried out in photon space, i.e., in the reference system moving with a light velocity. This reference system accompanies a photon, therefore, it is possible to carry out the display of a photon to receive representation about its form and to investigate its parameters and properties. In photon space, the Schrodinger's nonlinear equation with logarithmic nonlinearity (which the wave function of a photon obeys) is found. On the basis of this equation, the problem of a material particle and photon interaction in photon space is investigated. It is shown that the interaction of a photon and material particle can be calculated in the closed form in photon space. Such calculations can be carried out only approximately by a method of the perturbations theory in Euclidian spaces. It is shown that during interaction of a photon and electron on the electron surface, there are waves propagating with a light velocity. The problem of a vacuum in the photon space and also multiphoton system in this space is investigated.

During the quantization of a gravitational field, Einstein's equation for a field of gravitation as a basis is used. It is assumed that curved space-time (Riemann's space) is not quantized. Quantization is subjected to an energy-impulse tensor. It is supposed that the curvature of space-time due to the presence of the massive bodies does not create a strength condition in space. The part of corresponding components of an energy-impulse tensor is replaced with quantum sizes by a principle of formation for the quantum mechanics matrix form. On the basis of the quantum form of the gravitational field equation, the solution as a graviton-quantum of a gravitational field is received. It is shown that during the propagation of a graviton near a massive body, there is a pumping of the gravitation field energy in the graviton. Therefore, in the field of a massive body, the graviton is possible to register. When there is distance between the graviton and a massive body, its energy is pumped over back in a gravitation field of a massive body. Therefore, to registering the graviton far from a massive body is problematic. In the book, some standard questions of general relativity – the classical theory of gravitational radiation, the theory of gravitational waves, the Schwarzschild's theory of the solitary mass field, etc. – are submitted also.

PB 9781536139266 £71.99 September 2018 Nova Science Publishers 73 pages
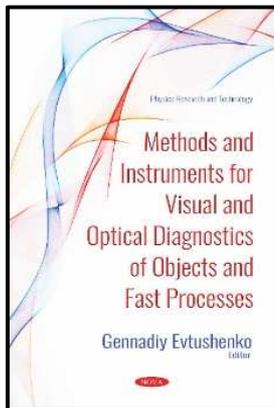
Methods and Instruments for Visual and Optical Diagnostics of Objects and Fast Processes

Edited by Gennadiy Sergeevich Evtushenko

This book presents new instruments and methods for studying the dynamics of fast processes. The manuscript consists of two parts: Part I discusses the use of high speed metal vapor brightness amplifiers for object and process imaging, and Part II addresses the plasma parameters of a high-voltage nanosecond discharge initiated by a runaway electron beam.

Nowadays, the interaction of powerful energy fluxes with various objects, namely plasma-induced processes, surface modification for operational characteristics improvement, production of new materials and nanoparticles, thermonuclear synthesis and others, is studied in various fields of science and technology. As a rule, observing these processes in real time is a challenging problem because of the intense background radiation, the brightness temperature of which reaches thousands or even tens of thousands of degrees. The use of active optical systems with brightness amplifiers allows one "to monitor" such processes. "Looking through the flame" becomes possible due to the use of high spectral brightness of metal vapor active media on self-terminating transitions. The medium serves as an amplifier in a narrow spectral range, or a "nanofilter," which allows for the viewing of the processes blocked by the broadband background radiation. Metal vapor active media on self-terminating transitions with high pulse repetition frequencies (PRF) and modern high-speed video cameras have been used to design a laser monitor. Optical systems based on such an amplifier have been used for monitoring a number of objects and high speed processes, including the diagnostics of fast discharges.

HB 9781536135688 £139.99 May 2018 Nova Science Publishers 184 pages
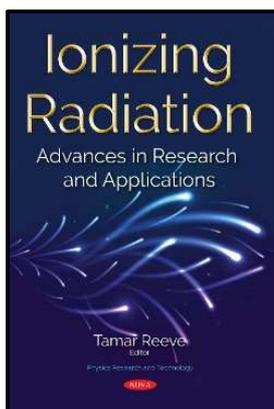
Ionizing Radiation
Advances in Research and Applications

Edited by Tamar Reeve

In this compilation, the authors examine the importance of ionizing radiations for thermoluminescence dosimetry that is the current area of research for medical and industrial purposes. Ionizing radiations are harmful to the human body, so, there is a need to measure small doses in the environment as well as very high doses at the time of accident like radiation leakage and for the treatment of cancer. Next, recent advances regarding effects on exposure of some foods to ionizing radiations are presented. The dosage required for complete sterilization may, at times, lead to undesirable changes in food flavours or may exceed the permitted levels. Combining irradiation with other treatments yields satisfactory results in these cases. Combined applications of ionizing radiation with heat, low temperature, high hydrostatic pressure, and modified atmospheres are also discussed. Later, new results concerning cell survival and genetic instability of wild-type and radiosensitive yeast cells of *Saccharomyces cerevisiae* surviving after irradiation with 60Co γ-rays, 239Pu α-particles and 254 nm UV light are presented. Survival was determined by cell ability to produce macrocolonies on a solid nutrient medium. The authors also review data on the radiation resistance of AlGaN/GaN and InAlN/GaN High Electron Mobility Transistors (HEMTs) as well as emerging Ga_2O_3 photodetectors and rectifiers to different types of ionizing radiation. Both of these wide bandgap semiconductor (nitride-based and gallium oxide-based) materials are much more radiation-hard than GaAs or Si and this is largely a result of their high bond strengths. By using the test system of blood lymphocytes of healthy individuals, the following paper presents the co-mutagenic (potentiating) effect of the drugs – a calcium channel blocker verapamil and an antioxidant ascorbic acid-on the radiosensitivity of cells. It was found that when the lymphocytes are irradiated in a small dose (0.3 Gy), ascorbic acid (80.0 µg / blood) and verapamil (4.0 µg / ml blood) increase the frequency of chromosomal aberrations in comparison with the radiation effect by 75 and 62, 5% respectively.

HB 9781536135398 £82.99 May 2018 Nova Science Publishers 206 pages
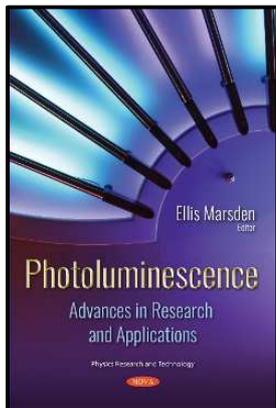
Photoluminescence
Advances in Research and Applications
Edited by Ellis Marsden

In this collection, chalcogenide glasses doped with rare earth elements are proposed as particularly attractive materials for applications in integrated photonics. The opening chapter is dedicated to reviewing the studies on optical properties of $(GeS_2)_{100-x}$ $(Ga_2S_3)_x$ (x=20, 25 and 33 mol%) glasses, doped with Er_2S_3 in a wide range from 1.8 to 2.7 mol%, by absorption and photoluminescence (PL) spectroscopy. The authors focus on features in absorption, emission, and local ordering and their derivatives as a function of excitation wavelength, Er^{3+} doping level, Ga content and temperature for the $(GeS_2)_{80}$ $(Ga_2S_3)_{20}$ host composition. Next, to demonstrate the technological importance of optical devices with unique properties derived from rare-earth activated glasses, the authors reviewed some fundamental aspects of rare-earth doped optical glassy devices where the light is confined in different volumes or shapes, namely fibers, monoliths, film/coatings and microspheres. Rare-earth activated glasses are often used as components in integrated optical circuits. Later, optical characteristics of semiconducting crystals with layered structure due to quantization effects in the architecture governed by the atomic arrangements are discussed. In order to study the microscopic optical processes of these materials, the phenomenological research from photoluminescence studies (PL) was determined to be essential to those established by conventional bulk materials. Layered crystals such as $Cs_3Bi_2I_9$, BiI_3 and PbI_2 have been considered for reporting the PL spectra in order to discuss relevant information concerning photo-induced charge carrier separation and also the radiative and non-radiative recombination dependent on deep or shallow trap states. Additionally, the photoluminescence properties of composites based on conjugated polymers and carbon nanoparticles of the type carbon nanotubes, reduced graphene oxide and fullerenes are analyzed. A review is presented on the photoluminescence properties of various macromolecular compounds, for example poly(para-phenylenevinylene), poly(3-hexylthiophene), poly(3,4-ethylenedioxythiophene-co-pyrene), polydiphenylamine and poly(9,9-dioctylfluorenyl-2,7-diyl) as well as effects induced by the carbon nanoparticles mentioned above. The following chapter focusses on fullerenes, carbon nanotubes, graphene, graphene oxide, graphene and carbon quantum dots. Firstly, the general physical and chemical properties of different carbon-based nanomaterials are presented, such as the crystalline structure, morphology and chemical composition. Additionally, the possibilities of application of carbon-based nanomaterials due to its PL properties are analyzed. The concluding chapter focuses on coordination polymers (CPs) / metal-organic frameworks (MOFs) containing metal ions from d and 4f series and a plethora of organic ligands, the resulted compounds showing remarkable photoluminescence properties with different applications in the field light emitting devices (LEDs), biosensors in medical assays, sensors for identifying certain species (molecules, ions) and so on.

HB 9781536135374 £139.99 May 2018 Nova Science Publishers 179 pages
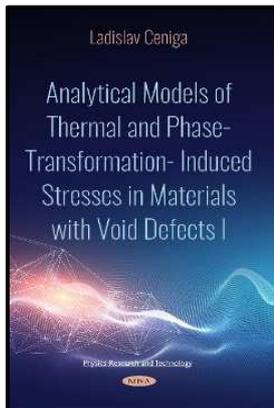
Analytical Models of Thermal and Phase - Transformation Induced Stresses in Materials with Void Defects I

Ladislav Ceniga

This book presents original analytical models of thermal and phase-transformation-induced stresses in isotropic components of two-component materials with void defects (i.e., dual-phase steel, materials of the precipitate-matrix type, etc.). These defects (i.e., pores, flaws) are a consequence of technological processes (e.g., powder metallurgy processes). These stresses, which are observed during a cooling process, originate below the relaxation temperature of a two-component material. The thermal stresses are a consequence of different thermal expansion coefficients of material components. The phase-transformation-induced stresses are a consequence of different dimensions of crystalline lattices, which originate during a phase transformation. The void defects exhibit a significant influence on mechanical properties of materials, as well as on the thermal and phase-transformation-induced stresses. This influence is included within the analytical models in this book. Accordingly, this book can be considered to present unique analytical results.

The analytical models result from a suitable model material system, which corresponds to real two-component materials. These models are determined by different mathematical procedures, which are applied to fundamental equations of solid continuum mechanics. These different procedures result in different partial differential equations with non-zero right-hand sides. These differential equations result in different mathematical solutions for the thermal and phase-transformation-induced stresses. Finally, due to these different solutions, the principle of minimum total potential energy of an elastic solid body is required to be considered. Results of this book are applicable within basic research (solid continuum mechanics, theoretical physics, materials science), as well as within the practice of engineering.

PB 9781536135268 £82.99 April 2018 Nova Science Publishers 153 pages
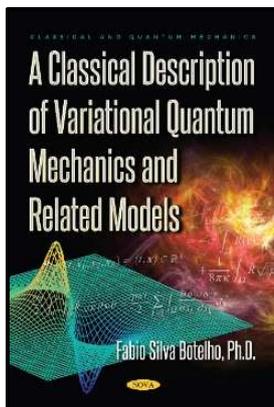
A Classical Description of Variational Quantum Mechanics and Related Models

Fabio Silva Botelho

In this text, the author establishes a connection between classical and quantum mechanics through the normal field definition and related wave function concept.

Indeed, the author proposes a new energy which includes both classical and quantum mechanics in a unified framework. Concerning such energy, they show that if $\hbar \ll m$, where m denotes the total system mass, then the energy is experienced in a classical mechanics context, whereas if the approximation $r(x,t) \approx x$ is assumed, where $r(x,t)$ denotes point-wise the particle classical field of position, and for appropriate m values the standard Schrödinger energies are re-obtained.

Among the examples of applications concerning the proposal, the author highlights the hydrogen atom as one example, where both the proton and electron are allowed to move. The consistent result of a proton mass concentration at r = 0 is obtained.

The author also develops a procedure to obtain eigenvalues of a positive definite symmetric matrix.

The novelty here, concerning previous results in the book entitled *Functional Analysis and Applied Optimization in Banach Spaces*, are the rigorous proofs presented.

Indeed, the results seem to be applicable to more general matrices. However, the author postpones the proof of such general results for future research.

HB 9781536130591 £71.99 February 2018 Nova Science Publishers 112 pages
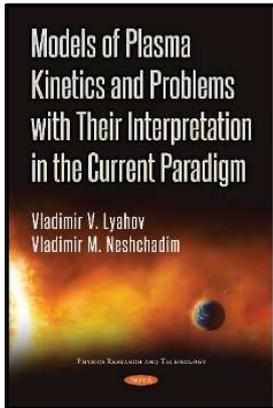
Models of Plasma Kinetics and Problems with Their Interpretation in the Current Paradigm

Vladimir V. Lyahov, Vladimir V. Neshchadim

Proposed by A.A. Vlasov in 1938, the kinetic equation with a self-consistent electromagnetic field led to a fundamentally new perspective in plasma physics. This equation represents the most profound approach to the description of plasma because it operates directly with plasma particles using the distribution function. Plasma is found everywhere in space; that is why this equation has an extensive application. A large number of works where the study of plasma properties based on the solution of the Vlasov equation have appeared.

However, the results based on the solution of the Vlasov equation should be assumed with caution. As noted in the manuscript, the Vlasov equation has a set of formal solutions. The researcher must have the ability to select the correct solutions, correct in the sense of their adequacy to the processes under investigation.

Some aspects of the polarization of a magnetoactive plasma are investigated. It is shown that neglecting the electric field in problems of such sharply inhomogeneous structures as a boundary or current layers leads to an inadequate model. Thus, the successive solution of the kinetic equation taking into account the electric polarization field indicates that the equations describing the equilibrium of these sharply inhomogeneous structures become nonlinear and exhibit the property of structural instability.

Natural science over time included the expansion of the field of numbers from natural to real. Now, physics is in the stage of semi-recognition of complex numbers. On the one hand, when solving the differential equation, the physicist finds the value of the roots of the characteristic equation in a complex field. However, at the final stage, all imaginary parts are discarded, and only real values of physical quantities are passed in response. In this case, the complex field has a fundamental feature that distinguishes it: it is algebraically closed. The restriction of physical quantities only to the field of real numbers seems logically unsatisfactory since often mathematical operations derive them from the field of the original definition. In this manuscript, some problems of the complexification of physics are investigated.

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