

Donglu Shi (Ed.)

# **Functional Thin Films and Functional Materials**

New Concepts  
and Technologies



Springer

# Functional Thin Films And Functional Materials

**Joao B. Sousa, Joao O. Ventura, Andre  
Pereira**



## **Functional Thin Films And Functional Materials:**

*Functional Thin Films and Functional Materials*, 2003      **Functional Thin Films and Functional Materials** Donglu Shi, 2003 This book provides an up to date introduction to the field of functional thin films and materials encompassing newly developed technologies and fundamental new concepts The focus is on the critical areas of novel thin films such as sol gel synthesis of membrane ferroelectric thin films and devices functional nanostructured thin films micromechanical analysis of fiber reinforced composites and novel applications An important aspect of the book lies in its wide coverage of practical applications It introduces not only the cutting edge technologies in modern industry but also unique applications in many rapidly advancing fields This book is written for a wide readership including university students and researchers from diverse backgrounds such as physics materials science engineering and chemistry Both undergraduate and graduate students will find it a valuable reference book on key topics related to solid state and materials science      *Functional Thin Films*

*Technology* Sam Zhang, Jyh-Ming Ting, Wan-Yu Wu, 2021-08-08 *Functional Thin Films Technology* features the functional aspects of thin films such as their application in solar selective absorbers fiber lasers solid oxide fuel cells piezo related areas catalysts superhydrophobicity semiconductors and trace pesticides detection It highlights developments and advances in the preparation characterization and applications of functional micro nano scaled films and coatings This book Presents technologies aimed at functionality used in nanoelectronics solar selective absorbers solid oxide fuel cells piezo applications and sensors Covers absorbers catalysts anodic aluminum oxide superhydrophobics and semiconductor devices Features a chapter on transport phenomena associated to structures Discusses transport phenomena and material informatics This second volume in the two volume set *Protective Thin Coatings and Functional Thin Films Technology* will benefit industry professionals and researchers working in areas related to semiconductors optoelectronics plasma technology solid state energy storages and 5G as well as advanced students studying electrical mechanical chemical and materials engineering

*Functional Thin Films and Nanostructures for Sensors* Anis Zribi, Jeffrey Fortin, 2009-04-05 In recent years there has been a convergence of fundamental materials science and materials processing methods This convergence although highly interdisciplinary in nature has been brought about by technologies such as bandgap engineering and related techniques that have led to application specific devices such as lab on chip and system on a chip The demand for reduced device size device portability and low power dissipation coupled with high speed of operation continues to dictate terms and conditions for the evolution of nanotechnology The present trend in approaches to systems manufacturing continues to focus on integration of mul functionalities on the same chip These functionalities include for example board laser sources sensors and amplifiers Both the military and civilian markets continue to drive the research and development component In recent years the emergency preparedness guidance systems have added excitement and curiosity to this expanding industry The outgrowth of technologies of interest for emergency preparedness includes the development of terahertz sources and detectors and s tems

for detection of explosives and concealed weapons among others Sensors made from bulk materials have been around for a long time Enormous advances in the processing technologies of thin films have led to the ability to manufacture application specific functional thin films      Functional Materials and Electronics Jiabao Yi, Sean Li, 2018-05-11 This informative book focuses on newly developed functional materials and their applications for electronic and spintronic devices Electronic devices have become a part of our daily modern life involving mobile phones data storage computers and satellites and there is relentless growth in microelectronics This volume covers the topics of oxide materials for electronics devices new materials and new properties especially in newly developed research areas such as oxide magnetic semiconductors and two dimensional electron gas Key features Emphasizes functional materials for electronic devices including two dimensional materials two dimensional electron gas multiferroic materials memory materials sensor materials and spintronic materials Describes the basics as well as new developments of these functional materials and devices      **Special Structural and Functional Materials** Nicușor-Alin SÎRBU, Steven Y. Liang, 2022-05-30 Special topic volume with invited peer reviewed papers only      **Mechanics of Advanced Functional Materials** Biao Wang, 2013-07-24 Mechanics of Advanced Functional Materials emphasizes the coupling effect between the electric and mechanical field in the piezoelectric ferroelectric and other functional materials It also discusses the size effect on the ferroelectric domain instability and phase transition behaviors using the continuum micro structural evolution models Functional materials usually have a very wide application in engineering due to their unique thermal electric magnetic optoelectronic etc functions Almost all the applications demand that the material should have reasonable stiffness strength fracture toughness and the other mechanical properties Furthermore usually the stress and strain fields on the functional materials and devices have some important coupling effect on the functionality of the materials Much progress has been made concerning the coupling electric and mechanical behaviors such as the coupled electric and stress field distribution in piezoelectric solids ferroelectric domain patterns in ferroelectrics fracture and failure properties under coupled electric and stress field etc The book is intended for researchers and postgraduate students in the fields of mechanics materials sciences and applied physics who are interested to work on the interdisciplinary mathematical modeling of the functional materials Prof Biao Wang is the Dean of School of Physics and Engineering of the Sun Yat sen University China      **Advanced Functional Materials and Devices** Saluru Baba Krupanidhi, Vinay Gupta, Anjali Sharma Kaushik, Anjani Kumar Singh, 2021-12-02 This book presents the select proceedings of the International Conference on Advanced Functional Materials and Devices AFMD 2021 It highlights the advancements in area of functional materials which includes electronic magnetic optical adaptive and dielectric materials that are required to develop new functionalities with better performance in this new era of technology The topics covered include materials for energy harvesting biomedical applications environmental monitoring photonics and optoelectronic devices strategic applications and high energy physics This book will be a useful reference for beginners researchers academicians and

professionals working in the area of material science and its allied fields      **Advanced Functional Materials** Ashutosh Tiwari, Lokman Uzun, 2015-05-14 Because of their unique properties size shape and surface functions functional materials are gaining significant attention in the areas of energy conversion and storage sensing electronics photonics and biomedicine Within the chapters of this book written by well known researchers one will find the range of methods that have been developed for preparation and functionalization of organic inorganic and hybrid structures which are the necessary building blocks for the architecture of various advanced functional materials The book discusses these innovative methodologies and research strategies as well as provides a comprehensive and detailed overview of the cutting edge research on the processing properties and technology developments of advanced functional materials and their applications Specifically **Advanced Functional Materials** Compiles the objectives related to functional materials and provides detailed reviews of fundamentals novel production methods and frontiers of functional materials including metallic oxides conducting polymers carbon nanotubes discotic liquid crystalline dimers calixarenes crown ethers chitosan and graphene Discusses the production and characterization of these materials while mentioning recent approaches developed as well as their uses and applications for sensitive chemiresistors optical and electronic materials solar hydrogen generation supercapacitors display and organic light emitting diodes functional adsorbents and antimicrobial and biocompatible layer formation This volume in the **Advanced Materials Book Series** includes twelve chapters divided into two main areas Part 1 Functional Metal Oxides Architecture Design and Applications and Part 2 Multifunctional Hybrid Materials Fundamentals and Frontiers      **Functional Materials** S. Banerjee, A. K. Tyagi, 2011-12-09 Functional materials have assumed a very prominent position in several high tech areas Such materials are not being classified on the basis of their origin nature of bonding or processing techniques but are classified on the basis of the functions they can perform This is a significant departure from the earlier schemes in which materials were described as metals alloys ceramics polymers glass materials etc Several new processing techniques have also evolved in the recent past Because of the diversity of materials and their functions it has become extremely difficult to obtain information from single source **Functional Materials Preparation Processing and Applications** provides a comprehensive review of the latest developments Serves as a ready reference for Chemistry Physics and Materials Science researchers by covering a wide range of functional materials in one book Aids in the design of new materials by emphasizing structure or microstructure property correlation Covers the processing of functional materials in detail which helps in conceptualizing the applications of them      **Functional Materials for the Oil and Gas Industry** Deepak Dwivedi, Amit Ranjan, Jitendra S. Sangwai, 2023-09-06 **Functional Materials for the Oil and Gas Industry Characterization and Applications** discusses the latest techniques in characterization and applications of functional materials in the oil and gas industry It provides an expert review of recent developments in a variety of materials such as ceramics composites and alloys and covers all major aspects relevant to the industry including asset management corrosion operation pipeline engineering energy

management and applications in extreme environments This book Discusses modern characterization techniques such as in situ TEM SAXS SANS X ray and neutron tomography Covers conventional and advanced nondestructive techniques NDTs such as ultrasonic testing and radiography for asset integrity checking in oil and gas sectors Describes advanced properties of a variety of functional materials and their applications to the oil and gas field Explains self cleaning coating technologies and their applications and materials for renewable energy sources Details advances in synthesis methods for functional materials Features industrial aspects of afunctional materials application in each chapter Written for an interdisciplinary audience of industrial practitioners academics and researchers in petroleum materials chemical and related disciplines of engineering this work offers significant insight into the state of the art in the development and characterization of advanced functional materials

Transport Phenomena in Micro- and Nanoscale Functional Materials and Devices Joao B. Sousa,Joao O. Ventura,Andre Pereira,2021-03-26 Transport Phenomena in Micro and Nanoscale Functional Materials and Devices offers a pragmatic view on transport phenomena for micro and nanoscale materials and devices both as a research tool and as a means to implant new functions in materials Chapters emphasize transport properties TP as a research tool at the micro nano level and give an experimental view on underlying techniques The relevance of TP is highlighted through the interplay between a micro nanocarrier s characteristics and media characteristics long short range order and disorder excitations couplings and in energy conversions Later sections contain case studies on the role of transport properties in functional nanomaterials This includes transport in thin films and nanostructures from nanogranular films to graphene and 2D semiconductors and spintronics and from read heads MRAMs and sensors to nano oscillators and energy conversion from figures of merit micro coolers and micro heaters to spincaloritronics Presents a pragmatic description of electrical transport phenomena in micro and nanoscale materials and devices from an experimental viewpoint Provides an in depth overview of the experimental techniques available to measure transport phenomena in micro and nanoscale materials Features case studies to illustrate how each technique works Highlights emerging areas of interest in micro and nanomaterial transport phenomena including spintronics

*Ellipsometry of Functional Organic Surfaces and Films* Karsten Hinrichs,Klaus-Jochen Eichhorn,2018-05-06 This new edition provides a state of the art survey of ellipsometric methods used to study organic films and surfaces from laboratory to synchrotron applications with a special focus on in situ use in processing environments and at solid liquid interfaces Thanks to the development of functional organic meta and hybrid materials for new optical electronic sensing and biotechnological devices the ellipsometric analysis of optical and material properties has made tremendous strides over the past few years The second edition has been updated to reflect the latest advances in ellipsometric methods The new content focuses on the study of anisotropic materials conjugated polymers polarons self assembled monolayers industrial membranes adsorption of proteins enzymes and RGD peptides as well as the correlation of ellipsometric spectra to structure and molecular interactions

Interfacial Engineering in Functional Materials for

Dye-Sensitized Solar Cells Alagarsamy Pandikumar, Kandasamy Jothivenkatachalam, Karuppanapillai B. Bhojanana, 2019-10-30 Offers an Interdisciplinary approach to the engineering of functional materials for efficient solar cell technology Written by a collection of experts in the field of solar cell technology this book focuses on the engineering of a variety of functional materials for improving photoanode efficiency of dye sensitized solar cells DSSC The first two chapters describe operation principles of DSSC charge transfer dynamics as well as challenges and solutions for improving DSSCs The remaining chapters focus on interfacial engineering of functional materials at the photoanode surface to create greater output efficiency Interfacial Engineering in Functional Materials for Dye Sensitized Solar Cells begins by introducing readers to the history configuration components and working principles of DSSC It then goes on to cover both nanoarchitectures and light scattering materials as photoanode Function of compact blocking layer in the photoanode and of  $\text{TiCl}_4$  post treatment in the photoanode are examined at next Next two chapters look at photoanode function of doped semiconductors and binary semiconductor metal oxides Other chapters consider nanocomposites namely plasmonic nanocomposites carbon nanotube based nanocomposites graphene based nanocomposites and graphite carbon nitride based nanocomposites as photoanodes The book Provides comprehensive coverage of the fundamentals through the applications of DSSC Encompasses topics on various functional materials for DSSC technology Focuses on the novel design and application of materials in DSSC to develop more efficient renewable energy sources Is useful for material scientists engineers physicists and chemists interested in functional materials for the design of efficient solar cells Interfacial Engineering in Functional Materials for Dye Sensitized Solar Cells will be of great benefit to graduate students researchers and engineers who work in the multi disciplinary areas of material science engineering physics and chemistry

*Defects In Functional Materials* Chi-chung Francis Ling, Shengqiang Zhou, Andrej Kuznetsov, 2020-08-21 The research of functional materials has attracted extensive attention in recent years and its advancement nitrifies the developments of modern sciences and technologies like green sciences and energy aerospace medical and health telecommunications and information technology The present book aims to summarize the research activities carried out in recent years devoting to the understanding of the physics and chemistry of how the defects play a role in the electrical optical and magnetic properties and the applications of the different functional materials in the fields of magnetism optoelectronic and photovoltaic etc

**Laser Printing of Functional Materials** Alberto Piqué, Pere Serra, 2018-01-04 The first book on this hot topic includes such major research areas as printed electronics sensors biomaterials and 3D cell printing Well structured and with a strong focus on applications the text is divided in three sections with the first describing the fundamentals of laser transfer The second provides an overview of the wide variety of materials that can be used for laser transfer processing while the final section comprehensively discusses a number of practical uses including printing of electronic materials printing of 3D structures as well as large area high throughput applications The book is rounded off by a look at the future for laser printed materials Invaluable reading for a

broad audience ranging from material developers to mechanical engineers from academic researchers to industrial developers and for those interested in the development of micro scale additive manufacturing techniques

**Functional Properties of Nanostructured Materials** Rainer Kassing, Plamen Petkov, Wilhelm Kulisch, Cyril Popov, 2007-09-26 This book based on the lectures and contributions of the NATO ASI on Functional Properties of Nanostructured Materials gives a broad overview on its topic as it combines basic theoretical articles papers dealing with experimental techniques and contributions on advanced and up to date applications in fields such as microelectronics optoelectronics electrochemistry sensorics and biotechnology

Functional Materials for Sustainable Energy Applications J A Kilner, S J Skinner, S J C Irvine, P P Edwards, 2012-09-28 Global demand for low cost efficient and sustainable energy production is ever increasing Driven by recent discoveries and innovation in the science and technology of materials applications based on functional materials are becoming increasingly important Functional materials for sustainable energy applications provides an essential guide to the development and application of these materials in sustainable energy production Part one reviews functional materials for solar power including silicon based thin film and dye sensitized photovoltaic solar cells thermophotovoltaic device modelling and photoelectrochemical cells Part two focuses on functional materials for hydrogen production and storage Functional materials for fuel cells are then explored in part three where developments in membranes catalysts and membrane electrode assemblies for polymer electrolyte and direct methanol fuel cells are discussed alongside electrolytes and ion conductors novel cathodes anodes thin films and proton conductors for solid oxide fuel cells Part four considers functional materials for demand reduction and energy storage before the book concludes in part five with an investigation into computer simulation studies of functional materials With its distinguished editors and international team of expert contributors Functional materials for sustainable energy applications is an indispensable tool for anyone involved in the research development manufacture and application of materials for sustainable energy production including materials engineers scientists and academics in the rapidly developing interdisciplinary field of sustainable energy An essential guide to the development and application of functional materials in sustainable energy production Reviews functional materials for solar power Focuses on functional materials for hydrogen production and storage fuel cells demand reduction and energy storage

**Double-Gyroid-Structured Functional Materials** Maik Rudolf Johann Scherer, 2013-06-25 The development of new high tech applications and devices has created a seemingly insatiable demand for novel functional materials with enhanced and tailored properties Such materials can be achieved by three dimensional structuring on the nanoscale giving rise to a significant enhancement of particular functional characteristics which stems from the ability to access both surface interface and bulk properties The highly ordered bicontinuous double gyroid morphology is a fascinating and particularly suitable 3D nanostructure for this purpose due to its highly accessible surface area connectivity narrow pore diameter distribution and superb structural stability The presented study encompasses a wide range of modern nanotechnology techniques in a highly



versatile bottom up nanopatterning strategy that splits the fabrication process into two successive steps the preparation of mesoporous double gyroid templates utilizing diblock copolymer self assembly and their replication with a functional material employing electrochemical deposition and atomic layer deposition The double gyroid structured materials discussed include metals metal oxides and conjugated polymers which are applied and characterized in high performance devices such as electrochromic displays supercapacitors chemical sensors and photovoltaics This publication addresses a wide range of readers from researchers and specialists who are professionally active in the field to more general readers interested in chemistry nanoscience and physics

*Recent Advances in Complex Functional Materials* Elson Longo, Felipe de Almeida La Porta, 2017-07-12 In this book we explore new approaches to understanding the physical and chemical properties of emergent complex functional materials revealing a close relationship between their structures and properties at the molecular level The primary focus of this book is on the ability to synthesize materials with a controlled chemical composition a crystallographic structure and a well defined morphology Special attention is also given to the interplay of theory simulation and experimental results in order to interconnect theoretical knowledge and experimental approaches which can reveal new scientific and technological directions in several fields expanding the versatility to yield a variety of new complex materials with desirable applications and functions Some of the challenges and opportunities in this field are also discussed targeting the development of new emergent complex functional materials with tailored properties to solve problems related to renewable energy health and environmental sustainability A more fundamental understanding of the physical and chemical properties of new emergent complex functional materials is essential to achieving more substantial progress in a number of technological fields With this goal in mind the editors invited acknowledged specialists to contribute chapters covering a broad range of disciplines

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## **Functional Thin Films And Functional Materials Introduction**

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