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Atomic Layer Deposition Atomic Layer Deposition for Semiconductors **Atomic Layer Deposition in Energy Conversion Applications** **Atomic Layer Deposition of Nanostructured Materials** *Surface Modification of Polymers* Atomic Layer Deposition Applications 6 **Atomic Layer Deposition Applications 10** **Atomic Layer Deposition Applications 3** Atomic Layer Deposition Applications 14 *Atomic Layer Deposition (ALD)* **Atomic Layer Deposition for Semiconductors** *Atomic Layer Deposition Chemical Vapor Deposition for Nanotechnology* **Chemistry of Atomic Layer Deposition** *Organometallic Chemistry* **Plasma-Assisted Atomic Layer Deposition of III-Nitride Thin Films** *Thin Films of Copper Oxide and Copper Grown by Atomic Layer Deposition for Applications in Metallization Systems of Microelectronic Devices* **Atomic Layer Deposition Onto Fibers** **Atomic Layer Deposition of Zinc Based Transparent Conductive Oxides.** Materials Science Precursor Chemistry of Advanced Materials **Chemical Vapour Deposition** Evaluation of Novel Metalorganic Precursors for Atomic Layer Deposition of Nickel-based Thin Films **Atomic Layer Deposition Applications 4** Atomic Layer Deposition for Continued Scaling of Interconnects **New Uses of Micro and Nanomaterials** **Handbook of Deposition Technologies for Films and Coatings** *Atomic Layer Epitaxy* **Atomic Layer Deposition Applications 2** Handbook of Crystal Growth **Spectroscopic Ellipsometry for the In-situ Investigation of Atomic Layer Depositions**

Experimental and Computational Investigations of Platinum and Gallium Nitride Vapor Deposition Processes Atomic Layer Deposition Applications 11 **Copper Area Selective Atomic Layer Deposition for Plasmonic Metallic Nanostructures** Vacuum Deposition onto Webs, Films and Foils Atomic Layer Deposition of Nanostructured Materials *Chemistry of Atomic Layer Deposition* **Oxide-Based Materials and Structures** *Atomic Layer Deposition Applications 7* Handbook of Manufacturing Engineering and Technology

Chemical Vapour Deposition Jan 11 2021 "The book is one of the most comprehensive overviews ever written on the key aspects of chemical vapour deposition processes and it is more comprehensive, technically detailed and up-to-date than other books on CVD. The contributing authors are all practising CVD technologists and are leading international experts in the field of CVD. It presents a logical and progressive overview of the various aspects of CVD processes. Basic concepts, such as the various types of CVD processes, the design of CVD reactors, reaction modelling and CVD precursor chemistry are covered in the first few"--BOOK JACKET.

Atomic Layer Deposition Applications 6 May 27 2022 The continuously expanding realm of Atomic Layer Deposition (ALD) Applications is the focus of this reoccurring symposium. ALD can enable the precise deposition of ultra-thin, highly conformal coatings over complex 3D topographies with controlled thickness and composition. This issue of ECS Transactions contains peer reviewed papers presented at the symposium. A broad spectrum of ALD applications is featured, including novel nano-composites and nanostructures, dielectrics for state-of-the-art transistors and capacitors, optoelectronics, and a variety of other emerging applications.

Vacuum Deposition onto Webs, Films and Foils

Nov 28 2019 Vacuum Deposition onto Webs: Films and Foils, Third Edition, provides the latest information on vacuum deposition, the technology that applies an even coating to a flexible material that can be held on a roll, thereby offering a much faster and cheaper method of bulk coating than deposition onto single pieces or non-flexible surfaces such as glass. This technology has been used in industrial-scale applications for some time, including a wide range of metalized packaging. Its potential as a high-speed, scalable process has seen an increasing range of new products emerging that employ this cost-effective technology, including solar energy products that are moving from rigid panels onto cheaper and more versatile flexible substrates, flexible electronic circuit 'boards', and flexible displays. In this third edition, all chapters are thoroughly revised with a significant amount of new information added, including newly developed barrier measurement techniques, improved in-vacuum monitoring technologies, and the latest developments in Atomic Layer Deposition (ALD). Provides the know-how to maximize productivity of vacuum coating systems Thoroughly revised with a significant amount of new information added, including newly developed barrier measurement techniques, improved in-vacuum monitoring technologies, and the latest on Atomic Layer Deposition (ALD) Presents the latest information on vacuum deposition, the technology that applies an even coating to a flexible material that can be held on a roll, thereby offering a much faster and cheaper method of bulk coating Enables engineers to specify systems more effectively and enhances dialogue between non-specialists and suppliers/engineers Empowers those in rapidly expanding fields such as solar energy, display panels, and flexible electronics to unlock the potential of vacuum coating to transform their processes and products

Chemical Vapor Deposition for Nanotechnology Oct 20 2021 Chemical vapor deposition (CVD) techniques have played a major role in the development of modern technology, and the rise of nanotechnology has further increased their importance, thanks to techniques such as atomic layer deposition (ALD) and vapor liquid solid growth, which are able to control the growth process at the nanoscale. This book aims to contribute to the knowledge of recent developments in CVD technology and its applications. To this aim, important process innovations, such as spatial ALD, direct liquid injection CVD, and electron cyclotron resonance CVD, are presented. Moreover, some of the most recent applications of CVD techniques for the growth of nanomaterials, including graphene, nanofibers, and diamond-like carbon, are described in the book.

Surface Modification of Polymers Jun 27 2022 A guide to modifying and functionalizing the surfaces of polymers Surface Modification of Polymers is an essential guide to the myriad methods that can be employed to modify and functionalize the surfaces of polymers. The functionalization of polymer surfaces is often required for applications in sensors, membranes, medicinal devices, and others. The contributors?noted experts on the topic?describe the polymer surface in detail and discuss the internal and external factors that influence surface properties. This comprehensive guide to the most important methods for the introduction of new functionalities is an authoritative resource for everyone working in the field. This book explores many applications, including the plasma polymerization technique, organic surface functionalization by initiated chemical vapor deposition, photoinduced functionalization on polymer surfaces, functionalization of polymers by hydrolysis, aminolysis, reduction, oxidation, surface modification of nanoparticles, and many more. Inside, readers will find information on various applications in the biomedical field, food science, and membrane science. This important book: -Offers a range of polymer functionalization methods for biomedical applications, water filtration membranes, and food science -Contains discussions of the key surface modification methods, including plasma and chemical techniques, as well as applications for nanotechnology, environmental filtration, food science, and biomedicine -Includes contributions from a team of international renowned experts Written for polymer chemists, materials scientists, plasma physicists, analytical chemists, surface physicists, and surface chemists, Surface Modification of Polymers offers a comprehensive and application-oriented review of the important functionalization methods with a special focus on biomedical applications, membrane science, and food science.

Atomic Layer Deposition Onto Fibers May 15 2021 Fiber reinforced composites are prepared by embedding fibers into metal, polymer, and ceramic matrices. Often these fibers are coated with nanometer thick layer before embedding into matrices to improve performance, especially life-time of the composites. In general, coatings are prepared by sol-gel or chemical vapor deposition. However, these techniques have limitations such as two or more fibers are linked by deposited coating and also form non-uniform coating thickness on fiber, which affect the composite adversely. Atomic layer deposition (ALD) is one of the techniques which can overcome these problems because it can deposit very thin layer with uniform thickness. An ALD reactor has been designed, especially for meter long bundle of fibers. Various oxides have been deposited onto bundle of carbon fibers. Coatings were uniform, and it improve oxidation resistance of the fibers significantly. This book, therefore will provide a new direction for material science, especially for composites science and technology. It will help to design composites for high temperature applications.

Spectroscopic Ellipsometry for the In-situ Investigation of Atomic Layer Depositions

Apr 01 2020 Project Report from the year 2014 in the subject Chemistry - Other, grade: 1.0, Dresden Technical University (Technische Universitat Dresden), course: Semiconductor Technology, language: English, abstract: Atomic Layer Deposition (ALD) is a special type of Chemical Vapor Deposition (CVD) technique based on self-terminating sequential gas reactions for a conformal and precise growth down to few nanometers range. Ideally due to the self-terminating reactions, ALD is a surface-controlled process, where process parameters other than the choice of precursors, substrates, and deposition temperature have little or no influence. In spite of the numerous applications of growth by ALD, many chemical and physical processes that control ALD growth are not yet sufficiently understood. Aim of this student research project is to develop an Aluminium Oxide (Al 2 O 3) ALD process from trimethylaluminum (TMA) and Ozone in comparison of two shower head designs. Then studying the detailed characteristics of Al 2 O 3 ALD process using various measurement techniques such as Spectroscopic Ellipsometry (SE), x-ray photoelec- tron spectroscopy (XPS), atomic force microscopy (AFM). The real-time ALD growth was studied by in-situ SE. In-situ SE is very promising technique that allows the time-continuous as well as time-discrete measurement of the actual growth over an ALD process time. The following ALD process parameters were varied and their inter-dependencies were studied in detail: exposure times of precursor and co-reactant as well as Argon purge times, the deposition temperature, total process pressure, flow dynamics of two different shower head designs. The effect of varying these ALD process parameters was studied by looking upon ALD cycle attributes. Various ALD cycle attributes are: TMA molecule adsorption (M ads), Ligand removal (L rem), growth kinetics (K O3) and growth per cycle (GPC)."

Atomic Layer Deposition (ALD) Jan 23 2022 Atomic layer deposition (ALD) is a thin film deposition technique used in the mass production of microelectronics. In this book, novel nonvolatile memory devices are discussed. The chapters examine the low-temperature fabrication process of single-crystal platinum non-thin films using plasma-enhanced atomic layer deposition (PEALD). A comprehensive review of ALD surface coatings for battery systems is provided, as well as a theoretical calculation on the mechanism of thermal and plasma-enhanced atomic layer deposition of SiO2; and fluorine doping behavior in Zn-based conducting oxide film grown by ALD.

Atomic Layer Deposition Applications 7 Jul 25 2019

Atomic Layer Deposition of Zinc Based Transparent Conductive Oxides. Apr 13 2021 In this work Atomic Layer deposition of niobium and titanium doped ZnO based Transparent Conductive Oxide (TCO) coatings were developed. The fundamentals required for the deposition and doping of ZnO TCOs are discussed. The various opto-electronic properties of the niobium and titanium doped ZnO films were determined and compared. A model was proposed to explain the various changes in the opto-electronic properties of these films.

Atomic Layer Deposition Applications 2 Jun 03 2020 This issue gives an overview of the cutting edge research in the various areas where Atomic Layer Deposition (ALD) can be used, enabling the identification of issues, challenges, and areas where further research is needed. Contributions include: Memory applications, Interconnects and contacts, ALD Productivity enhancement and precursor development, ALD for optical and photonic applications, and

Applications in other areas, such as MEMs, nanotechnology, fabrication of sensors and catalysts, etc.

Atomic Layer Deposition for Semiconductors Dec 22 2021 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.

Handbook of Deposition Technologies for Films and Coatings Aug 06 2020 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

Materials Science Mar 13 2021 Today modern materials science is a vibrant, emerging scientific discipline at the forefront of physics, chemistry, engineering, biology and medicine, and is becoming increasingly international in scope as demonstrated by emerging international and intercontinental collaborations and exchanges. The overall purpose of this book is to provide timely and in-depth coverage of selected advanced topics in materials science. Divided into five sections, this book provides the latest research developments in many aspects of materials science. This book is of interest to both fundamental research and also to practicing scientists and will prove invaluable to all chemical engineers, industrial chemists and students in industry and academia.

Atomic Layer Epitaxy Jul 05 2020 This book provides a detailed study of the Atomic Layer Epitaxy technique (ALE), its development, current and potential applications. The rapid development of coating technologies over the last 25 years has been instrumental in generating interest and expertise in thin films of materials, and indeed the market for thin film coatings is currently £3 billion with projected annual growth of 20 to 30% [1]. ALE is typical of thin-film processes in that problems in the processing or preparation of good quality epitaxial films have been overcome, resulting in better performance, novel applications of previously unsuitable materials, and the development of new devices. Many materials exhibit interesting and novel properties when prepared as thin films and doped. Vapour-deposited coatings and films are used extensively in the semiconductor and related industries for making single devices, integrated circuits, microwave hybrid integrated circuits, compact discs, solar reflective glazing, fibre optics, photo voltaic cells, sensors, displays, and many other products in general, everyday use. The ALE technique was developed by a research team led by Tuomo Suntola, working for Instrumentarium Oy in Finland. The key members of this team were lorma Antson, Arto Pakkala and Sven Lindfors. In 1977, the research team moved from Instrumentarium to Lohja Corporation, where they continued the development of ALE and were granted a patent in the same year. By 1980, the technique was sufficiently advanced that they were producing flat-screen electroluminescent displays based on a manganese-doped zinc sulphide layer.

Copper Area Selective Atomic Layer Deposition for Plasmonic Metallic Nanostructures Dec 30 2019 Plasmonics, a flourishing emergent science and technology, is about the interactions between electromagnetic radiation and electrons at metallic nanoparticles. It opens a new pathway for controlling chemical reactions on metallic nanostructures. Plasmonic dimers, especially with sub-10 nm nanogaps, can greatly enhance local electric field intensity through excitations of surface plasmons, which are collective oscillations of electrons excited by light. Previous studies to fabricate plasmonic dimers with sub-10 nm nanogaps include techniques such as electromigration, electroless gold plating, self-assembly, and high resolution electron beam lithography. However, these methods are limited either in pattern design or low yield for scaling up. To attain more flexibility and reliability in fabrication, there is a need for scalable methods to fabricate plasmonic dimers with sub-10 nm nanogaps, which is crucial for their use in practical applications. Atomic layer deposition (ALD) is a thin-film deposition technique capable of producing conformal thin films with precise control of thickness and composition at the atomic level. Area-selective ALD (AS-ALD) is a bottom-up process for direct deposition of materials only on desired regions of a substrate. In this study, we have explored incident light excitations and plasmonic resonances matching to achieve localized surface plasmon resonances (LSPRs) in the area-selective atomic layer deposition (AS-ALD) process. We have applied copper AS-ALD to tune gap sizes of layered and mixed plasmonic dimer arrays and electrically connected dipole-line arrays to sub-10 nm. Results demonstrate that AS-ALD is a reliable and flexible method to achieve sub-10 nm gaps on large area arrays.

Oxide-Based Materials and Structures Aug 25 2019 Oxide-based materials and structures are becoming increasingly important in a wide range of practical fields including microelectronics, photonics, spintronics, power harvesting, and energy storage in addition to having environmental applications. This book provides readers with a review of the latest research and an overview of cutting-edge patents received in the field. It covers a wide range of materials, techniques, and approaches that will be of interest to both established and early-career scientists in nanoscience and nanotechnology, surface and material science, and bioscience and bioengineering in addition to graduate students in these areas. Features: Contains the latest research and developments in this exciting and emerging field Explores both the fundamentals and applications of the research Covers a wide range of materials, techniques, and approaches

Organometallic Chemistry Aug 18 2021 With the increase in volume, velocity and variety of information, researchers can find it difficult to keep up to date with the literature in their field. Providing an invaluable resource, this volume contains analysed, evaluated and distilled information on the latest in organometallic chemistry research and emerging fields. The reviews range in scope and include π-coordinated arene metal complexes and catalysis by arene exchange, rylenes as chromophores in catalysts for CO2 photoreduction, metal nodes and metal sites in metal–organic frameworks, developments in molecular precursors for CVD and ALD, and multiphoton luminescence processes in f-element containing compounds.

Precursor Chemistry of Advanced Materials Feb 09 2021 Material synthesis by the transformation of organometallic compounds (precursors) by vapor deposition techniques such as chemical vapor deposition (CVD) and atomic layer deposition (ALD) has been in the forefront of modern day research and development of new materials. There exists a need for new routes for designing and synthesizing new precursors as well as the application of established molecular precursors to derive tuneable materials for technological demands. With regard to the precursor chemistry, a most detailed understanding of the mechanistic complexity of materials formation from molecular precursors is very important for further development of new processes and advanced materials. To emphasize and stimulate research in these areas, this volume comprises a selection of case studies covering various key-aspects of the interplay of precursor chemistry with the process conditions of materials formation, particularly looking at the similarities and differences of CVD, ALD and nanoparticle synthesis, e.g. colloid chemistry, involving tailored molecular precursors.

Atomic Layer Deposition for Continued Scaling of Interconnects Oct 08 2020 With the need for more compute performance, smaller semiconductor device dimensions and denser interconnections have required the use of ultra-thin layers conformally deposited in three-dimensional structures such as the gate-all-around MOSFET and in high-aspect-ratio interconnect vias. Atomic layer deposition (ALD), with the ability to precisely control thickness as well as selectively deposit layers on different materials, is used in current process nodes for gate oxides and barrier layers, but new channel materials such as silicon-germanium (SiGe) and new interconnect metals such as cobalt (Co) and ruthenium (Ru) require new surface preparation techniques and ALD processes.Chapter 2 of this dissertation describes the passivation of defects in gate oxides deposited by ALD in SiGe-channel devices. SiGe's high carrier mobility shows promise for future devices, but the presence of unstable germanium oxides (GeOx) in the interface between oxide and channel results in high defect densities, limiting device performance. By nitridating the surface prior to gate oxide ALD using an RF plasma, a reduction in defect densities is demonstrated. TEM and XPS studies confirmed the formation of a GeNx interfacial layer suppressing GeOx formation during ALD, improving gate oxide nucleation and decreasing defect densities. With shrinking device dimensions, interconnect via widths correspondingly shrink. While copper has long been used for due to its low bulk resistivity, ultra-narrow (

Atomic Layer Deposition of Nanostructured Materials Oct 27 2019 Atomic layer deposition, formerly called atomic layer epitaxy, was developed in the 1970s to meet the needs of producing high-quality, large-area fl at displays with perfect structure and process controllability. Nowadays, creating nanomaterials and producing nanostructures with structural perfection is an important goal for many applications in nanotechnology. As ALD is one of the important techniques which offers good control over the surface structures created, it is more and more in the focus of scientists. The book is structured in such a way to fi t both the need of the expert reader (due to the systematic presentation of the results at the forefront of the technique and their applications) and the ones of students and newcomers to the fi eld (through the first part detailing the basic aspects of the technique). This book is a must-have for all Materials Scientists, Surface Chemists, Physicists, and Scientists in the Semiconductor Industry.

Atomic Layer Deposition of Nanostructured Materials Jul 29 2022 Atomic layer deposition, formerly called atomic layer epitaxy, was developed in the 1970s to meet the needs of producing high-quality, large-area fl at displays with perfect structure and process controllability. Nowadays, creating nanomaterials and producing nanostructures with structural perfection is an important goal for many applications in nanotechnology. As ALD is one of the important techniques which offers good control over the surface structures created, it is more and more in the focus of scientists. The book is structured in such a way to fi t both the need of the expert reader (due to the systematic presentation of the results at the forefront of the technique and their applications) and the ones of students and newcomers to the fi eld (through the first part detailing the basic aspects of the technique). This book is a must-have for all Materials Scientists, Surface Chemists, Physicists, and Scientists in the Semiconductor Industry.

Atomic Layer Deposition in Energy Conversion Applications Aug 30 2022 Combining the two topics for the first time, this book begins with an introduction to the recent challenges in energy conversion devices from a materials preparation perspective and how they can be overcome by using atomic layer deposition (ALD). By bridging these subjects it helps ALD specialists to understand the requirements within the energy conversion field, and researchers in energy conversion to become acquainted with the opportunities offered by ALD. With its main focus on applications of ALD for photovoltaics, electrochemical energy storage, and photo- and electrochemical devices, this is important reading for materials scientists, surface chemists, electrochemists, electrotechnicians, physicists, and those working in the semiconductor industry.

Evaluation of Novel Metalorganic Precursors for Atomic Layer Deposition of Nickel-based Thin Films Dec 10 2020 Master's Thesis from the year 2015 in the subject Physics - Electrodynamics, grade: 1.0, Dresden Technical University (Faculty of Electrical and Computer Engineering/Institute of Semiconductors and Microsystems), course: Nanoelectronic Systems, language: English, abstract: Nickel and nickel(II) oxide are widely used in advanced electronic devices. In microelectronic industry, nickel is used to form nickel silicide. The nickel mono-silicide (NiSi) has emerged as an excellent material of choice for source-drain contact applications below 45 nm node CMOS technology. As compared to other silicides used for the contact applications, NiSi is preferred because of its low resistivity, low contact resistance, relatively low formation temperature and low silicon consumption. Nickel is used in nickel-based rechargeable batteries and ferromagnetic random access memories (RAMs). Nickel(II) oxide is utilized as transistor gate-oxide and oxide in resistive RAMs. Atomic Layer Deposition (ALD) is a special type of Chemical

Vapor Deposition (CVD) technique, that is used to deposit very smooth as well as homogeneous thin films with excellent conformality even at high aspect ratios. In spite of huge number of practical applications of nickel and nickel(II) oxide, a few nickel precursors are available for thermal based ALD. Moreover, these precursors have resulted in poor film qualities and the process properties were also limited. Therefore in this master thesis, the properties of various novel nickel precursors had to be evaluated. All novel precursors are heteroleptic (different types of ligands) complexes and were specially designed by the manufacturer for thermal based ALD of pure nickel with hydrogen as a co-reactant. In order to evaluate the novel precursors, a new methodology was designed to test small amounts (down to 2 g) of precursors in a very time efficient way. This methodology includes: TGA/DTA curve analyses of the precursors, thermal stability tests in which the pre

New Uses of Micro and Nanomaterials Sep 06 2020 A fundamental part of modern technology is composed of devices that use special materials as main components. Since the last few decades of the last century and even more recently, a remarkable development has been achieved in new micro- and nanostructured materials with compositional structures and production methods that open unprecedented technological, economic, and ecological perspectives due to high yields, economies of scale, the possibility of reducing weight and size, and the low environmental impact of the equipment that contains them. This book offers a collection of excellent studies that use state-of-the-art methodologies developed by professional researchers from different countries in diverse areas of materials. In this way, this book is particularly useful to academics, scientists, practicing researchers, and postgraduate students whose work relates to the latest nanomaterial technologies.

Atomic Layer Deposition Applications 14 Feb 21 2022

Atomic Layer Deposition for Semiconductors Sep 30 2022 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.

Experimental and Computational Investigations of Platinum and Gallium Nitride Vapor Deposition Processes Mar 01 2020 Chemical vapor deposition (CVD) and atomic layer deposition (ALD) are widely used and still rapidly growing material synthesis technologies. CVD and ALD are used to prepare thin films and nanoparticles from a chemically diverse library of precursors and, under the right conditions, have excellent process control that enables atomic scale precision. This dissertation primarily focuses on the deposition chemistry associated with the metal organic platinum precursor trimethyl (methylcyclopentadienyl) platinum (MeCpPtMe3) used in ALD and CVD of Pt, and with a special focus on substrates functionalized via ALD pretreatments and doping. The first focus of this dissertation was a platinum deposition process that utilized repeated doses of MeCpPtMe3 to deposit platinum nuclei on SiO2, monolayer graphene, and in mesoporous nitrogen-doped carbon powder (MPNC). The main purpose of this study was to enhance the nucleation density of platinum, further enabling the deposition of ultrathin films and catalytic materials, and to synthesize platinum nuclei with enhanced resistance to agglomeration under thermal stress. The effects of AlN and Al2O3 ALD-based pretreatment processes on the nucleation density and thermal stability of Pt nuclei deposited on planar SiO2 and graphene substrates were assessed. AlN was chosen as a promising pretreatment layer due to its relatively high surface energy as compared to Al_2O_3, which has been used previously to enhance the density of atomic layer deposited platinum nuclei. It was found that both Al_2O_3 and AlN pretreatments enhanced Pt nucleation density on SiO_2 and graphene dramatically compared to bare SiO_2 at 250 °C. The nucleation density for depositions performed at 300 °C was not so greatly enhanced by either pretreatment. However, four-point probe measurements indicated that depositing at 300 °C on pretreated SiO_2 substrates, especially those pretreated with AlN, resulted in conductive films with significantly lower sheet resistance than films on untreated SiO_2. After annealing these samples at 400 °C for one hour, it was found that Pt nuclei on pretreated samples generally resisted agglomeration more so than on untreated samples. Interestingly, a fully coalesced Pt film was deposited on AlN pretreated graphene at 300 °C. Conductive films with thicknesses in the range of 10-17 nm were deposited using just $MeCpPtMe_3$. However, a combination of Al_2O_3 pretreatment, extended $MeCpPtMe_3$ exposure, and $MeCpPtMe_3/H_2$ ALD was used to prepare films with the lowest thickness and resistivity. Another substrate functionalization strategy employed to influence the properties of deposited nuclei involved doping. Specifically, N doping in graphene-based materials, like MPNC, is proven to enhance catalytic activity and limit the agglomeration of nuclei under working conditions. The MPNC used in this dissertation was prepared elsewhere by carbonizing a composite of polyaniline and SiO_2 nanoparticles then etching away the SiO_2 to make a disordered, inverse structure composed largely of nitrogen-doped sp^2 hybridized carbon. MPNC carbonized at 1000 °C (MPNC-1000) was observed via X-ray photoelectron spectroscopy to contain higher amounts of O and N dopants than MPNC carbonized at 1500 °C (MPNC-1500). It was found that exposure of both MPNC types to static pulses of MeCpPtMe3 resulted in the deposition of Pt nuclei up to 10 nm in diameter. Depositions performed at 250 °C resulted in nearly the same Pt loading (at. %) for both MPNC types, but increasing the deposition temperature to 300 °C resulted in a large increase in Pt loading for MPNC-1000 only, indicating a thermally driven change in reactivity for MPNC-1000 that is attributable to higher levels of O and N. The purpose of the second study was to use density functional theory to assess the effects of N doping on the reactivity of oxidized monovacancies in graphene towards MeCpPtMe3 adsorption and dissociation, and to identify a possible reason for the temperature-dependent reactivity of MPNC-1000. The substrates considered in this investigation consisted of monovacancies in monolayer graphene oxidized by two and three oxygen atoms. Each of these substrates was doped with a single N atom at various locations around the monovacancy. The chosen substrates are believed to be representative of defects found in N-doped, graphene-based substrates like MPNC. Oxidation of monovacancies in graphene with and without N dopants at various locations relative to the vacancy is thermodynamically favorable. N doping at and around monovacancies increased the length of critical oxygen-substrate bonds, indicating increased reactivity of the involved oxygen atoms, and resulted in a more robust interaction between adsorbed MeCpPtMe3 and oxidized defects. Nudged elastic band calculations were used to characterize the effects of N doping on methyl transfer from an adsorbed MeCpPtMe3 molecule to oxygen atoms bound to vacancies in doped and undoped substrates. All methyl transfer reactions were found to have positive activation energies and enthalpies of reaction. In each case, N dopants reduced the enthalpy and activation energy and made the reaction less reversible, with pyridinic N yielding the most pronounced changes. After losing one methyl group during the methyl transfer reaction, MeCpPtMe2 was generally found to bind much more strongly to the substrate than MeCpPtMe3, especially in the case of N-doped substrates. Thus, N doping at or near oxidized monovacancies in graphene significantly enhances the likelihood of precursor dissociation and adsorption. The deposition of GaN via plasma enhanced ALD (PEALD) and high pressure confined CVD (HPcCVD) was the final focus of this dissertation. A PEALD process was used to investigate the synthesis of amorphous GaN (a-GaN) and the subsequent crystallization of a-GaN by thermal annealing while in contact with a highly oriented GaN crystal template. By depositing a-GaN on amorphous Al2O3, it was thought that highly oriented crystalline GaN might be prepared on an amorphous substrate, thus creating a process that would enable crystalline GaN films to be deposited on any substrate capable of withstanding the process conditions regardless of epitaxial mismatch. Whether deposited GaN films were amorphous or crystalline depended largely on oxygen incorporation and its complex relationship with the background level of oxygen in the reactor and plasma chemistry, duration, and power. Shorter plasma duration, higher hydrogen concentration in the plasma, and lower plasma power were found to increase oxygen content in the deposited films. An oxygen concentration of ~17 at. % was required for the deposition of a-GaN. Lastly, HPcCVD was chosen as a potentially new method of preparing high surface area GaN structures for photocatalytic and sensing applications. A homemade reactor was used to contain mixtures of nitrogen gas, trimethyl gallium, and ammonia pressurized up to ~5000 psi. By venting this mixture through hollow core silica optical fiber heated to 650 °C, deposition of centimeter-scale micron-thick gallium nitride films could be performed on the interior surface of the fiber. The findings herein contribute to a deeper understanding of vapor deposition processes at the nanoscale and highlight the role of computational materials science in providing insight into precursor-substrate interactions at the early stages of deposition.

Chemistry of Atomic Layer Deposition Sep 26 2019 This book will help chemists and non-chemists alike understand the fundamentals of surface chemistry and precursor design, and how these precursors drive the processes of atomic layer deposition, and how the surface-precursor interaction governs atomic layer deposition processes. The underlying principles in atomic layer deposition rely on the chemistry of a precursor with a surface.

Atomic Layer Deposition Nov 01 2022 Since the first edition was published in 2008, Atomic Layer Deposition (ALD) has emerged as a powerful, and sometimes preferred, deposition technology. The new edition of this groundbreaking monograph is the first text to review the subject of ALD comprehensively from a practical perspective. It covers ALD's application to microelectronics (MEMS) and nanotechnology; many important new and emerging applications; thermal processes for ALD growth of nanometer thick films of semiconductors, oxides, metals and nitrides; and the formation of organic and hybrid materials.

Handbook of Crystal Growth May 03 2020 Volume IIIA Basic Techniques Handbook of Crystal Growth, 2nd Edition Volume IIIA (Basic Techniques), edited by chemical and biological engineering expert Thomas F. Kuech, presents the underpinning science and technology associated with epitaxial growth as well as highlighting many of the chief and burgeoning areas for epitaxial growth. Volume IIIA focuses on major growth techniques which are used both in the scientific investigation of crystal growth processes and commercial development of advanced epitaxial structures. Techniques based on vacuum deposition, vapor phase epitaxy, and liquid and solid phase epitaxy are presented along with new techniques for the development of three-dimensional nano-and micro-structures. Volume IIIB Materials, Processes, and Technology Handbook of Crystal Growth, 2nd Edition Volume IIIB (Materials, Processes, and Technology), edited by chemical and biological engineering expert Thomas F. Kuech, describes both specific techniques for epitaxial growth as well as an array of materials-specific growth processes. The volume begins by presenting variations on epitaxial growth process where the kinetic processes are used to develop new types of materials at low temperatures. Optical and physical characterizations of epitaxial films are discussed for both in situ and exit to characterization of epitaxial materials. The remainder of the volume presents both the epitaxial growth processes associated with key technology materials as well as unique structures such as monolayer and two dimensional materials. Volume IIIA Basic Techniques Provides an introduction to the chief epitaxial growth processes and the underpinning scientific concepts used to understand and develop new processes. Presents new techniques and technologies for the development of three-dimensional structures such as quantum dots, nano-wires, rods and patterned growth Introduces and utilizes basic concepts of thermodynamics, transport, and a wide cross-section of kinetic processes which form the atomic level text of growth process Volume IIIB Materials, Processes, and Technology Describes atomic level epitaxial deposition and other low temperature growth techniques Presents both the development of thermal and lattice mismatched streams as the techniques used to characterize the structural properties of these materials Presents in-depth discussion of the epitaxial growth techniques associated with silicone silicone-based materials, compound semiconductors, semiconducting nitrides, and refractory materials

Handbook of Manufacturing Engineering and

Technology Jun 23 2019 The Springer Reference Work Handbook of Manufacturing Engineering and Technology provides overviews and in-depth and authoritative analyses on the basic and cutting-edge manufacturing technologies and sciences across a broad spectrum of areas. These topics are commonly encountered in industries as well as in academia. Manufacturing engineering curricula across universities are now essential topics covered in major universities worldwide.

Thin Films of Copper Oxide and Copper Grown by Atomic Layer Deposition for Applications in Metallization Systems of Microelectronic Devices Jun 15 2021

Atomic Layer Deposition Applications 4 Nov 08 2020 The continuously expanding realm of Atomic Layer Deposition (ALD) Applications is the symposium focus. ALD can enable the precise deposition of ultra-thin, highly conformal coatings over complex 3D topography, with controlled composition and properties. This issue of the ECS Transactions contains peer reviewed papers presented at the symposium. Breadths of ALD Applications are featured: novel nano-composites and nanostructures, dielectrics for state-of-the-art transistors and capacitors, optoelectronics and a variety of other emerging applications.

Atomic Layer Deposition Nov 20 2021 Atomic layer deposition (ALD) is a thin film deposition process renowned for its ability to produce layers with unrivaled control of thickness and composition, conformability to extreme three-dimensional structures, and versatility in the materials it can produce. These range from multi-component compounds to elemental metals and structures with compositions that can be adjusted over the thickness of the film. It has expanded from a small-scale batch process to large scale production, also including continuous processing – known as spatial ALD. It has matured into an industrial technology essential for many areas of materials science and engineering from microelectronics to corrosion protection. Its attributes make it a key technology in studying new materials and structures over an enormous range of applications. This Special Issue contains six research articles and one review article that illustrate the breadth of these applications from energy storage in batteries or supercapacitors to catalysis via x-ray, UV, and visible optics.

Atomic Layer Deposition Applications 3 Mar 25 2022 The continuously expanding realm of Atomic Layer Deposition (ALD) Applications is the symposium focus. ALD can enable the precise deposition of ultra-thin, highly conformal coatings over complex 3D topography, with controlled composition and properties. Following two successful years, this symposium is well on its way to becoming a forum for the sharing of cutting edge research in the various areas where ALD is used.

Plasma-Assisted Atomic Layer Deposition of III-Nitride Thin Films Jul 17 2021 III-nitride compound semiconductors (AlN, GaN, InN) and their alloys have emerged as versatile and high-performance materials for a wide range of electronic and optoelectronic device applications. Although high quality III-nitride thin films can be grown at high temperatures (>1000 C) with significant rates, deposition of these films on temperature-sensitive device layers and substrates necessitates the adaptation of low-temperature methods such as atomic layer deposition (ALD). When compared to other low-temperature thin film deposition techniques, ALD stands out with its self-limiting growth mechanism, which enables the deposition of highly uniform and conformal thin films with sub-angstrom thickness control. These unique characteristics make ALD a powerful method especially for depositing films on nanostructured templates, as well as preparing alloy thin films with well-defined compositions. This monograph reports on the development of low-temperature (200 C) plasma-assisted ALD processes for III-nitrides, and presents detailed characterization results for the deposited thin films and fabricated nanostructures."

Chemistry of Atomic Layer Deposition Sep 18 2021 This book will help chemists and non-chemists alike understand the fundamentals of precursor design, and how these precursors drive the processes of atomic layer deposition. The underlying principle in atomic layer deposition relies on the chemistry of a precursor with a surface. But what makes a good precursor? How does a precursor's reaction at a surface allow it such phenomenal and exploitable characteristics? How do you design a precursor?

Atomic Layer Deposition Applications 11 Jan 29 2020

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