M. S. Ramachandra Rao Tatsuo Okada *Editors* 

# ZnO Nanocrystals and Allied Materials



Klaus Ellmer, Andreas Klein, Bernd Rech

ZnO Nanocrystals and Allied Materials M S Ramachandra Rao, Tatsuo Okada, 2013-09-12 ZnO has been the central theme of research in the past decade due to its various applications in band gap engineering and textile and biomedical industries In nanostructured form it offers ample opportunities to realize tunable optical and optoelectronic properties and it was also termed as a potential material to realize room temperature ferromagnetism. This book presents 17 high quality contributory chapters on ZnO related systems written by experts in this field These chapters will help researchers to understand and explore the varied physical properties to envisage device applications of ZnO in thin film heterostructure and nanostructure forms The Science of Nanomaterials Suresh C. Ameta, Rakshit Ameta, 2022-12-29 Nanoparticles have a smaller size as compared to their micro macro or bulk counterparts Reduction in size of these particles provides them with some unique characteristics such as surface to volume ratio quantum confinement effect surface plasmon response widening of band gap etc These nanoparticles have attracted attention of scientists all over the globe in last few decades Written in a convenient and easy to read style this book covers the important aspects of nanomaterials by focusing on the many issues related to the food and textile industries treatment of polluted water health energy crises targeted drug delivery etc The editors take an interdisciplinary approach to discussing how the scenario will change on a global level in the future and explore when these nanomaterials will replace almost all micro and macromaterials. The Science of Nanomaterials is a ready at hand guide to the many issues related to the use of nanomaterials in drug and gene delivery sensors photosplitting of water wastewater treatment microbial diagnosis textile industries nanocomposites food industries safety security packaging Innovation in Nano-polysaccharides for Eco-sustainability Preeti Singh, Kaiser Manzoor, Saiga and preservation etc Ikram, Pratheep Kumar Annamalai, 2021-10-08 Innovation in Nano polysaccharides for Eco sustainability From Science to Industrial Applications presents fundamentals advanced preparation methods and novel applications for polysaccharide based nanomaterials Sections cover the fundamental aspects of polysaccharides and nano polysaccharides including their structure and properties surface modification processing and characterization Key considerations are explained in detail including the connection between the substituents of polysaccharides and their resulting physical properties renewable resources their sustainable utilization and specific high value applications such as pharmaceuticals photocatalysts energy and wastewater treatment and more This is a valuable resource for researchers scientists and advanced students across bio based polymers nanomaterials polymer chemistry sustainable materials biology materials science and engineering and chemical engineering In industry this book will support scientists R D and engineers looking to utilize bio based materials in advanced industrial applications Covers the fundamentals mechanisms preparation methods unique properties and performance of nano polysaccharide materials Explores sustainable applications of nano polysaccharides in areas such as pharmaceuticals energy and wastewater treatment Addresses key challenges including the implementation of sustainable

concepts in chemical design and paths to scalability and commercialization Fundamentals of Low Dimensional Magnets Ram K. Gupta, Sanjay R. Mishra, Tuan Anh Nguyen, 2022-08-29 A low dimensional magnet is a key to the next generation of electronic devices In some respects low dimensional magnets refer to nanomagnets nanostructured magnets or single molecule magnets molecular nanomagnets They also include the group of magnetic nanoparticles which have been widely used in biomedicine technology industries and environmental remediation Low dimensional magnetic materials can be used effectively in the future in powerful computers hard drives magnetic random access memory ultra low power consumption switches etc The properties of these materials largely depend on the doping level phase defects and morphology This book covers various nanomagnets and magnetic materials The basic concepts various synthetic approaches characterizations and mathematical understanding of nanomaterials are provided Some fundamental applications of 1D 2D and 3D materials are covered This book provides the fundamentals of low dimensional magnets along with synthesis theories structure property relations and applications of ferromagnetic nanomaterials This book broadens our fundamental understanding of ferromagnetism and mechanisms for realization and advancement in devices with improved energy efficiency and high storage capacity Biogenic Wastes-Enabled Nanomaterial Synthesis Abhishek Kumar Bhardwaj, Arun Lal Srivastav, Swapnil Rai, 2024-06-08 This book encompasses the knowledge about diverse types of advanced functional nanomaterial development using biogenic materials and associated applications along with various types of waste materials Biomass generated from different industries has been long identified as major organic waste and it is a one of the major sources of contamination in the environment This book will provide the global scenarios of low cost biogenic materials and their suitability pretreatment and the ways to synthesize different kinds of nanomaterials NMs including carbonaceous organic inorganic and polymeric methods The quantitative and qualitative characterization and applications of NMs will also be discussed in this book along with scientific and technical knowledge to manage suitable waste materials for NMs synthesis Significant gaps and similarities between chemical synthesis and green synthesis along with their mechanism will be covered in detail as a point of comparison The book will also contain the information on the need of policies required for waste management and option for their utilization along with the sources of their generation The book also contains latest broad aspects of both practical and theoretical fabrication of metal NPs using biogenic waste materials An emphasis has been made on the recent research related to advance NPs and their application This book will be useful for undergraduate students teachers engineers and researchers especially those working in areas of environmental science material science physical science biotechnology Handbook on Synthesis Strategies for Advanced Materials A. K. Tyagi, Raghumani S. biochemistry and microbiology Ningthoujam, 2021-08-17 This book presents state of the art coverage of synthesis of advanced functional materials Unconventional synthetic routes play an important role in the synthesis of advanced materials as many new materials are metastable and cannot be synthesized by conventional methods. This book presents various synthesis methods such as

conventional solid state method combustion method a range of soft chemical methods template synthesis molecular precursor method microwave synthesis sono chemical method and high pressure synthesis It provides a comprehensive overview of synthesis methods and covers a variety of materials including ceramics films glass carbon based and metallic materials Many techniques for processing and surface functionalization are also discussed Several engineering aspects of materials synthesis are also included The contents of this book are useful for researchers and professionals working in the areas of materials and chemistry Design and development of new therapeutics against infectious diseases using computational and experimental approaches Parth Sarthi Sen Gupta, Yogendra Kumar Mishra, Simone Brogi, 2024-07-15 Infectious diseases are caused by bacteria fungus viruses and other microorganisms Biomolecules such as proteins DNA and or RNA play a crucial role in the infections of these disorders These infectious illnesses are often transmissible meaning they may be passed from one person to another by a variety of means Even though medical technology has progressed some illnesses continue to cause anxiety among individuals worldwide If we examine the situation of COVID 19 the entire world is terrified of the pandemic Similarly In the last decades other infections including Dengue Chikungunya Zika Ebola Japanese Encephalitis Virus JEV influenza the common cold tuberculosis TB Hepatitis A and B and human immunodeficiency syndrome HIV have also challenged the human population Zinc Oxide Claus F. Klingshirn, Andreas Waag, Axel Hoffmann, Jean Geurts, 2010-07-01 The book gives a comprehensive review of the present state of the art in ZnO R D including growth doping lattice dynamics electric magnetic and optical properties The emphasis is on the electric and optical properties because this is the area where novel applications may be expected with highest promise The book highlights not only the most recent results but gives both an overview of past research and of the present status not avoiding critical and controversial discussions of various aspects such as bank symmetries and laser processes Intended to have long lasting impact on ZnO R D this monograph addresses post graduate students but also advanced scientists who want to embark on ZnO research or are already involved the present state of the art and assists them in avoiding duplication of old results or mistakes **Plant Nanobionics** Ram Prasad, 2019-04-30 An improved understanding of the interactions between nanoparticles and plant retorts including their uptake localization and activity could revolutionize crop production through increased disease resistance nutrient utilization and crop yield This may further impact other agricultural and industrial processes that are based on plant crops This two volume book analyses the key processes involved in the nanoparticle delivery to plants and details the interactions between plants and nanomaterials Potential plant nanotechnology applications for enhanced nutrient uptake increased crop productivity and plant disease management are evaluated with careful consideration regarding safe use social acceptance and ecological impact of these technologies Plant Nanobionics Volume 1 Advances in the Understanding of Nanomaterials Research and Applications begins the discussion of nanotechnology applications in plants with the characterization and nanosynthesis of various microbes and covers the mechanisms and etiology of nanostructure

function in microbial cells It focuses on the potential alteration of plant production systems through the controlled release of agrochemicals and targeted delivery of biomolecules Industrial and medical applications are included Volume 2 continues this discussion with a focus on biosynthesis and toxicity *Nanomaterials for Sustainable Development* Rajaram S. Mane, Rashmi P. Sharma, Amruta P. Kanakdande, 2023-05-18 This book highlights recent advances in variety of nanomaterials classes including metal chalcogenides metal oxides hydroxides polymer metal organic frameworks and hybrid nanostructures with a focus on their properties synthesis methods and key applications. It also offers detailed coverage on the toxicity aspects with possible solution Additionally it provides complete and comprehensive information on surface modification strategies of nanoparticles to achieve desired outcomes. This book discusses potential applications and major challenges of using these nanomaterials in the fields of biomedical sciences agricultural industry bioenergy biofuel production and environmental remediation etc Overall this book provides crucial background in nanobiotechnology that compliments the understanding of experimental design for the production of more customized nanomaterials to avail desirable benefits

GaN and ZnO-based Materials and Devices Stephen Pearton, 2012-01-14 The AlInGaN and ZnO materials systems have proven to be one of the scientifically and technologically important areas of development over the past 15 years with applications in UV visible optoelectronics and in high power high frequency microwave devices The pace of advances in these areas has been remarkable and the wide band gap community relies on books like the one we are proposing to provide a review and summary of recent progress **Zinc Oxide - A Material for Micro- and Optoelectronic Applications** Norbert H. Nickel, Evgenii Terukov, 2005-12-28 Recently a significant effort has been devoted to the investigation of ZnO as a suitable semiconductor for UV light emitting diodes lasers and detectors and hetero substrates for GaN Research is driven not only by the technological requirements of state of the art applications but also by the lack of a fundamental understanding of growth processes the role of intrinsic defects and dopants and the properties of hydrogen The NATO Advanced Research Workshop on Zinc oxide as a material for micro and optoelectronic applications held from June 23 to June 25 2004 in St Petersburg Russia was organized accordingly and started with the growth of ZnO A variety of growth methods for bulk and layer growth were discussed These techniques comprised growth methods such as closed space vapor transport CSVT metal organic chemical vapor deposition reactive ion sputtering and pulsed laser deposition From a structural point of view using these growth techniques ZnO can be fabricated ranging from single crystalline bulk material to polycrystalline ZnO and nanowhiskers A major aspect of the ZnO growth is doping n type doping is relatively easy to accomplish with elements such al Al or Ga At room temperature single crystal ZnO exhibits a resistivity of about 0 3 cm an electron mobility of 2 17 3 225 cm Vs and a carrier concentration of 10 cm In n type ZnO two shallow donors are observable with activation energies of 30 40 meV and 60 70 meV Transparent Conductive Zinc Oxide Klaus Ellmer, Andreas Klein, Bernd Rech, 2007-12-29 Zinc oxide ZnO belongs to the class of transparent conducting oxides that can be used as transparent

electrodes in electronic devices or heated windows In this book the material properties of the deposition technologies for and applications of zinc oxide in thin film solar cells are described in a comprehensive manner Structural morphological optical Oxide and Nitride Semiconductors Takafumi Yao, Soon-Ku and electronic properties of ZnO are treated in this review Hong, 2009-03-20 This is a unique book devoted to the important class of both oxide and nitride semiconductors It covers processing properties and applications of ZnO and GaN The aim of this book is to provide the fundamental and technological issues for both ZnO and GaN Handbook of Zinc Oxide and Related Materials Zhe Chuan Feng, 2012-09-26 Through their application in energy efficient and environmentally friendly devices zinc oxide ZnO and related classes of wide gap semiconductors including GaN and SiC are revolutionizing numerous areas from lighting energy conversion photovoltaics and communications to biotechnology imaging and medicine With an emphasis on engineering and materials science Handbook of Zinc Oxide and Related Materials provides a comprehensive up to date review of various technological aspects of ZnO Volume One presents fundamental knowledge on ZnO based materials and technologies It covers the basic physics and chemistry of ZnO and related compound semiconductors and alloys The first part of this volume discusses preparation methods modeling and doping strategies It then describes epitaxial methods used to create thin films and functional materials The book concludes with a review of alloys and related materials exploring their preparation bulk properties and applications Covering key properties and important technologies of ZnO based devices and nano engineering the handbook highlights the potential of this wide gap semiconductor It also illustrates the remaining challenging issues in nanomaterial preparation and device fabrication for R D in the twenty first century Oxide and Nitride Semiconductors Takafumi Yao, Soon-Ku Hong, 2009-04-29 This is a unique book devoted to the important class of both oxide and nitride semiconductors It covers processing properties and applications of ZnO and GaN The aim of this book is to provide the fundamental and technological issues for both ZnO and GaN Handbook of Zinc Oxide and Related Materials Zhe Chuan Feng, 2012-09-26 Through their application in energy efficient and environmentally friendly devices zinc oxide ZnO and related classes of wide gap semiconductors including GaN and SiC are revolutionizing numerous areas from lighting energy conversion photovoltaics and communications to biotechnology imaging and medicine With an emphasis on engineering a Synthesis of Zinc Oxide by Sol-Gel Method for Photoelectrochemical Cells Siti Salwa Alias, Ahmad Azmin Mohamad, 2013-11-20 This book focuses on the study of synthesized ZnO powder using Zn CH3COO 2 2H2O precursor methanol as solvent and sodium hydroxide NaOH to vary the pH The successfully synthesized ZnO powder from the sol gel centrifugation and sol gel storage methods were characterized and investigated by X ray diffraction field emission scanning electron microscopy transmission electron microscopy Fourier transform infrared spectroscopy UV visible spectroscopy and photoluminescence test to compare the properties of the nanoparticles The best characteristic of the ZnO powder from both methods was observed when the powders were coated on an ITO glass to fabricate a PEC The current density voltage performances of both PECs

were investigated under luminescent and dark conditions 
Zinc Oxide and Related Materials: Volume 957 Jürgen H. Christen, 2007-04-05 The MRS Symposium Proceeding series is an internationally recognised reference suitable for researchers and practitioners The topics covered in this volume first published in 2007 include devices defects spintronics and magnetism growth optical properties and nanostructures and doping and processing TFTs 
Zinc Oxide Hadis Morkoç, Ümit Özgür, 2008-12-03 This first systematic authoritative and thorough treatment in one comprehensive volume presents the fundamentals and technologies of the topic elucidating all aspects of ZnO materials and devices Following an introduction the authors look at the general properties of ZnO as well as its growth optical processes doping and ZnO based dilute magnetic semiconductors Concluding sections treat bandgap engineering processing and ZnO nanostructures and nanodevices Of interest to device engineers physicists and semiconductor and solid state scientists in general

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