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Creating Thin Films with Non-Linear Optical Properties Eli Yablonovitch @ MIT: What New Device Will Replace the Transistor? Orbital Infrastructure \"SCIENCE IN SPACE\" EARLY 1960s SPACE EXPLORATION FILM SPUTNIK \u0026 EXPLORER VANGUARD ROCKET 12494 Laserdisc: An Introduction OPTICAL PROPERTIES Thin Films 5 - Antireflection Coating I Electric Properties-I Perovskite Solar Cells UFO Hunters: Alien Contact (Season 1, Episode 9) | Full Episode | History Printed Electronics: A Disruptive Manufacturing Platform and an Enabler of Functional Surfaces Novel structural and electronic phases of 2D transition metal dichalcogenides - Oleg Yazyev Preparation of high quality

Perovskite thin films. The End of the Universe - with Geraint Lewis What is Light? Maxwell and the Electromagnetic Spectrum Total station survey Wire Bonding Basics - Manual Wedge Bonding ICs Semiconductor Fabrication Basics - DIY Homemade NMOS FET/MOSFET/Transistor Step by Step

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What you need to know about printing Solar CellsThe Concept of Mass - with Jim Baggott How to Make a Pinhole Camera Upward Bound: Space Elevators Substrate Integrated Circuits - A Paradigm for MHz-to-THz Electronic and Photonic Systems Thin-film and Multilayer Defect Analysis in Metals, Metal Coatings and Optical Coatings What is the Electromagnetic Spectrum? Electronic Theory of Valency and Bonding 3.

Light Absorption and Optical Losses

12. Thin Films: Material Choices \u0026 Manufacturing, Part I

AI4EU Café: Earth Observation Big Data Challenges the AI change of paradigmCircuit Skills: Fiber Optics

Metallic Films For Electronic Optical

Metallic Films for Electronic, Optical and Magnetic Applications is a technical resource for electronics components manufacturers, scientists, and engineers working in the semiconductor industry, product developers of sensors, displays, and other optoelectronic devices, and academics working in the field.

Metallic Films for Electronic, Optical and Magnetic ...

The Woodhead Publishing Series in Electronic and Optical Materials recently released "Metallic Films for

Electronic, Optical and Magnetic Applications: Structure, Processing and Properties," edited by Katayun Barmak, the Philips Electronics Professor in the APAM Department at Columbia University, and Kevin Coffey, a Professor in the Department of Materials Science and

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Metallic Films for Electronic, Optical and Magnetic Applications: Structure, Processing and Properties: Barmak, Katayun, Coffey, Kevin: Amazon.sg: Books

Metallic Films for Electronic, Optical and Magnetic ...

Metallic magnetic thin films are an active and vibrant area of scientific research that provides the underpinning for many technological advances. Much of this interest is focused on films less than 50 nm thick, which has guided the choice of work described here.

Magnetic properties of metallic thin films - ScienceDirect

Optical properties of metallic films for vertical-cavity optoelectronic devices Aleksandar D. Rakic´, Aleksandra B. Djurisˇic´, Jovan M. Elazar, and Marian L. Majewski We present models for the optical functions of 11 metals used as mirrors and contacts in optoelectronic

Optical properties of metallic films for vertical-cavity ...

We present models for the optical functions of 11 metals used as mirrors and contacts in optoelectronic and optical devices: noble metals (Ag, Au, Cu), aluminum, beryllium, and transition metals (Cr, Ni, Pd, Pt, Ti, W). We used two simple phenomenological models, the Lorentz–Drude (LD) and the Brendel–Bormann (BB), to interpret both the free-electron and the interband parts of the ...

OSA | Optical properties of metallic films for vertical ...

This study presents a general 3D nanofabrication technique, the focused ion beam stress induced deformation process, which allows a programmable and accurate bidirectional folding (−70°–+90°) of various metal and dielectric thin films. Using this method, 3D helical optical antennas with different handedness, improved surface smoothness, and tunable geometries are fabricated, and the strong optical rotation effects of single helical antennas are demonstrated.

Metallic films play an important role in modern technologies such as integrated circuits, information storage, displays, sensors, and coatings. Metallic Films for Electronic, Optical and Magnetic Applications reviews the structure, processing and properties of metallic films. Part one explores the structure of metallic films using characterization methods such as x-ray diffraction and transmission electron microscopy. This part also encompasses the processing of metallic films, including structure formation during deposition and post-deposition reactions and phase transformations. Chapters in part two focus on the properties of metallic films, including mechanical, electrical, magnetic, optical, and thermal properties. Metallic Films for Electronic, Optical and Magnetic Applications is a technical resource for electronics components manufacturers, scientists, and engineers working in the semiconductor industry, product developers of sensors, displays, and other optoelectronic devices, and academics working in the field. Explores the structure of metallic films using characterization methods such as x-ray diffraction and transmission electron microscopy Discusses processing of metallic films, including structure formation during deposition and post-deposition reactions and phase transformations Focuses on the properties of metallic films, including mechanical, electrical, magnetic, optical, and thermal properties

Vapor-based growth of thin metal films with controlled morphology on weakly-interacting substrates (WIS), including oxides and van der Waals materials, is essential for the fabrication of multifunctional metal contacts in a wide array of optoelectronic devices. Achieving this entails a great challenge, since weak film/substrate interactions yield a pronounced and uncontrolled 3D morphology. Moreover, the far-from-equilibrium nature of vapor-based film growth often leads to generation of mechanical stress, which may further compromise device reliability and functionality. The objectives of this thesis are related to metal film growth on WIS and seek to: (i) contribute to the understanding of atomic-scale processes that control film morphological evolution; (ii) elucidate the dynamic competition between nanoscale processes that govern film stress generation and evolution; and (iii) develop methodologies for manipulating and controlling nanoscale film morphology between 2D and 3D. Investigations focus on magnetron sputter-deposited Ag and Cu films on SiO2 and amorphous carbon (a-C) substrates. Research is conducted by strategically combining of in situ and real-time film growth monitoring, ex situ chemical and (micro)-structural analysis, optical modelling, and deterministic growth simulations. In the first part, the scaling behavior of characteristic morphological transition thicknesses (i.e., percolation and continuous film formation thickness) during growth of Ag and Cu films on a-C are established as function of deposition rate and temperature. These data are interpreted using a theoretical framework based on the droplet growth theory and the kinetic freezing model for island coalescence, from which the diffusion rates of film forming species during Ag and Cu growth are estimated. By combining experimental data with ab initio molecular dynamics simulations, diffusion of multiatomic clusters, rather than monomers, is identified as the rate-limiting structure-forming process. In the second part, the effect of minority metallic or gaseous species (Cu, N2, O2) on Ag film morphological evolution on SiO2 is studied. By employing in situ spectroscopic ellipsometry, it is found that addition of minority species at the film growth front promotes 2D morphology, but also yields an increased continuous-layer resistivity. Ex situ analyses show that 2D morphology is favored because minority species hinder the rate of coalescence completion. Hence, a novel growth manipulation strategy is compiled in which minority species are deployed with high temporal precision to selectively target specific film growth stages and achieve 2D morphology, while retaining opto-electronic properties of pure Ag films. In the third part, the evolution of stress during Ag and Cu film growth on a-C and its dependence on growth kinetics (as determined by deposition rate, substrate temperature) is systematically investigated. A general trend toward smaller compressive stress magnitudes with increasing temperature/deposition rate is found, related to increasing grain size/decreasing adatom diffusion length. Exception to this trend is found for Cu films, in which oxygen incorporation from the residual growth atmosphere at low deposition rates inhibits adatom diffusivity and decreases the magnitude of compressive stress. The effect of N2 on stress type and magnitude in Ag films is also studied. While Ag grown in N2-free atmosphere exhibits a typical compressive-tensile-compressive stress evolution as function of thickness, addition of a few percent of N2 yields to a stress turnaround from compressive to tensile stress after film continuity which is attributed to giant grain growth and film roughening. The overall results of the thesis provide the foundation to: (i) determine diffusion rates over a wide range of WIS film/substrates systems; (ii) design non-invasive strategies for multifunctional contacts in optoelectronic devices; (iii) complete important missing pieces in the fundamental understanding of stress, which can be used to expand theoretical descriptions for predicting and tuning stress magnitude. La morphologie de films minces métalliques polycristallins élaborés par condensation d’une phase vapeur sur des substrats à faible interaction (SFI) possède un caractère 3D intrinsèque. De plus, la nature hors équilibre de la croissance du film depuis une phase vapeur conduit souvent à la génération de contraintes mécaniques, ce qui peut compromettre davantage la fiabilité et la fonctionnalité des dispositifs optoélectroniques. Les objectifs de cette thèse sont liés à la croissance de films métalliques sur SFI et visent à: (i) contribuer à une meilleure compréhension des processus à l'échelle atomique qui contrôlent l'évolution morphologique des films; (ii) élucider les processus dynamiques qui régissent la génération et l'évolution des contraintes en cours de croissance; et (iii) développer des méthodologies pour manipuler et contrôler la morphologie des films à l'échelle nanométrique. L'originalité de l'approche mise en œuvre consiste à suivre la croissance des films in situ et en temps réel par couplage de plusieurs diagnostics, complété par des analyses microstructurales ex situ. Les grandeurs mesurées sont confrontées à des modèles optiques et des simulations atomistiques. La première partie est consacrée à une étude de comportement d’échelonnement des épaisseurs de transition morphologiques caractéristiques, à savoir la percolation et la continuité du film, lors de la croissance de films polycristallins d'Ag et de Cu sur carbone amorphe (a-C). Ces grandeurs sont examinées de façon systématique en fonction de la vitesse de dépôt et de la température du substrat, et interprétées dans le cadre de la théorie de la croissance de gouttelettes suivant un modèle cinétique décrivant la coalescence d’îlots, à partir duquel les coefficients de diffusion des espèces métalliques sont estimés. En confrontant les données expérimentales à des simulations par dynamique moléculaire ab initio, la diffusion de clusters multiatomiques est identifiée comme l’étape limitante le processus de croissance. Dans la seconde partie, l’incorporation, et l’impact sur la morphologie, d’espèces métalliques ou gazeuses minoritaires (Cu, N2, O2) lors de la croissance de film Ag sur SiO2 est étudié. A partir de mesures ellipsométriques in situ, on constate que l'addition d'espèces minoritaires favorise une morphologie 2D, entravant le taux d'achèvement de la coalescence, mais donne également une résistivité accrue de la couche continue. Par conséquent, une stratégie de manipulation de la croissance est proposée dans laquelle des espèces minoritaires sont déployées avec une grande précision temporelle pour cibler sélectivement des stades de croissance de film spécifiques et obtenir une morphologie 2D, tout en conservant les propriétés optoélectroniques des films dAg pur. Dans la troisième partie, l'évolution des contraintes résiduelles lors de la croissance des films d'Ag et de Cu sur a-C et leur dépendance à la cinétique de croissance est systématiquement étudiée. On observe une tendance générale vers des amplitudes de contrainte de compression plus faibles avec une augmentation de la température/vitesse de dépôt, liée à l'augmentation de la taille des grains/à la diminution de la longueur de diffusion des adatomes. Également, lajout dans le plasma de N2 sur le type et l'amplitude des contraintes dans les films d'Ag est étudié. L'ajout de quelques pourcents de N2 en phase gaz donne lieu à un renversement de la contrainte de compression et une évolution en tension au-delà de la continuité du film. Cet effet est attribué à une croissance anormale des grains géants et le développement de rugosité de surface. L'ensemble des résultats obtenus dans cette thèse fournissent les bases pour: (i) déterminer les coefficients de diffusion sur une large gamme de systèmes films/SFI; (ii) concevoir des stratégies non invasives pour les contacts multifonctionnels dans les dispositifs optoélectroniques; (iii) apporter des éléments de compréhension à l'origine du développement de contrainte, qui permettent de prédire et contrôler le niveau de contrainte intrinsèque à la croissance de films minces polycristallins.

Physics of Thin Films: Advances in Research and Development, Volume 6 reviews the rapid progress that has been made in research and development concerning the physics of thin films, with emphasis on metallic films. Topics covered include anodic oxide films, thin metal films and wires, and multilayer magnetic films. This volume is comprised of five chapters and begins with a discussion on the dielectric properties and the technique of plasma anodization which are relevant to the applications of anodic oxide films in electronic devices. Conduction, polarization, and dielectric breakdown effects are also considered. The next chapter examines studies on size-dependent electrical conduction in thin metal films and wires, paying particular attention to both classical and quantum size effects and some of the anisotropic characteristics of epitaxial metal films. The reader is then introduced to the optical properties of metal films and interactions in multilayer magnetic films. This text concludes with a chapter that looks at diffusion in metallic films and presents experimental results for phase-forming systems, miscible systems, and lateral diffusion. This monograph will be of value to students and practitioners of physics, especially those interested in thin films.

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

Rare Earth and Transition Metal Doping of Semiconductor Material explores traditional semiconductor devices that are based on control of the electron□s electric charge. This book looks at the semiconductor materials used for spintronics applications, in particular focusing on wide band-gap semiconductors doped with transition metals and rare earths. These materials are of particular commercial interest because their spin can be controlled at room temperature, a clear opposition to the most previous research on Gallium Arsenide, which allowed for control of spins at supercold temperatures. Part One of the book explains the theory of magnetism in semiconductors, while Part Two covers the growth of semiconductors for spintronics. Finally, Part Three looks at the characterization and properties of semiconductors for spintronics, with Part Four exploring the devices and the future direction of spintronics. Examines materials which are of commercial interest for producing smaller, faster, and more power-efficient computers and other devices Analyzes the theory behind magnetism in semiconductors and the growth of semiconductors for spintronics Details the properties of semiconductors for spintronics

This dissertation, "Growth of Transition Metal Dichalcogenide Thin Films by Molecular Beam Epitaxy" by Lu, Jiao, □□, was obtained from The University of Hong Kong (Pokfulam, Hong Kong) and is being sold pursuant to Creative Commons: Attribution 3.0 Hong Kong License. The content of this dissertation has not been altered in any way. We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation. All rights not granted by the above license are retained by the author. Abstract: Atomically thin transition metal dichalcogenides (TMD) have attracted intensive research interests due to their extraordinary properties and potential applications in electronics and optoelectronics. In this thesis, epitaxial growths of two-dimensional (2D) $MoSe_2$ and WSe_2 thin films were carried out in Molecular Beam Epitaxy (MBE). Multiple characterization techniques were employed to investigate thin films' structural, morphological, electronic and optical properties. A series of submonolayer $MoSe_2$ coverage samples have been grown on highly ordered pyrolytic graphite (HOPG) substrate. Growth temperature and post-growth annealing temperature were seen to have obvious impacts on film's morphology and crystal quality. Layer-by-layer growth mode has been identified for the Van der Waals epitaxy of $MoSe_2$ on HOPG. Dense networks of inversion domain boundaries (IDBs) have been observed in as-grown MoSe2 epifilms by scanning tunneling microscopy (STM) and transmission electron microscopy (TEM), and their density can be tuned by changing the MBE conditions. Scanning tunneling spectroscopy (STS) measurements reveal mid-gap electronic states associated with the IDB defects. STS measurements also reveal energy bandgaps of monolayer (ML) and bilayer (BL) MoSe2. ML WSe2 thin films were also grown at varying conditions on HOPG substrates through the Van der Waals epitaxy process and the growth characteristics were found similar to that of MoSe2. However, differences are also noted, particularly about the IDB defects. Contrary to MoSe2, as-grown WSe2 films do not contain the line defects. The reason behind such differences will be discussed. Finally, besides the STM/S studies about the morphological and electronic properties of MBE $MoSe_2$ and WSe_2 films, high quality samples have been synthesized on graphene-on-SiC substrate with reduced defect density and well-controlled thicknesses for some ex situ characterizations by photoluminescence and Raman spectroscopy methods. The results will be summarized and discussed in this thesis. Subjects: Molecular beam epitaxy Metallic films

Optical Thin Films and Coatings: From Materials to Applications, Second Edition, provides an overview of thin film materials and their properties, design and manufacture across a wide variety of application areas. Sections explore their design and manufacture and their unconventional features, including the scattering properties of random structures in thin films, optical properties at short wavelengths, thermal properties and color effects. Other chapters focus on novel materials, including organic optical coatings, surface multiplasmonics, optical thin films containing quantum dots, and optical coatings, including laser components, solar cells, displays and lighting, and architectural and automotive glass. The book presents a technical resource for researchers and engineers working with optical thin films and coatings. It is also ideal for professionals in the security, automotive, space and other industries who need an understanding of the topic. Provides thorough review of applications of optical coatings including laser components, solar cells, glazing, displays and lighting One-stop reference that addresses deposition techniques, properties, and applications of optical thin films and coatings Novel methods, suggestions for analysis, and applications makes this a valuable resource for experts in the field as well

Small molecules and conjugated polymers, the two main types of organic materials used for optoelectronic and photonic devices, can be used in a number of applications including organic light-emitting diodes, photovoltaic devices, photorefractive devices and waveguides. Organic materials are attractive due to their low cost, the possibility of their deposition from solution onto large-area substrates, and the ability to tailor their properties.

The Handbook of organic materials for optical and (opto)electronic devices provides an overview of the properties of organic optoelectronic and nonlinear optical materials, and explains how these materials can be used across a range of applications. Parts one and two explore the materials used for organic optoelectronics and nonlinear optics, their properties, and methods of their characterization illustrated by physical studies. Part three moves on to discuss the applications of optoelectronic and nonlinear optical organic materials in devices and includes chapters on organic solar cells, electronic memory devices, and electronic chemical sensors, electro-optic devices. The Handbook of organic materials for optical and (opto)electronic devices is a technical resource for physicists, chemists, electrical engineers and materials scientists involved in research and development of organic semiconductor and nonlinear optical materials and devices. Comprehensively examines the properties of organic optoelectronic and nonlinear optical materials Discusses their applications in different devices including solar cells, LEDs and electronic memory devices An essential technical resource for physicists, chemists, electrical engineers and materials scientists

This volume provides a broad overview of the fundamental materials science of thin films that use silicon as an active substrate or passive template, with an emphasis on opportunities and challenges for practical applications in electronics and photonics. It covers three materials classes on silicon: Semiconductors such as undoped and doped Si and SiGe, SiC, GaN, and III-V arsenides and phosphides; dielectrics including silicon nitride and high-k, low-k, and electro-optically active oxides; and metals, in particular silicide alloys. The impact of film growth and integration on physical, electrical, and optical properties, and ultimately device performance, is highlighted.

This book takes a holistic approach to reliability engineering for electrical and electronic systems by looking at the failure mechanisms, testing methods, failure analysis, characterisation techniques and prediction models that can be used to increase reliability for a range of devices. The text describes the reliability behavior of electrical and electronic systems. It takes an empirical scientific approach to reliability engineering to facilitate a greater understanding of operating conditions, failure mechanisms and the need for testing for a more realistic characterisation. After introducing the fundamentals and background to reliability theory, the text moves on to describe the methods of reliability analysis and charactersation across a wide range of applications. Takes a holistic approach to reliability engineering Looks at the failure mechanisms, testing methods, failure analysis, characterisation techniques and prediction models that can be used to increase reliability Facilitates a greater understanding of operating conditions, failure mechanisms and the need for testing for a more realistic characterisation