

## Thin Film Materials Technology Sputtering Of Compound Materials

This book brings together detailed discussions by leading experts on the various innovative aspects of thin films growth, deposition and characterization techniques, and new thin film materials and devices. It addresses through the different viewpoints of the contributors, the major problem of thin films science - the relation between the energy of the condensing species and the resulting properties of the films. Some of the issues considered include energetic condensation, bombardment stabilization, pulsed electron beam ablation, orientation and self-organization of organic, ferroelectric and nanoparticle thin films. Several chapters focus on applications such as the recent developments in organic optoelectronics, large area electronic technology and superconducting thin film devices.

The x-ray is the only invention that became a regular diagnostic tool in hospitals within a week of its first observation by Roentgen in 1895. Even today, x-rays are a great characterization tool at the hands of scientists working in almost every field, such as medicine, physics, material science, space science, chemistry, archeology, and metallurgy. With vast existing applications of x-rays, it is even more surprising that every day people are finding new applications of x-rays or refining the existing techniques. This book consists of selected chapters on the recent applications of x-ray spectroscopy that are of great interest to the scientists and engineers working in the fields of material science, physics, chemistry, astrophysics, astrochemistry, instrumentation, and techniques of x-ray based characterization. The chapters have been grouped into two major sections based upon the techniques and applications. The book covers some basic principles of satellite x-rays as characterization tools for chemical properties and the physics of detectors and x-ray spectrometer. The techniques like EDXRF, WDXRF, EPMA, satellites, micro-beam analysis, particle induced XRF, and matrix effects are discussed. The characterization of thin films and ceramic materials using x-rays is also covered.

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 (microelectromechanical 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.

A concise, comprehensive overview of sputter deposition technology—a key technology for materials research in the next decade. Cathode sputtering is widely used in the microelectronics industry for silicon integrated circuit production and for metallurgical coatings. High temperature superconductors can be synthesized with sputtering under non-equilibrium conditions. Diamond films and ferroelectric materials are other applications.

Two-dimensional materials created ab initio by the process of condensation of atoms, molecules, or ions, called thin films, have unique properties significantly different from the corresponding bulk materials as a result of their physical dimensions, geometry, nonequilibrium microstructure, and metallurgy. Further, these characteristic features of thin films can be drastically modified and tailored to obtain the desired and required physical characteristics. These features form the basis of development of a host of extraordinary active and passive thin film device applications in the last two decades. On the one extreme, these applications are in the submicron dimensions in such areas as very large scale integration (VLSI), Josephson junction quantum interference devices, magnetic bubbles, and integrated optics. On the other extreme, large-area thin films are being used as selective coatings for solar thermal conversion, solar cells for photovoltaic conversion, and protection and passivating layers. Indeed, one would be hard pressed to find many sophisticated modern optical and electronic devices which do not use thin films in one way or the other. With the impetus provided by industrial applications, the science and technology of thin films have undergone revolutionary development and even today continue to be recognized globally as frontier areas of R&D work. Major technical developments in any field of science and technology are invariably accompanied by an explosion of published literature in the form of scientific publications, reviews, and books.

The most comprehensive source available on the preparation, characterization, and emerging applications of thin film. This book features extensive new advances applied in multichip modules (MCMs), and covers the basic principles and applications of thin film deposition techniques for practical use. It provides and develops design guidelines to realize multilayer structures in microcircuits, thus addressing a critical and rapidly growing area.

This book presents a current review of photonic technologies and their applications. The papers published in this book are extended versions of the papers presented at the International Conference on Applications of Photonic Technology (ICAPT'96) held in Montreal, Canada, on July 29 to August 1, 1996. The theme of this event was "Closing the Gap Between Theory, Developments and Applications." The term photonics covers both optics and optical engineering areas of growing scientific and commercial importance throughout the world. It is estimated that photonic technology-related applications to increase exponentially over the next few years and will play a significant role in the global economy by reaching a quarter of a trillion of US dollars by the year 2000. The global interest and advancements of this technology are represented in this book, where leading scientists of twenty-two countries with advanced technology in photonics present their latest results. The papers selected herein are grouped to address six distinct areas of photonic technology. The reader will find throughout the book a combination of invited and contributed papers which reflect the state of the art today and provide some insight about the future of this technology. The first two papers are invited. They discuss business aspects of photonic engineering. One examines if chip-to-chip interconnections by means of optical technology are a good economic choice, while the other discusses the photonic technology from entrepreneurial viewpoint. Papers related to materials and considered for photonic applications, e. g.

The Foundations of Vacuum Coating Technology, Second Edition, is a revised and expanded version of the first edition, which was published in 2003. The book reviews the histories of the various vacuum coating technologies and expands on the history of the enabling technologies of vacuum technology, plasma technology, power supplies, and low-pressure plasma-enhanced chemical vapor deposition. The melding of these technologies has resulted in new processes and products that have greatly expanded the application of vacuum coatings for use in our everyday lives. The book is unique in that it makes extensive reference to the patent literature (mostly US) and how it relates to the history of vacuum coating. The book includes a Historical Timeline of Vacuum Coating Technology and a Historical Timeline of Vacuum/Plasma Technology, as well as a Glossary of Terms used in the vacuum coating and surface engineering industries. History and detailed descriptions of Vacuum Deposition Technologies Review of Enabling Technologies and their importance to current applications Extensively referenced text Patents are referenced as part of the history Historical Timelines for Vacuum Coating Technology and Vacuum/Plasma Technology Glossary of Terms for vacuum coating

An invaluable resource for industrial science and engineering newcomers to sputter deposition technology in thin film production applications, this book is rich in coverage of both historical developments and the newest experimental and technological information about ceramic thin film, a key technology for nano-materials in high-speed information applications and large-area functional coating such as automotive or decorative painting of plastic parts. Key topics: Principles and examples of making thin-film materials and devices such as nanometer composite thin films, nanometer superlattice of compound ceramics, micro-sensors and actuators, micro-MEMS, mobile compact/flexible ferroelectric memory, flat display including plasma display and PLD, and thin film catalysis, solar battery, and large-area functional window glass coating for energy and environmental uses; Covers techniques in automotive parts coatings :non-peel plastics coatings with metal, alloy, and compound films.

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.

This title contains rich historical coverage of the basics and new experimental and technological information about ceramic thin film and large-area functional coating. Included are principles and examples of making thin-film materials and devices.

Oxynitride thin film technology is rapidly impacting a broad spectrum of applications, ranging from decorative functions (through optoelectronics) to corrosion resistance.

Developing a better understanding of the relationships between deposition processes, structure and composition of the deposited films is critical to the continued evolution of these applications. This e-book provides valuable information about the process modeling, fabrication and characterization of metallic oxynitride-based thin films produced by reactive sputtering and some related deposition processes. Its contents are spread in twelve main and concise chapters through which the book thoroughly reviews the bases of oxynitride thin film technology and deposition processes, sputtering processes and the resulting behaviors of these oxynitride thin films. More importantly, the solutions for the growth of oxynitride technology are given in detail with an emphasis on some particular compounds. This is a valuable resource for academic learners studying materials science and industrial coaters, who are concerned not only about fundamental aspects of oxynitride synthesis, but also by their innate material characteristics.

“Handbook of Thin Film Technology” covers all aspects of coatings preparation, characterization and applications. Different deposition techniques based on vacuum and plasma processes are presented. Methods of surface and thin film analysis including coating thickness, structural, optical, electrical, mechanical and magnetic properties of films are detailed described. The several applications of thin coatings and a special chapter focusing on nanoparticle-based films can be found in this handbook. A complete reference for students and professionals interested in the science and technology of thin films.

Sputtered Thin Films: Theory and Fractal Descriptions provides an overview of sputtered thin films and demystifies the concept of fractal theory in analysis of sputtered thin films. It simplifies the use of fractal tools in studying the growth and properties of thin films during sputtering processes. Part 1 of the book describes the basics and theory of thin film sputtering and fractals. Part 2 consists of examples illustrating specific descriptions of thin films using fractal methods. Discusses thin film growth, structure, and properties Covers fractal theory Presents methods of fractal measurements Offers typical examples of fractal descriptions of thin films grown via magnetron sputtering processes Describes application of fractal theory in prediction of thin film growth and properties This reference book is aimed at engineers and scientists working across a variety of disciplines including materials science and metallurgy as well as mechanical, manufacturing, electrical, and biomedical engineering.

Thin Film Materials TechnologySputtering of Compound MaterialsWilliam Andrew

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

An invaluable resource for industrial science and engineering newcomers to sputter deposition technology in thin film production applications, this book is rich in coverage of both historical developments and the newest experimental and technological information about ceramic thin films, a key technology for nano-materials in high-speed information applications and large-area functional coating such as automotive or decorative painting of plastic parts, among other topics. In seven concise chapters, the book thoroughly reviews basic thin film technology and deposition processes, sputtering processes, structural control of compound thin films, and microfabrication by sputtering.

In this valuable work, all aspects of the reactive magnetron sputtering process, from the discharge up to the resulting thin film growth, are described in detail, allowing the reader to understand the complete process. Hence, this book gives necessary information for those who want to start with reactive magnetron sputtering, understand and investigate the technique, control their sputtering process and tune their existing process, obtaining the desired thin films.

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.

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.

The Handbook of Thin Film Process Technology is a practical handbook for the thin film scientist, engineer and technician. This handbook is regularly updated with new material, and this volume is a special issue on reactive sputtering which will be of interest to a wide range of industrial and academic researchers in addition to owners of the main Handbook. Some recent developments in the reactive sputtering field are covered, including unbalanced magnetron sputtering and pulsed reactive sputtering. The articles contain a wealth of practical information relating to applications, practice and manufacturing techniques.

This is the first book that can be considered a textbook on thin film science, complete with exercises at the end of each chapter. Ohring has contributed many highly regarded reference books to the AP list, including Reliability and Failure of Electronic Materials and the Engineering Science of Thin Films. The knowledge base is intended for science and engineering students in advanced undergraduate or first-year graduate level courses on thin films and scientists and engineers who are entering or require an overview of the field. Since 1992, when the book was first published, the field of thin films has expanded tremendously, especially with regard to technological applications. The second edition will bring the book up-to-date with regard to these advances. Most chapters have been greatly updated, and several new chapters have been added.

An important resource for students, engineers and researchers working in the area of thin film deposition using physical vapor deposition (e.g. sputtering) for semiconductor, liquid crystal displays, high density recording media and photovoltaic device (e.g. thin film solar cell) manufacturing. This book also reviews microelectronics industry topics such as history of inventions and technology trends, recent developments in sputtering technologies, manufacturing steps that require sputtering of thin films, the properties of thin films and the role of sputtering target performance on overall productivity of various processes. Two unique chapters of this book deal with productivity and troubleshooting issues. The content of the book has been divided into two sections: (a) the first section (Chapter 1 to Chapter 3) has been prepared for the readers from a range of disciplines (e.g. electrical, chemical, chemistry, physics) trying to get an insight into use of sputtered films in various devices (e.g. semiconductor, display, photovoltaic, data storage), basic of sputtering and performance of sputtering target in relation to productivity, and (b) the second section (Chapter 4 to Chapter 8) has been prepared for readers who already have background knowledge of sputter deposition of thin films, materials science principles and interested in the details of sputtering target manufacturing methods, sputtering behavior and thin film properties specific to semiconductor, liquid crystal display, photovoltaic and magnetic data storage applications. In Chapters 5 to 8, a general structure has been used, i.e. a description of the applications of sputtered thin films, sputtering target manufacturing methods (including flow charts), sputtering behavior of targets (e.g. current - voltage relationship, deposition rate) and thin film properties (e.g. microstructure, stresses, electrical properties, in-film particles). While discussing these topics, attempts have been made to include examples from the actual commercial processes to highlight the increased complexity of the commercial processes with the growth of advanced technologies. In addition to personnel working in industry setting, university researchers with advanced knowledge of sputtering would also find discussion of such topics (e.g. attributes of target design, chamber design, target microstructure, sputter surface characteristics, various troubleshooting issues) useful. . Unique coverage of sputtering target manufacturing methods in the light of semiconductor, displays, data storage and photovoltaic industry requirements Practical information on technology trends, role of sputtering and major OEMs Discussion on properties of a wide variety of thin films which include silicides, conductors, diffusion barriers, transparent conducting oxides, magnetic films etc. Practical case-studies on target performance and troubleshooting Essential technological information for students, engineers and scientists working in the semiconductor, display, data storage and photovoltaic industry Organized around the key subjects associated with functions of optical thin film performance, this book provides a valuable resource in the field of thin film technology. The information is widely backed up with citations to patents and published literature. Many questions are answered, such as: what are the conventions for a given analysis formalism? and, what other design approaches have been tried for this application? This book represents the experience of Philip Baumeister's 25 years of teaching classes on Optical Thin Film Technology at the UCLA Extension Program, and at companies worldwide.

Hard or protective coatings are widely used in conventional and modern industries and will continue to play a key role in future manufacturing, especially in the micro and nano areas. Protective Thin Coatings Technology highlights the developments and advances in the preparation, characterization, and applications of protective micro-/nanoscaled films and coatings. This book Covers technologies for sputtering of flexible hard nanocoatings, deposition of solid lubricating films, and multilayer transition metal nitrides Describes integrated nanomechanical characterization of hard coatings, corrosion and tribo-corrosion of hard coatings, and high entropy alloy films and coatings Investigates thin films and coatings for high-temperature applications, nanocomposite coatings on magnesium alloys, and the correlation between coating properties and industrial applications Features various aspects of hard coatings, covering advanced sputtering technologies, structural characterizations, and simulations, as well as applications This first 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 material engineering.

Ferroelectricity is one of the most studied phenomena in the scientific community due the importance of ferroelectric materials in a wide range of applications including high dielectric constant capacitors, pyroelectric devices, transducers for medical diagnostic, piezoelectric sonars, electrooptic light valves, electromechanical transducers and ferroelectric random access memories. Actually the ferroelectricity at nanoscale receives a great attention to the development of new technologies. The demand for ferroelectric systems with specific applications enforced the in-depth research in addition to the improvement of processing and characterization techniques. This book contains twenty two chapters and offers an up-to-date view of recent research into ferroelectricity. The chapters cover various formulations, their forms (bulk, thin films, ferroelectric liquid crystals), fabrication, properties, theoretical topics and ferroelectricity at nanoscale. This book, by 36 authorities on the subject, deals with ion beam processing for basic sputter etching of samples, for sputter deposition of thin films, for synthesis of material in thin film form, and of the modification of thin film properties.

The Handbook of Thin Film Deposition Techniques: Principles, Methods, Equipment and Applications, Second Edition explores the technology behind the spectacular growth in the silicon semiconductor industry and the continued trend in miniaturization over the last 20 years. This growth has been fueled in large part by improved thin film deposition techniques and the development of highly specialized equipment to enable this deposition. This second edition explains the growth of sophisticated, automatic tools capable of measuring thickness and spacing of submicron dimensions. The book covers PVD, laser and E-beam assisted deposition, MBE, and ion beam methods to bring together all of the physical vapor deposition techniques. The book also includes coverage of chemical mechanical polishing that helps attain the flatness that is required by modern lithography methods and new materials used for interconnect dielectric materials, specifically organic polyimide materials.

High Power Impulse Magnetron Sputtering: Fundamentals, Technologies, Challenges and Applications is an in-depth introduction to HiPIMS that emphasizes how this novel sputtering technique differs from conventional magnetron processes in terms of both discharge physics and the resulting thin film characteristics. Ionization of sputtered atoms is discussed in detail for various target materials. In addition, the role of self-sputtering, secondary electron emission and the importance of controlling the process gas dynamics, both inert and reactive gases, are examined in detail with an aim to generate stable HiPIMS processes. Lastly, the book also looks at how to characterize the HiPIMS discharge, including essential diagnostic equipment. Experimental results and simulations based on industrially relevant material systems are used to illustrate mechanisms controlling nucleation kinetics, column formation and microstructure evolution. Includes a comprehensive description of the HiPIMS process from fundamental physics to applications Provides a distinctive link between the process plasma and thin film communities Discusses the industrialization of HiPIMS and its real world applications

Based on lecture notes that have been used successfully by the authors for the past 10 years, with revisions made each year, this book is aimed at graduate students as well as professionals and researchers involved in thin film physics and technology. It is concise, comprehensive and well organized. The first part of the book introduces the concept, describes the various deposition procedures and illustrates PVD methods, evaporation and sputtering. The basic physical processes of film formation are then analyzed and formulated, including methods for monitoring and measuring film thickness. This book also shows how the subject matter connects with, relates and applies to other fields. In the second part of the book, 3 special topics — ferromagnetic films, diffusion in thin films and mechanical properties of thin films — are discussed. Given its wide scope, this book is relevant not just to those involved in materials science but also to engineers as well. Contents: Part I: Thin Film Deposition Methods Theories of Nucleation and Film Growth Control and Measurement of Film Thickness Electrical Conduction in Thin Films Dielectric Properties of Thin Insulator Films Superconducting Films Semiconducting Films Part II: Thin Ferromagnetic Films Diffusion in Thin Films Mechanical Properties of Thin Films References Index Readership: Materials scientists. keywords: Thin Films; Deposition Technology; Physical Vapor Deposition; Chemical Vapor Deposition; Theory of Nucleation; Growth Kinetics and Mechanism; Thickness Control and Measurement; Physical Properties; Diffusion; Mechanical Behavior "This book discuss mainly the systems of deposited thin films on a substrate ... The book is mainly focused on the processes in film formation and the microstructural properties such as amorphous, polycrystalline and single crystalline films ... The book is very handy in the thin film laboratory when one need to find quickly some answers on the most relevant questions around the subjects mentioned above." Cock Lodder

This thoroughly updated new edition includes an entirely new team of contributing authors with backgrounds specializing in the various new applications of sputtering technology. It forms a bridge between fundamental theory and practical application, giving an insight into innovative new materials, devices and systems. Organized into three parts for ease of use, this Handbook introduces the fundamentals of thin films and sputtering deposition, explores the theory and practices of this field, and also covers new technology such as nano-functional materials and MEMS. Wide varieties of functional thin film materials and processing are described, and experimental data is provided with detailed examples and theoretical descriptions. A strong applications focus, covering current and emerging technologies, including nano-materials and MEMS (microelectromechanical 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

This volume comprises the expert contributions from the invited speakers at the 17th International Conference on Thin Films (ICTF 2017), held at CSIR-NPL, New Delhi, India. Thin film research has become increasingly important over the last few decades owing to the applications in latest technologies and devices. The book focuses on current advances in thin film deposition processes and characterization including thin film measurements. The chapters cover different types of thin films like metal, dielectric, organic and inorganic, and their diverse applications across transistors, resistors, capacitors, memory elements for computers, optical filters and mirrors, sensors, solar cells, LED's, transparent conducting coatings for liquid crystal display, printed circuit board, and automobile headlamp covers. This book can be a useful reference for students, researchers as well as industry professionals by providing an up-to-date

knowledge on thin films and coatings.

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.

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

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.

The goal of producing devices that are smaller, faster, more functional, reproducible, reliable and economical has given thin film processing a unique role in technology. Principles of Vapor Deposition of Thin Films brings in to one place a diverse amount of scientific background that is considered essential to become knowledgeable in thin film deposition techniques. Its ultimate goal as a reference is to provide the foundation upon which thin film science and technological innovation are possible. \* Offers detailed derivation of important formulae. \* Thoroughly covers the basic principles of materials science that are important to any thin film preparation. \* Careful attention to terminologies, concepts and definitions, as well as abundance of illustrations offer clear support for the text.

This volume provides the first comprehensive look at a pivotal new technology in integrated circuit fabrication. For some time researchers have sought alternate processes for interconnecting the millions of transistors on each chip because conventional physical vapor deposition can no longer meet the specifications of today's complex integrated circuits. Out of this research, ionized physical vapor deposition has emerged as a premier technology for the deposition of thin metal films that form the dense interconnect wiring on state-of-the-art microprocessors and memory chips. For the first time, the most recent developments in thin film deposition using ionized physical vapor deposition (I-PVD) are presented in a single coherent source. Readers will find detailed descriptions of relevant plasma source technology, specific deposition systems, and process recipes. The tools and processes covered include DC hollow cathode magnetrons, RF inductively coupled plasmas, and microwave plasmas that are used for depositing technologically important materials such as copper, tantalum, titanium, TiN, and aluminum. In addition, this volume describes the important physical processes that occur in I-PVD in a simple and concise way. The physical descriptions are followed by experimentally-verified numerical models that provide in-depth insight into the design and operation I-PVD tools. Practicing process engineers, research and development scientists, and students will find that this book's integration of tool design, process development, and fundamental physical models make it an indispensable reference. Key Features: The first comprehensive volume on ionized physical vapor deposition Combines tool design, process development, and fundamental physical understanding to form a complete picture of I-PVD Emphasizes practical applications in the area of IC fabrication and interconnect technology Serves as a guide to select the most appropriate technology for any deposition application \*This single source saves time and effort by including comprehensive information at one's finger tips \*The integration of tool design, process development, and fundamental physics allows the reader to quickly understand all of the issues important to I-PVD \*The numerous practical applications assist the working engineer to select and refine thin film processes

Thin film technology is used in many applications such as microelectronics, optics, hard and corrosion resistant coatings and micromechanics, and thin films form a uniquely versatile material base for the development of novel technologies within these industries. Thin film growth provides an important and up-to-date review of the theory and deposition techniques used in the formation of thin films. Part one focuses on the theory of thin film growth, with chapters covering nucleation and growth processes in thin films, phase-field modelling of thin film growth and surface roughness evolution. Part two covers some of the techniques used for thin film growth, including oblique angle deposition, reactive magnetron sputtering and epitaxial growth of graphene films on single crystal metal surfaces. This section also includes chapters on the properties of thin films, covering topics such as substrate plasticity and buckling of thin films, polarity control, nanostructure growth dynamics and network behaviour in thin films. With its distinguished editor and international team of contributors, Thin film growth is an essential reference for engineers in electronics, energy materials and mechanical engineering, as well as those with an academic research interest in the topic. Provides an important and up-to-date review of the theory and deposition techniques used in the formation of thin films Focusses on the theory and modelling of thin film growth, techniques and mechanisms used for thin film growth and properties of thin films An essential reference for engineers in electronics, energy materials and mechanical engineering

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