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KEY=SEMICONDUCTOR - JOSEPH KENDRA

CHEMICAL SOLUTION DEPOSITION OF SEMICONDUCTOR FILMS

CRC Press *Discussing specific depositions of a wide range of semiconductors and properties of the resulting films, Chemical Solution Deposition of Semiconductor Films examines the processes involved and explains the effect of various process parameters on final film and film deposition outcomes through the use of detailed examples. Supplying experimental res*

CHEMICAL SOLUTION DEPOSITION OF SEMICONDUCTING AND NON-METALLIC FILMS

PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM

The Electrochemical Society

CHEMICAL SOLUTION SYNTHESIS FOR MATERIALS DESIGN AND THIN FILM DEVICE APPLICATIONS

Elsevier *Chemical Solution Synthesis for Materials Design and Thin Film Device Applications presents current research on wet chemical techniques for thin-film based devices. Sections cover the quality of thin films, types of common films used in devices, various thermodynamic properties, thin film patterning, device configuration and applications. As a whole, these topics create a roadmap for developing new materials and incorporating the results in device fabrication. This book is suitable for graduate, undergraduate, doctoral students, and researchers looking for quick guidance on material synthesis and device fabrication through wet chemical routes. Provides the different wet chemical routes for materials synthesis, along with the most relevant thin film structured materials for device applications Discusses patterning and solution processing of inorganic thin films, along with solvent-based processing techniques Includes an overview of key processes and methods in thin film synthesis, processing and device fabrication, such as nucleation, lithography and solution processing*

CHEMICAL SOLUTION DEPOSITION OF FUNCTIONAL OXIDE THIN FILMS

Springer Science & Business Media *This is the first text to cover all aspects of solution processed functional oxide thin-films. Chemical Solution Deposition (CSD) comprises all solution based thin- film deposition techniques, which involve chemical reactions of precursors during the formation of the oxide films, i. e. sol-gel type routes, metallo-organic decomposition routes, hybrid routes, etc. While the development of sol-gel type processes for optical coatings on glass by silicon dioxide and titanium dioxide dates from the mid-20th century, the first CSD derived electronic oxide thin films, such as lead zirconate titanate, were prepared in the 1980's. Since then CSD has emerged as a highly flexible and cost-effective technique for the fabrication of a very wide variety of functional oxide thin films. Application areas include, for example, integrated dielectric capacitors, ferroelectric random access memories, pyroelectric infrared detectors, piezoelectric micro-electromechanical systems, antireflective coatings, optical filters, conducting-, transparent conducting-, and superconducting layers, luminescent coatings, gas sensors, thin film solid-oxide fuel cells, and photoelectrocatalytic solar cells. In the appendix detailed "cooking recipes" for selected material systems are offered.*

SOLUTION DEPOSITION OF SEMICONDUCTOR THIN FILMS FOR PHOTOVOLTAICS

Thin film photovoltaics are among the most promising clean, renewable energy technologies and have the potential to meet future world energy demand by covering only a small fraction of the earth's

surface. To meet this challenge, annual production of photovoltaic modules, despite recent escalation, must still increase several orders of magnitude, and the development of inexpensive and scalable thin film deposition methods is of crucial importance to this effort. The cost and scalability limitations of the standard high-vacuum thin film deposition methods may be overcome by using solution-based methods. Furthermore, the transition from photovoltaic materials containing cadmium, indium, and tellurium to materials comprised of earth-abundant, non-toxic elements is expected to accelerate their large-scale deployment. Here, I present several strategies for the improvement of inorganic thin films synthesized by solution deposition. In this work, two low-cost, solution-based methods (chemical bath deposition and nanocrystal inks) were applied to the deposition of thin films of ZnS, SnS, and Cu2ZnSnS4 (CZTS), all potential earth-abundant non-toxic materials for photovoltaics. First, through the chemical bath deposition of SnS, I show how film quality is a function of deposition kinetics and can be manipulated through control of bath compositions and post-annealing parameters to improve film properties In the same SnS system, using nanocrystal inks, I show that control over nanocrystal morphology can be used as a strategy for improving thin film quality. A selective synthesis was developed for the production of high-aspect ratio sheet-like nanocrystals. Nanocrystal inks formulated from these crystals were capable of producing extremely highly-oriented thin films through the lamellar stacking of SnS sheets, which yielded favorable optical and electronic properties. The second major study in nanocrystal inks examined the efficacy of inorganic ligand exchanges and the resulting effect on film formation. Ammonium polysulfides were demonstrated as a novel species for ligand exchange on cubic ZnS nanocrystals, where they were shown to remove native ligands with high efficacy and improve film quality. Finally, this ligand exchange was applied to CZTS nanocrystal inks with promising implications for the deposition solar absorber layers. The use of these ligands has the potential to improve efficiency and lower costs in the production of CZTS photovoltaics and other chalcogenide thin films.

ELECTRICAL AND OPTICAL PROPERTIES OF LEAD SELENIDE THIN FILMS BY CHEMICAL BATH DEPOSITION

Lulu.com

FERROELECTRICITY IN DOPED HAFNIUM OXIDE

MATERIALS, PROPERTIES AND DEVICES

Woodhead Publishing *Ferroelectricity in Doped Hafnium Oxide: Materials, Properties and Devices covers all aspects relating to the structural and electrical properties of HfO2 and its implementation into semiconductor devices, including a comparison to standard ferroelectric materials. The ferroelectric and field-induced ferroelectric properties of HfO2-based films are considered promising for various applications, including non-volatile memories, negative capacitance field-effect-transistors, energy storage, harvesting, and solid-state cooling. Fundamentals of ferroelectric and piezoelectric properties, HfO2 processes, and the impact of dopants on ferroelectric properties are also extensively discussed in the book, along with phase transition, switching kinetics, epitaxial growth, thickness scaling, and more. Additional chapters consider the modeling of ferroelectric phase transformation, structural characterization, and the differences and similarities between HFO2 and standard ferroelectric materials. Finally, HfO2 based devices are summarized. Explores all aspects of the structural and electrical properties of HfO2, including processes, modelling and implementation into semiconductor devices Considers potential applications including FeCaps, FeFETs, NCFETs, FTJs and more Provides comparison of an emerging ferroelectric material to conventional ferroelectric materials with insights to the problems of downscaling that conventional ferroelectrics face*

INVESTIGATION OF LOW TEMPERATURE SOLUTION-BASED DEPOSITION PROCESS FOR FLEXIBLE ELECTRONICS

The critical contribution of this dissertation is to provide a better understanding of the fundamental Chemical Bath Deposition (CBD) growth kinetic and mechanism for the well known II-VI semiconductor CdS using the newly developed continuous flow microreactor. This continuous flow microreactor provides the temporal resolution to control the homogeneous reaction of the chemical solution before it impinges on the substrate surface. This capability was used to decouple the homogeneous particle formation and deposition from the molecular level heterogeneous surface reaction to overcome the drawbacks associated with a conventional batch process. Transmission electron microscopy (TEM) analysis indicated an impinging flux without the formation of nanoparticles which could be obtained from this reactor in a short residence time. In addition, the reactor could be operated in a homogeneous particle formation regime. Size increasing CdS nanoparticles grown by homogeneous reaction were clearly observed from TEM and SEM micrographs by increasing the residence time from 1 to 280 sec using pre-heated precursor solutions. The formation of CdS nanorod and arrayed nanorod bundle structures using the CBD recipe were also observed in some areas and reported here for the first time. The growth kinetics were studied using a particle-free flux. The deposition results suggest that HS- ions formed through the thiourea hydrolysis reaction are the dominant sulfide ion source responsible for the CdS deposition rather than thioura itself that had been widely discussed in almost all of the previous literature. This finding could not be observed previously by a conventional CBD batch setup because all the reactant solutions were sequentially pulled into the reaction beaker and mixed all at once. An impinging flux without the formation of nanoparticles enables us to deposit extremely smooth and highly oriented nanocrystalline CdS semiconductor thin films at low temperature (80°C). Enhancement-mode functional thin film transistors with an effective mobility of mueff =1.46 cm2/V s, drain current on-to-off ratio of approximately 105 and turn-on voltage at 0 V were fabricated from the as-deposited films without any post annealing process. This microreactor could be adapted for the deposition of other compound semiconductor thin films such as highly transparent amorphous Indium

Oxide (In2O3) thin films at low temperature (70°C) using chemical solution deposition and opens a low-cost avenue to fabricate thin film flexible electronics on polymeric substrates.

TRANSPARENT CONDUCTIVE MATERIALS

MATERIALS, SYNTHESIS, CHARACTERIZATION, APPLICATIONS

Wiley-VCH *Edited by well-known pioneers in the field, this handbook and ready reference provides a comprehensive overview of transparent conductive materials with a strong application focus. Following an introduction to the materials and recent developments, subsequent chapters discuss the synthesis and characterization as well as the deposition techniques that are commonly used for energy harvesting and light emitting applications. Finally, the book concludes with a look at future technological advances. All-encompassing and up-to-date, this interdisciplinary text runs the gamut from chemistry and materials science to engineering, from academia to industry, and from fundamental challenges to readily available applications.*

ATOMIC LAYER DEPOSITION FOR SEMICONDUCTORS

Springer Science & Business Media *Offering thorough coverage of atomic layer deposition (ALD), this book moves from basic chemistry of ALD and modeling of processes to examine ALD in memory, logic devices and machines. Reviews history, operating principles and ALD processes for each device.*

EPITAXIAL GROWTH OF COMPLEX METAL OXIDES

Elsevier *The atomic arrangement and subsequent properties of a material are determined by the type and conditions of growth leading to epitaxy, making control of these conditions key to the fabrication of higher quality materials. Epitaxial Growth of Complex Metal Oxides reviews the techniques involved in such processes and highlights recent developments in fabrication quality which are facilitating advances in applications for electronic, magnetic and optical purposes. Part One reviews the key techniques involved in the epitaxial growth of complex metal oxides, including growth studies using reflection high-energy electron diffraction, pulsed laser deposition, hybrid molecular beam epitaxy, sputtering processes and chemical solution deposition techniques for the growth of oxide thin films. Part Two goes on to explore the effects of strain and stoichiometry on crystal structure and related properties, in thin film oxides. Finally, the book concludes by discussing selected examples of important applications of complex metal oxide thin films in Part Three. Provides valuable information on the improvements in epitaxial growth processes that have resulted in higher quality films of complex metal oxides and further advances in applications for electronic and optical purposes Examines the techniques used in epitaxial thin film growth Describes the epitaxial growth and functional properties of complex metal oxides and explores the effects of strain and defects*

THIN FILM PROCESSES

ARTIFACTS ON SURFACE PHENOMENA AND TECHNOLOGICAL FACETS

BoD – Books on Demand *The book Thin Film Processes - Artifacts on Surface Phenomena and Technological Facets presents topics on global advancements in theoretical and experimental facts, instrumentation and practical applications of thin-film material perspectives and its applications. The aspect of this book is associated with the thin-film physics, the methods of deposition, optimization parameters and its wide technological applications. This book is divided into three main sections: Thin Film Deposition Methods: A Synthesis Perspective; Optimization Parameters in the Thin Film Science and Application of Thin Films: A Synergistic Outlook. Collected chapters provide applicable knowledge for a wide range of readers: common men, students and researchers. It was constructed by experts in diverse fields of thin-film science and technology from over 15 research institutes across the globe.*

SOLUTION PROCESSING OF INORGANIC MATERIALS

John Wiley & Sons *Discover the materials set to revolutionize the electronics industry The search for electronic materials that can be cheaply solution-processed into films, while simultaneously providing quality device characteristics, represents a major challenge for materials scientists. Continuous semiconducting thin films with large carrier mobilities are particularly desirable for high-speed microelectronic applications, potentially providing new opportunities for the development of low-cost, large-area, flexible computing devices, displays, sensors, and solar cells. To date, the majority of solution-processing research has focused on molecular and polymeric organic films. In contrast, this book reviews recent achievements in the search for solution-processed inorganic semiconductors and other critical electronic components. These components offer the potential for better performance and more robust thermal and mechanical stability than comparable organic-based systems. Solution Processing of Inorganic Materials covers everything from the more traditional fields of sol-gel processing and chemical bath deposition to the cutting-edge use of nanomaterials in thin-film deposition. In*

particular, the book focuses on materials and techniques that are compatible with high-throughput, low-cost, and low-temperature deposition processes such as spin coating, dip coating, printing, and stamping. Throughout the text, illustrations and examples of applications are provided to help the reader fully appreciate the concepts and opportunities involved in this exciting field. In addition to presenting the state-of-the-art research, the book offers extensive background material. As a result, any researcher involved or interested in electronic device fabrication can turn to this book to become fully versed in the solution-processed inorganic materials that are set to revolutionize the electronics industry.

HANDBOOK OF DEPOSITION TECHNOLOGIES FOR FILMS AND COATINGS

SCIENCE, APPLICATIONS AND TECHNOLOGY

William Andrew *This 3e, edited by Peter M. Martin, PNNL 2005 Inventor of the Year, is an extensive update of the many improvements in deposition technologies, mechanisms, and applications. This long-awaited revision includes updated and new chapters on atomic layer deposition, cathodic arc deposition, sculpted thin films, polymer thin films and emerging technologies. Extensive material was added throughout the book, especially in the areas concerned with plasma-assisted vapor deposition processes and metallurgical coating applications. * Explains in depth the many recent i*

AQUEOUS-DERIVED THIN FILMS AND THEIR INTERFACIAL INTERACTIONS WITH SEMICONDUCTOR SURFACES

A SPECTROSCOPIC STUDY

Metal oxide systems are well known for their high dielectric constants, which are important for advanced microelectronics applications. The microelectronics industry currently employs vacuum-based techniques, such as chemical vapor deposition (CVD), to deposit metal oxide films. These vapor-phase deposition techniques suffer due to their slow deposition rates and their use of expensive equipment. Additionally, these processes sometimes require the use of harmful source gases and/or generate corrosive by-products. On the other hand, solution-processed thin films fabricated by spin-coating are advantageous because the process is simple, low cost, and scalable. Aqueous solution deposition is particularly attractive because it offers a green alternative to vapor-phase deposition and has been shown to produce uniform thin films by spin coating on hydrophilic silicon surfaces. However, it has been shown that silicon's native oxide can degrade device performance due to its electronic interfacial states. In addition, aqueousderived thin films suffer from poor electrical performance due to mobile water and hydroxyl protons, often requiring very high temperature anneals to mitigate. Such anneals compromise the interface between the film and the silicon substrate, hence the electrical performance. One effective method to control the interface, and thus improve device performance, is to functionalize the semiconductor surface using wet chemistry. Here, we address the concerns of aqueous thin film deposition and present a method for alleviating the issues associated with current silicon-silicon oxide devices. We use wet chemical functionalization to graft selfassembled monolayers (SAMs) onto oxide-free silicon, then spin-coat an aqueous thin film on top of the SAM layer. The chemical stability of the SAM and the changes that occur at the interfaces between the Si/SAM/film stack during film deposition and dehydration are monitored by in situ Fourier transform infrared spectroscopy (FTIR) and ex situ X-ray photoelectron spectroscopy (XPS). The modification of the Si/SAM interface is studied as a function of annealing temperature, with electrical measurements used as a metric to quantify the effectiveness of the SAM layer to alleviate issues of interfacial defects observed for films on silicon oxide. The results are presented in three parts: (1) a dehydration study of aqueous-derived thin films deposited on silicon oxide, (2) the synthesis of a novel SAM interfacial layer tailored to accommodate aqueous, Al-based precursors and (3) a study to quantify the effectiveness, if any, on the SAM interfacial layer through electrical characterization methods. In the first part, we investigate the mechanism for dehydration of aqueous thin films and present a method to enhance the removal of water from the films. Using in situ FTIR, we find that the addition of a protective capping layer can enhance the dehydration of the thin film and prevent water reabsorption for a period of up to 14 days. In the second part, we present hydrosilylation methods to graft SAMs onto oxide-free silicon surfaces. The results show that it is possible to covalently attach the SAMs to silicon, evidenced by the formation of Si-C (detected by XPS) at the interface between the Si and the SAM. Four phosphonic acid-terminated SAMs are prepared and contact angle measurements are used as a metric for evaluating which can best accommodate aqueous spin-coater solutions. To conclude, we investigate the interface between the SAM layer and an aluminum-based thin film derived from aqueous precursor solutions. Current-voltage and capacitance-voltage measurements are used to quantify the effectiveness of the SAM layer.

DEKKER ENCYCLOPEDIA OF NANOSCIENCE AND NANOTECHNOLOGY

CRC Press

SEMICONDUCTOR NANOCLUSTERS - PHYSICAL, CHEMICAL, AND CATALYTIC ASPECTS

Elsevier Science Serials *Reflecting the shift over the past decade from theoretical descriptions to field utilizations of nanostructure-based devices, researchers present the salient features of nanocrystalline semiconductor materials for scientists, engineers, and advanced graduate students in physical chemistry and materials science. The topics include preparing and characterizing*

nanoparticles, sonochemistry in colloidal systems, the pseudopotential theory of nanometer silicon quantum dots, size quantization in semiconductor films deposited by chemical solutions, electronic junctions, analytical chemistry, semiconductor-mediated photocatalysis for organic synthesis, and applications in purifying air. Annotation copyrighted by Book News, Inc., Portland, OR

THIN FILMS ON SILICON

ELECTRONIC AND PHOTONIC APPLICATIONS

Materials and Energy *A thin film is a layer of material ranging from fractions of a nanometer (monolayer) to several micrometers in thickness. Silicon (Si) is one of the most important semiconductors today because it has a very low occurrence of defects. While it's the building block of most electronic devices, other semiconductors are becoming more important in the industry because of their superior properties. The search for organic semiconductors as well as hybrid materials which combine organic and inorganic materials is underway. Scientists are searching for the materials most capable of absorbing light over a wide range of solar wavelengths and with the lowest manufacturing cost. This book explores the recent advances and remaining challenges in thin-film silicon.*

THE MATERIALS SCIENCE OF THIN FILMS

Academic Press *Prepared as a textbook complete with problems after each chapter, specifically intended for classroom use in universities.*

PRINCIPLES OF CHEMICAL VAPOR DEPOSITION

Springer Science & Business Media *Principles of Chemical Vapor Deposition provides a simple introduction to heat and mass transfer, surface and gas phase chemistry, and plasma discharge characteristics. In addition, the book includes discussions of practical films and reactors to help in the development of better processes and equipment. This book will assist workers new to chemical vapor deposition (CVD) to understand CVD reactors and processes and to comprehend and exploit the literature in the field. The book reviews several disparate fields with which many researchers may have only a passing acquaintance, such as heat and mass transfer, discharge physics, and surface chemistry, focusing on key issues relevant to CVD. The book also examines examples of realistic industrial reactors and processes with simplified analysis to demonstrate how to apply the principles to practical situations. The book does not attempt to exhaustively survey the literature or to intimidate the reader with irrelevant mathematical apparatus. This book is as simple as possible while still retaining the essential physics and chemistry. The book is generously illustrated to assist the reader in forming the mental images which are the basis of understanding.*

COATINGS AND THIN-FILM TECHNOLOGIES

BoD – Books on Demand *The field of coatings and thin-film technologies is rapidly advancing to keep up with new uses for semiconductor, optical, tribological, thermoelectric, solar, security, and smart sensing applications, among others. In this sense, thin-film coatings and structures are increasingly sophisticated with more specific properties, new geometries, large areas, the use of heterogeneous materials and flexible and rigid coating substrates to produce thin-film structures with improved performance and properties in response to new challenges that the industry presents. This book aims to provide the reader with a complete overview of the current state of applications and developments in thin-film technology, discussing applications, health and safety in thin films, and presenting reviews and experimental results of recognized experts in the area of coatings and thin-film technologies.*

CHEMICAL PHYSICS OF THIN FILM DEPOSITION PROCESSES FOR MICRO- AND NANO-TECHNOLOGIES

Springer Science & Business Media *An up-to-date collection of tutorial papers on the latest advances in the deposition and growth of thin films for micro and nano technologies. The emphasis is on fundamental aspects, principles and applications of deposition techniques used for the fabrication of micro and nano devices. The deposition of thin films is described, emphasising the gas phase and surface chemistry and its effects on the growth rates and properties of films. Gas-phase phenomena, surface chemistry, growth mechanisms and the modelling of deposition processes are thoroughly described and discussed to provide a clear understanding of the growth of thin films and microstructures via thermally activated, laser induced, photon assisted, ion beam assisted, and plasma enhanced vapour deposition processes. A handbook for engineers and scientists and an introduction for students of microelectronics.*

CHEMICALLY DEPOSITED NANOCRYSTALLINE METAL OXIDE THIN FILMS

SYNTHESIS, CHARACTERIZATIONS, AND APPLICATIONS

Springer Nature *This book guides beginners in the areas of thin film preparation, characterization, and device making, while providing insight into these areas for experts. As chemically deposited metal oxides are currently gaining attention in development of devices such as solar cells, supercapacitors, batteries, sensors, etc., the book illustrates how the chemical deposition route is emerging as a relatively inexpensive, simple, and convenient solution for large area deposition. The advancement in the nanostructured materials for the development of devices is fully discussed.*

THIN FILM PROCESSES

Elsevier *Remarkable advances have been made in recent years in the science and technology of thin film processes for deposition and etching. It is the purpose of this book to bring together tutorial reviews of selected filmdeposition and etching processes from a process viewpoint. Emphasis is placed on the practical use of the processes to provide working guidelines for their implementation, a guide to the literature, and an overview of each process.*

COMPOUND SEMICONDUCTORS 1996, PROCEEDINGS OF THE TWENTY-THIRD INT SYMPOSIUM ON COMPOUND SEMICONDUCTORS HELD IN ST PETERSBURG, RUSSIA, 23-27 SEPTEMBER 1996

CRC Press *Providing a comprehensive overview of developments to both the academic and industrial communities, Compound Semiconductors 1996 covers all types of compound semiconducting materials and devices. The book includes results on blue and green lasers, heterostructure devices, nanoelectronics, and novel wide band gap semiconductors. With invited review papers and research results in current topics of interest, this volume is part of a well-known series of conferences for the dissemination of research results in the field.*

TRANSITION METAL CARBIDES AND NITRIDES

Elsevier *Refractory Materials, Volume 7: Transition Metal Carbides and Nitrides discusses the developments in transition metal carbide and nitride research. This volume is organized into nine chapters that emphasize the mechanical and superconducting properties of these compounds. The introductory chapters deal with the general properties, preparation techniques, characterization, crystal chemistry, phase relationships, and thermodynamics of transition metal carbides and nitrides. The following chapter highlights the mechanical properties of these compounds, such as elastic and plastic deformation, fracture, strengthening mechanisms, and hardness. The discussion then shifts to specific electrical and magnetic properties, including electrical resistivity, Hall coefficient, and magnetic susceptibility. A separate chapter is devoted to carbides and nitrides as superconductors. The concluding chapters explore certain theories that explain the mechanisms of band structure and bonding in carbides and nitrides. This volume is of great value to research workers in metallurgy, ceramics, physics, chemistry, and related fields, as well as to advanced students investigating problems concerning high temperature materials or interstitial compounds.*

PROCEEDINGS OF THE 6TH INTERNATIONAL CONFERENCE AND EXHIBITION ON SUSTAINABLE ENERGY AND ADVANCED MATERIALS

ICE-SEAM 2019, 16—17 OCTOBER 2019, SURAKARTA, INDONESIA

Springer Nature *This book gathers the proceedings of the 6th International Conference and Exhibition on Sustainable Energy and Advanced Materials (ICE-SEAM 2019), held on 16–17 October 2019 in Surakarta, Indonesia. It focuses on two relatively broad areas – advanced materials and sustainable energy – and a diverse range of subtopics: Advanced Materials and Related Technologies: Liquid Crystals, Semiconductors, Superconductors, Optics, Lasers, Sensors, Mesoporous Materials, Nanomaterials, Smart Ferrous Materials, Amorphous Materials, Crystalline Materials, Biomaterials, Metamaterials, Composites, Polymers, Design, Analysis, Development, Manufacturing, Processing and Testing for Advanced Materials. Sustainable Energy and Related Technologies: Energy Management, Storage, Conservation, Industrial Energy Efficiency, Energy-Efficient Buildings, Energy-Efficient Traffic Systems, Energy Distribution, Energy Modeling, Hybrid and Integrated Energy Systems, Fossil Energy, Nuclear Energy, Bioenergy, Biogas, Biomass Geothermal Power, Non-Fossil Energies, Wind Energy, Hydropower, Solar Photovoltaic, Fuel Cells, Electrification, and Electrical Power Systems and Controls.*

THIN FILM PHYSICS AND DEVICES: FUNDAMENTAL MECHANISM, MATERIALS AND APPLICATIONS FOR THIN FILMS

World Scientific *Thin films have an extremely broad range of applications from electronics and optics to new materials and devices. Collaborative and multidisciplinary efforts from physicists, materials scientists, engineers and others have established and advanced a field with key pillars constituting (i) the synthesis and processing of thin films, (ii) the understanding of physical properties in relation to the nanometer scale, (iii) the design and fabrication of nano-devices or devices with thin film materials as building blocks, and (iv) the design and construction of novel tools for characterization of thin*

films.Against the backdrop of the increasingly interdisciplinary field, this book sets off to inform the basics of thin film physics and thin film devices. Readers are systematically introduced to the synthesis, processing and application of thin films; they will also study the formation of thin films, their structure and defects, and their various properties — mechanical, electrical, semiconducting, magnetic, and superconducting. With a primary focus on inorganic thin film materials, the book also ventures on organic materials such as self-assembled monolayers and Langmuir-Blodgett films.This book will be effective as a teaching or reference material in the various disciplines, ranging from Materials Science and Engineering, Electronic Science and Engineering, Electronic Materials and Components, Semiconductor Physics and Devices, to Applied Physics and more. The original Chinese publication has been instrumental in this purpose across many Chinese universities and colleges.

INTELLIGENT COATINGS FOR CORROSION CONTROL

Butterworth-Heinemann *Intelligent Coatings for Corrosion Control covers the most current and comprehensive information on the emerging field of intelligent coatings. The book begins with a fundamental discussion of corrosion and corrosion protection through coatings, setting the stage for deeper discussion of the various types of smart coatings currently in use and in development, outlining their methods of synthesis and characterization, and their applications in a variety of corrosion settings. Further chapters provide insight into the ongoing research, current trends, and technical challenges in this rapidly progressing field. Reviews fundamentals of corrosion and coatings for corrosion control before delving into a discussion of intelligent coatings—useful for researchers and grad students new to the subject Covers the most current developments in intelligent coatings for corrosion control as presented by top researchers in the field Includes many examples of current and potential applications of smart coatings to a variety of corrosion problems*

CVD POLYMERS

FABRICATION OF ORGANIC SURFACES AND DEVICES

John Wiley & Sons *The method of CVD (chemical vapor deposition) is a versatile technique to fabricate high-quality thin films and structured surfaces in the nanometer regime from the vapor phase. Already widely used for the deposition of inorganic materials in the semiconductor industry, CVD has become the method of choice in many applications to process polymers as well. This highly scalable technique allows for synthesizing high-purity, defect-free films and for systematically tuning their chemical, mechanical and physical properties. In addition, vapor phase processing is critical for the deposition of insoluble materials including fluoropolymers, electrically conductive polymers, and highly crosslinked organic networks. Furthermore, CVD enables the coating of substrates which would otherwise dissolve or swell upon exposure to solvents. The scope of the book encompasses CVD polymerization processes which directly translate the chemical mechanisms of traditional polymer synthesis and organic synthesis in homogeneous liquids into heterogeneous processes for the modification of solid surfaces. The book is structured into four parts, complemented by an introductory overview of the diverse process strategies for CVD of polymeric materials. The first part on the fundamentals of CVD polymers is followed by a detailed coverage of the materials chemistry of CVD polymers, including the main synthesis mechanisms and the resultant classes of materials. The third part focuses on the applications of these materials such as membrane modification and device fabrication. The final part discusses the potential for scale-up and commercialization of CVD polymers.*

ELECTRICAL AND OPTICAL CHARACTERIZATION OF CDXZN1-XS AND PBS THIN FILMS FOR PHOTOVOLTAIC APPLICATIONS

THIN FILM CHARACTERIZATION FOR SOLAR CELLS

GRIN Verlag *Master's Thesis from the year 2011 in the subject Physics - Applied physics, grade: A, Kenyatta University, course: Master of Science (Physics), language: English, abstract: In this research an n-type CdxZn1-xS and p-type PbS thin films were optimised for solar cell applications employing chemical bath deposition technique. The thin films were prepared using thiourea and nitrates of cadmium, zinc and lead. Deposition of optimised CdxZn1-xS was done by CBD at 820 C and in alkaline conditions while that of PbS was done at room temperature and both films at normal atmospheric pressure utilizing aqueous conditions. This study concentrated on optimising optical and electrical characterization of the films. Optical constant suitable for photovoltaic applications were sort for and for this purpose a UV VIS IR spectrophotometer 3700 DUV was utilised while the electrical properties were investigated using a four point probe connected to a Keithley 2400 source meter interfaced with computer. The optical band gap of the as deposited CdxZn1-xS films varied from 2.47eV (x =0.6) to 2.72 eV (x =1.0), and transmittance above 79% in the VIS - NIR region for the concentration range of x = 0.6 to 1.0, that is, the band gap increased with increasing Zn concentration of the alloy and Cd06Zn0.4S sample showed the widest band gap. It was obtained that the presence of zinc increased optical band gap. The average extinction coefficients for the as deposited CdxZn1-xS samples were very low revealing that they absorb very little radiation hence a good window layer material. As measured by the four point probe connected to a Keithley 2400 source meter, electrical resistivity increased with increase in Zn in the bath in CdxZn1-xS and a resistivity range of 9.5×101 – 1.22× 102 Ω-cm was obtained. These properties are appropriate for window layers used for photovoltaic cell applications. PbS thin films had a band gap of 0.89 eV and a transmittance of below 55% appropriate for absorber layers of photovoltaic cells and a resistivity range of 6.78 × 103 to 1.26 × 104 Ω-cm. The fabricated photovoltaic cell had a short circuit current, Isc = 0.031 A, open voltage, Voc = 0.37V, efficiency, η =*

0.9% and a fill factor, FF = 0.66 implying that the two materials are appropriate for photovoltaic applications especially in the VIS and IR light spectrum.

THIN-FILM COMPOUND SEMICONDUCTOR PHOTOVOLTAICS - 2007: VOLUME 1012

Mrs Proceedings *Thin-film compound semiconductor photovoltaic solar cells have demonstrated efficiencies of nearly 20% and are leading candidates to provide lower-cost energy due to potential advantages in manufacturing and materials costs. To fulfill the promise, a number of technical issues are being addressed, including a lack of fundamental understanding of these unique materials, devices and processes for large-area deposition. This book focuses on advances in the materials science, chemistry, processing and device issues of thin-film compound semiconductor materials that are used, or have potential use, in photovoltaic solar cells and related applications. Topics include: growth and performance of compound thin-film solar cells; novel materials and processes; defects and impurities; industrial perspectives; contacts and interfaces; grain boundaries and inhomogeneities; and structural, optical and electronic characterization.*

SOLUTION PROCESSED METAL OXIDE THIN FILMS FOR ELECTRONIC APPLICATIONS

Elsevier *Solution Processed Metal Oxide Thin Films for Electronic Applications discusses the fundamentals of solution processing materials chemistry techniques as they are applied to metal oxide materials systems for key device applications. The book introduces basic information (materials properties, materials synthesis, barriers), discusses ink formulation and solution processing methods, including sol-gel processing, surface functionalization aspects, and presents a comprehensive accounting on the electronic applications of solution processed metal oxide films, including thin film transistors, photovoltaic cells and other electronics devices and circuits. This is an important reference for those interested in oxide electronics, printed electronics, flexible electronics and large-area electronics. Provides in-depth information on solution processing fundamentals, techniques, considerations and barriers combined with key device applications Reviews important device applications, including transistors, light-emitting diodes, and photovoltaic cells Includes an overview of metal oxide materials systems (semiconductors, nanomaterials and thin films), addressing materials synthesis, properties, limitations and surface aspects*

MULTILAYER THIN FILMS

VERSATILE APPLICATIONS FOR MATERIALS ENGINEERING

BoD – Books on Demand *This book, "Multilayer Thin Films-Versatile Applications for Materials Engineering", includes thirteen chapters related to the preparations, characterizations, and applications in the modern research of materials engineering. The evaluation of nanomaterials in the form of different shapes, sizes, and volumes needed for utilization in different kinds of gadgets and devices. Since the recently developed two-dimensional carbon materials are proving to be immensely important for new configurations in the miniature scale in the modern technology, it is imperative to innovate various atomic and molecular arrangements for the modifications of structural properties. Of late, graphene and graphene-related derivatives have been proven as the most versatile two-dimensional nanomaterials with superb mechanical, electrical, electronic, optical, and magnetic properties. To understand the in-depth technology, an effort has been made to explain the basics of nano dimensional materials. The importance of nano particles in various aspects of nano technology is clearly indicated. There is more than one chapter describing the use of nanomaterials as sensors. In this volume, an effort has been made to clarify the use of such materials from non-conductor to highly conducting species. It is expected that this book will be useful to the postgraduate and research students as this is a multidisciplinary subject.*

LEAD ZIRCONIUM TITANATE FILMS AND DEVICES MADE BY A LOW- TEMPERATURE SOLUTION-BASED PROCESS

As the most important multifunctional oxide material, lead zirconium titanate (PZT) has a diverse range of applications such as piezo actuators, ferroelectric nonvolatile memories, sensors, and transducers due to its excellent structural and electrical properties. However, it generally requires a high annealing temperature (above 600°C) to attain the desired properties, which hinders the integration of PZT with silicon-based Complementary Metal Oxide Semiconductor (CMOS). Therefore, the fabrication of PZT films by a chemical solution deposition (CSD) at temperatures compatible with Si-CMOS technology or even with polymeric substrate for flexible electronics would be of high technological interest. So far, different strategies to decrease the crystallization temperature of CSD-derived PZT films have been studied. This chapter presents a critical review on the low-temperature solution-processed PZT films and devices, and addresses challenges for fundamental understanding and practical integration of multifunctional PZT in devices. In the first part, recent advances in fabrication of CSD-derived PZT films at a low temperature are thoroughly reviewed. The second part discusses various techniques for patterning PZT into micro-nano-sized patterns. Lastly, some potential applications of the low-temperature CSD-derived PZT films and devices are demonstrated.

FERROELECTRIC THIN FILMS IV: VOLUME 361

Materials Research Society *This book represents the latest technical information from academia, government organizations and industry on ferroelectric thin films. Highlights can be separated into four major categories: the first public technical disclosure of the materials processing and characterization of the much-acclaimed 'Y1' nonvolatile memory material; enhanced understanding of the role of electronic and ionic defects in ferroelectric thin film degradation; extensive technical progress in metalorganic chemical vapor deposition of ferroelectric thin films; and the development of enhanced process integration techniques for ferroelectric thin films with semiconductor technology. In addition, improved process technologies that are bringing the optical properties of these complex, multicomponent oxide films to the verge of commercial viability, are discussed. Topics include: layered structure ferroelectrics; characterization; photonic phenomena; process integration issues; dram thin film technology; chemical vapor deposition; solution deposition; vapor deposition; pulsed laser deposition and piezoelectric and IR thin film technology.*

HANDBOOK OF SPUTTER DEPOSITION TECHNOLOGY

FUNDAMENTALS AND APPLICATIONS FOR FUNCTIONAL THIN FILMS, NANO-MATERIALS AND MEMS

William Andrew *Sputtering is a Physical Vapor Deposition vacuum process used to deposit very thin films onto a substrate for a wide variety of commercial and scientific purposes. Sputtering occurs when an ionized gas molecule is used to displace atoms of a specific material. These atoms then bond at the atomic level to a substrate and create a thin film. Several types of sputtering processes exist, including: ion beam, diode, and magnetron sputtering. Cathode sputtering is widely used in the microelectronics industry for silicon integrated circuit production and for metallic coatings. High temperature, diamond films and ferroelectric materials are other applications. Sputtering applications are important across a wide range of industries, including the automotive, medical, semiconductors, space, plastics, and military sectors. A strong applications focus, covering current and emerging technologies, including nano-materials and MEMS (microelectrolmechanical systems) for energy, environments, communications, and/or bio-medical field. New chapters on computer simulation of sputtering and MEMS completes the update and insures that the new edition includes the most current and forward-looking coverage available. All applications discussed are supported by theoretical discussions, offering readers both the "how" and the "why" of each technique. 40% revision: the new edition includes an entirely new team of contributing authors with backgrounds specializing in the various new applications that are covered in the book and providing the most up-to-date coverage available anywhere.*

BOROPHOSPHOSILICATE GLASS THIN FILMS IN ELECTRONICS

Nova Science Pub Incorporated *This comprehensive monograph summarizes the 30-year studies of borophosphosilicate glass (BPSG) thin film used in electronic technologies, including the authors personal experience with the film deposition, characterization, and implementation in microelectronic technology. The main core of the monograph is the interrelation of chemical vapor deposition (CVD) kinetic features, thin film material properties, and electronic device technology aspects. Part one of the monograph is devoted to the analysis of thin film synthesis, such as: CVD methodology and BPSG film processes, silicon dioxide and glass film growth kinetics, CVD step coverage and gap-fill features. Part two of the book is a description of BPSG film properties, film structure, glass flow capability, BPSG film-moisture interaction and the film defect formation phenomenon. A number of experimental data are presented and discussed in detail.*

MODERN TECHNOLOGIES FOR CREATING THE THIN-FILM SYSTEMS AND COATINGS

BoD – Books on Demand *Development of the thin film and coating technologies (TFCT) made possible the technological revolution in electronics and through it the revolution in IT and communications in the end of the twentieth century. Now, TFCT penetrated in many sectors of human life and industry: biology and medicine; nuclear, fusion, and hydrogen energy; protection against corrosion and hydrogen embrittlement; jet engine; space materials science; and many others. Currently, TFCT along with nanotechnologies is the most promising for the development of almost all industries. The 20 chapters of this book present the achievements of thin-film technology in many areas mentioned above but more than any other in medicine and biology and energy saving and energy efficiency.*

ADVANCES IN ENERGY MATERIALS

Springer Nature *This book presents recent advances in experimental and theoretical research on energy materials, focusing on materials that can potentially be used in the production of solar cells, hydrogen and energy storage devices. It discusses in detail the latest synthetic methods, processes, characterization methods and applications of materials like perovskite materials, metal sulfides, nanomaterials, and two-dimensional, transition metal dichalcogenides.*