

A USERS GUIDE TO **VACUUM TECHNOLOGY**

FOURTH EDITION

JOHN F. O'HANLON - TIMOTHY A. GESSERT

WILEY

User Guide To Vacuum Technology

Andrew Sarangan



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A User's Guide to Vacuum Technology John F. O'Hanlon, 1980 **A Users Guide to Vacuum Technology** John F. O'Hanlon, Timothy A. Gessert, 2023-10-31 A USERS GUIDE TO VACUUM TECHNOLOGY Choose and understand the vacuum technology that fits your project's needs with this indispensable guide Vacuum technology is used to provide process environments for other kinds of engineering technology making it an unsung cornerstone of hundreds of projects incorporating analysis research and development manufacturing and more Since it is very often a secondary technology users primarily interested in processes incorporating it will frequently only encounter vacuum technology when purchasing or troubleshooting There is an urgent need for a guide to vacuum technology made with these users in mind For decades A User's Guide to Vacuum Technology has met this need with a user focused introduction to vacuum technology as it is incorporated into semiconductor optics solar cell and other engineering processes With an emphasis on otherwise neglected subjects and on accessibility to the secondary user of vacuum technology it balances treatment of older systems that are still in use with a survey of the latest cutting edge technologies The result promises to continue as the essential guide to vacuum systems Readers of the fourth edition of A User's Guide to Vacuum Technology will also find Expanded treatment of gauges pumps materials systems and best operating practices Detailed discussion of cutting edge topics like ultraclean vacuum and contamination control An authorial team with decades of combined research and engineering experience A User's Guide to Vacuum Technology is essential for those entering emerging STEM programs engineering professionals and graduate students working with a huge range of engineering technologies

A User's Guide to Vacuum Technology John F. O'Hanlon, 2005-02-18 In the decade and a half since the publication of the Second Edition of A User's Guide to Vacuum Technology there have been many important advances in the field including spinning rotor gauges dry mechanical pumps magnetically levitated turbo pumps and ultraclean system designs These along with improved cleaning and assembly techniques have made contamination free manufacturing a reality Designed to bridge the gap in both knowledge and training between designers and end users of vacuum equipment the Third Edition offers a practical perspective on today's vacuum technology With a focus on the operation understanding and selection of equipment for industrial processes used in semiconductor optics packaging and related coating technologies A User's Guide to Vacuum Technology Third Edition provides a detailed treatment of this important field While emphasizing the fundamentals and touching on significant topics not adequately covered elsewhere the text avoids topics not relevant to the typical user

High-Vacuum Technology Marsbed H. Hablanian, 2017-11-13 Offering a basic understanding of each important topic in vacuum science and technology this book concentrates on pumping issues emphasizes the behavior of vacuum pumps and vacuum systems and explains the relationships between pumps instrumentation and high vacuum system performance The book delineates the technical and theoretical aspects of the subject without getting in too deep It leads readers through the subtleties of vacuum technology without using a dissertation on mathematics to get them there An interesting blend of easy to understand technician level information combined with engineering data and formulae the book provides a non analytical introduction to high vacuum technology Nanofabrication Andrew Sarangan, 2016-10-26 This book is designed to

introduce typical cleanroom processes techniques and their fundamental principles It is written for the practicing scientist or engineer with a focus on being able to transition the information from the book to the laboratory Basic theory such as electromagnetics and electrochemistry is described in as much depth as necessary to understand and explain the current practice and their limitations Examples from various areas of interest will be covered such as the fabrication of photonic devices including photo detectors waveguides and optical coatings which are not commonly found in other fabrication texts

Fundamentals of Infrared and Visible Detector Operation and Testing John David Vincent, Steve Hodges, John Vampola, Mark Stegall, Greg Pierce, 2015-10-26 Presents a comprehensive introduction to the selection operation and testing of infrared devices including a description of modern detector assemblies and their operation This book discusses how to use and test infrared and visible detectors The book provides a convenient reference for those entering the field of IR detector design test or use those who work in the peripheral areas and those who teach and train others in the field Chapter 1 contains introductory material Radiometry is covered in Chapter 2 The author examines Thermal detectors in Chapter 3 the Classical photon detectors simple photoconductors and photovoltaics in Chapter 4 and Modern Photon Detectors in Chapter 5 Chapters 6 through 8 consider respectively individual elements and small arrays of elements the readouts ROICs used with large imaging arrays and Electronics for FPA Operation and Testing The Test Set and The Testing Process are analyzed in Chapters 9 and 10 with emphasis on uncertainty and trouble shooting Chapters 11 through 15 discuss related skills such as Uncertainty Cryogenics Vacuum Optics and the use of Fourier Transforms in the detector business Some highlights of this new edition are that it Discusses radiometric nomenclature and calculations detector mechanisms the associated electronics how these devices are tested and real life effects and problems Examines new tools in Infrared detector operations specifically selection and use of ROICs electronics for FPA operation operation of single element and very small FPAs microbolometers and multi color FPAs Contains five chapters with frequently sought after information on related subjects such as uncertainty optics cryogenics vacuum and the use of Fourier mathematics for detector analyses Fundamentals of Infrared and Visible Detector Operation and Testing Second Edition provides the background and vocabulary necessary to help readers understand the selection operation and testing of modern infrared devices *Biological Electron Microscopy*

Michael J. Dykstra, 2012-12-06 In this practical text the author covers the fundamentals of biological electron microscopy including fixation instrumentation and darkroom work to provide an excellent introduction to the subject for the advanced undergraduate or graduate student

Reliability in Scientific Research I. R. Walker, 2011-01-27 Covering many techniques widely used in research this book will help researchers in the physical sciences and engineering solve troublesome and potentially very time consuming problems in their work The book deals with technical difficulties that often arise unexpectedly during the use of various common experimental methods as well as with human error It provides preventive measures and solutions for such problems thereby saving valuable time for researchers Some of the topics covered are sudden leaks in vacuum systems electromagnetic interference in electronic instruments vibrations in sensitive equipment and bugs in computer software The book also discusses mistakes in mathematical calculations and pitfalls in designing and carrying out experiments Each chapter contains a summary of its key points to give a quick overview of important potential problems and their solutions in a given area

Thin metal films on weakly-interacting substrates Andreas Jamnig, 2020-09-30 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 optoelectronic 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 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 multicristallins obtenus par condensation d'une phase vapeur sur des substrats faiblement interactifs possède un caractère 3D intrinsèque. De plus, la nature hors équilibre de la croissance du film depuis une phase vapeur conduit souvent la génération de contraintes mécaniques ce qui peut compromettre davantage la fiabilité et la fonctionnalité des dispositifs optoelectroniques. Les objectifs de cette thèse sont liés à la croissance de films multicristallins sur SFI et visent à contribuer à une meilleure compréhension des processus à l'échelle atomique qui contrôlent l'évolution morphologique des films, à élucider les processus dynamiques qui régissent la génération et l'évolution des contraintes en cours de croissance et à 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 complétés 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 l'étude du comportement de décalage des transitions morphologiques caractéristiques, savoir la percolation et la continuité du film lors de la croissance de films multicristallins 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 de lots partant duquel les coefficients de diffusion des espèces multicristallines 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 du processus de

croissance Dans la seconde partie l incorporation et l impact sur la morphologie d esp ces m talliques ou gazeuses minoritaires Cu N₂ O₂ lors de la croissance de film Ag sur SiO₂ est tudi A partir de mesures ellipsom triques in situ on constate que l addition d esp ces minoritaires favorise une morphologie 2D entravant le taux d ach vement de la coalescence mais donne galement une r sistivit accrue de la couche continue Par cons quent une strat gie de manipulation de la croissance est propos e dans laquelle des esp ces minoritaires sont d ploy es avec une grande pr cision temporelle pour cibler s lectivement des stades de croissance de film sp cifiques et obtenir une morphologie 2D tout en conservant les propri t s opto lectroniques des films d Ag pur Dans la troisi me partie l volution des contraintes r siduelles lors de la croissance des films d Ag et de Cu sur a C et leur d pendance la cin tique de croissance est syst matiquement tudi e On observe une tendance g n rale vers des amplitudes de contrainte de compression plus faibles avec une augmentation de la temp rature vitesse de d p t li e l augmentation de la taille des grains la diminution de la longueur de diffusion des adatoms galement l ajout dans le plasma de N₂ sur le type et l amplitude des contraintes dans les films d Ag est tudi L ajout de quelques pourcents de N₂ en phase gaz donne lieu un renversement de la contrainte de compression et une volution en tension au del de la continuit du film Cet effet est attribu une croissance anormale des grains g ants et le d veloppement de rugosit de surface L ensemble des r sultats obtenus dans cette th se fournissent les bases pour i d terminer les coefficients de diffusion sur une large gamme de syst mes films SFI ii concevoir des strat gies non invasives pour les contacts multifonctionnels dans les dispositifs opto lectroniques iii apporter des l ments de compr hension l origine du d veloppement de contrainte qui permettent de pr dire et contr ler le niveau de contrainte intrins que la croissance de films minces polycristallins

User Guide To Vacuum Technology: Bestsellers in 2023 The year 2023 has witnessed a remarkable surge in literary brilliance, with numerous engrossing novels captivating the hearts of readers worldwide. Lets delve into the realm of top-selling books, exploring the captivating narratives that have captivated audiences this year. The Must-Read : Colleen Hoover's "It Ends with Us" This touching tale of love, loss, and resilience has captivated readers with its raw and emotional exploration of domestic abuse. Hoover skillfully weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can triumph. User Guide To Vacuum Technology : Taylor Jenkins Reids "The Seven Husbands of Evelyn Hugo" This captivating historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reids compelling storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery. Discover the Magic : Delia Owens "Where the Crawdads Sing" This captivating coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens weaves a tale of resilience, survival, and the transformative power of nature, captivating readers with its evocative prose and mesmerizing setting. These top-selling novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of captivating stories waiting to be discovered. The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts. The Secret History is a masterful and suspenseful novel that will keep you speculating until the very end. The novel is a cautionary tale about the dangers of obsession and the power of evil.

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