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Nanofabrication Thin-film Evaporation from Well-defined Silicon Micropillar Wicks for High-heat-flux Thermal Management Principles of Vapor Deposition of Thin Films Analytical and Experimental Study of Thin Film Evaporation in Heat Pipes Thin Film Thermal Deposition at Various Pressures Thin Film Evaporation in the Pores of Micro Loop Heat Pipe with Non-uniform Heat Flux Thermal Control Thin Films Comprehensive Modeling of Thin Film Evaporation in Micropillar Wicks Oscillating Heat Pipes The Evaporation of a Thin Liquid Film from a Solid Surface Evaporation from Nanoporous Membranes The Evaporation Mechanism in the Wick of Copper Heat Pipes Thermal Hydraulic Design of Components for Steam Generation Plants Thermosyphons and Heat Pipes: Theory and Applications Bioseparations Science and Engineering Heat Transfer and Evaporation Helical-coil Heat Exchanger Application in Falling Film Evaporator for Energy Saving Handbook of Evaporation Technology Production and Packaging of Non-Carbonated Fruit Juices and Fruit Beverages THERMAL DESALINATION PROCESSES - Volume II Evaporation from Nanoporous Membranes for High Heat Flux Thermal Management Implications of the Interface Modelling

Approach on the Heat Transfer Across Solid-Liquid Interfaces and Thin-Film Evaporation Optical Properties of Rubrene Thin Film Prepared by Thermal Evaporation*Project Supported by the Funding for the Development Project of Beijing Municipal Education Commission of Science and Technology, China (Grant No. KZ201410005008), the Natural Science Foundation of Beijing City, China (Grant No. 4102014), and the Graduate Science Fund of the Beijing University of Technology, China (Grant No. Ykj-2013-9835). Electroluminescent Displays The Foundations of Vacuum Coating Technology Heat Transfer and Convective Structure of Evaporating Films Under Pressure-modulated Conditions Evaporation Technology Fundamentals and Applications of Nanomaterials Evaporation and Heating of Laminar and Turbulent Falling Liquid Films Handbook of Thin Film Technology Experimental Investigation of Nucleate Boiling and Thin-film Evaporation on Enhanced Silicon Surfaces Heat Exchangers Sculptured Thin Films Solar Energy Update Advance Deposition Techniques for Thin Film and Coating Investigation of N Single Atom and Diatom Dopant Gas Effect on the Conductivity of Nitrogen-doped ZnO Thin Films Grown by Thermal Evaporation Process Process Analysis, Design, and Intensification in Microfluidics and Chemical Engineering Thin Film Processes II Handbook of Sugar Refining Food Processing

Thin films have a great impact on the modern era of technology. Thin films are considered as backbone for advanced applications in the various fields such as optical devices, environmental applications, telecommunications devices, energy storage devices, and so on . The crucial issue for all applications of thin films depends on their morphology and the stability. The morphology of the thin films strongly hinges on deposition techniques. Thin films can be deposited by the physical and chemical routes. In this chapter, we discuss some advance techniques and principles of thin-film depositions. The vacuum thermal evaporation technique, electron beam evaporation, pulsed-layer deposition, direct current/radio frequency magnetron sputtering, and chemical route deposition systems will be discussed in detail. This work examines the fluid mechanical and heat transfer characteristics of evaporating films under cyclical superheat conditions. This research was motivated by the need to further understand the instability drivers in films undergoing unsteady and cyclical evaporation. The superheat was controlled modulating the system pressure. An isolated test cell allowed the films to evaporate into their own vapor without non-condensable present. A non-intrusive thickness measurement technique was used to yield dynamic heat flux measurements. A double pass schlieren system was employed to capture convective structures. System temperature and pressure measurements completed the diagnostics. The primary conclusions are briefly summarized as follows: * The evolution of thermal profile within evaporating films has a strong impact on the development of convective structure and heat transfer. In some cases convective structure appears within the film under pressure-modulated conditions even when the evaporation intervals are sufficiently short that conduction is expected to be the only heat transfer mode within the film. * Convective structure appears to persist in many cases even after evaporation is stopped. * Stopping the evaporation for short time intervals appears to have a negligible effect on the temperature profile in the film based on the subsequent evaporation behavior. * Complex, multi-wavelength convective structure behavior can be induced through cyclical superheating of the films. * A modest gain in short-term heat flux is achievable under some pressure-modulated conditions. * Surface instabilities of quasi-steady evaporating films do not lead to an increase in the evaporation rate. * Reduced gravity tests were seriously compromised by unsteady g-levels and g-jitter. This excellent volume combines a great deal of data only previously available from many different sources into a single, informative volume. It presents evaporation technology as it exists today. Although evaporation is one of the oldest unit operations, it is also an area with dramatic changes in the last quarter century. Although other methods of separation are available, evaporation remains the best process for many applications. All factors must be evaluated in order to select the best evaporator type. This book will be extremely useful in evaluating and deciding which evaporation technology will meet a particular set of requirements. Heat dissipation is a critical limitation in a range of electronic devices including microprocessors, solar cells, laser diodes and power amplifiers. The most demanding devices require dissipation of heat fluxes in excess of 1 kW/cm2 with heat transfer coefficients more than 30 W/cm 2K. Advanced thermal management solutions using phase change heat transfer are the most promising approach to address these challenges, yet current solutions are limited due to the combination of heat flux, thermal resistance, size and flow stability. This thesis reports the design, fabrication and experimental characterization for an evaporation device with a nanoporous membrane for high heat flux dissipation. Evaporation in the thin film regime is achieved using nanopores with reduced liquid film thicknesses while liquid pumping is enhanced using the capillary pressure of the 120 nm pores. The membrane is mechanically supported by ridges that form liquid supply channels and also serve as a heat conduction path to the evaporating meniscus at the surface of the membrane. The combination of high capillarity pores with high permeability channels facilitates theoretical critical heat fluxes over 2 kW/cm2 and heat transfer coefficients over 100 W/cm2K. Proof-of-concept devices were fabricated using a two-wafer stack consisting of a bonded silicon-on-insulator (SOI) wafer to a silicon wafer. Pores with diameters 110 - 130 nm were defined with interference lithography and etched in the SOI. Liquid supply microchannels were etched on a silicon wafer and the two wafers were fusion bonded together to form a monolithic evaporator. Once bonded, the membrane was released by etching through the backside of the SOI. Finally, platinum heaters and Resistive Temperature Detectors (RTDs) were deposited by e-beam evaporation and liftoff to heat the sample and measure the device temperature during experiments, respectively. Samples were experimentally characterized in a custom environmental chamber for comparison to the model using R245fa, methanol, pentane, water and isopropyl alcohol as working fluids. A comparison of the results with different working fluids demonstrates that transport at the liquid-vapor interface is the dominant thermal resistance in the system, suggesting a figure of merit: ... The highest heat flux recorded was with pentane at ... and the highest heat transfer coefficient recorded was with ... not including the substrate resistance. However, the samples were observed to clog with soluble, nonvolatile contaminants which limited operation to several minutes. The clogging behavior was captured in a mass diffusion model and a new configuration was suggested which is resistant to clogging. Evaporation from nanopores represents a new paradigm in phase change cooling with a figure of merit that favors high volatility, low surface tension fluids rather than water. The models and experimental results validate the functionality and understanding of the proposed approach and provide recommendations for enhancements in performance and understanding as well as strategies for resistance to clogging. This work demonstrates that nanoporous membranes have the potential for ultra-high heat flux dissipation to address next generation thermal management needs. This book discusses recent developments in electroluminescent (EL) displays, in particular thin-film EL displays, which are all-solid emissive displays with fast response, wide viewing angle, high resolution, wide operating temperature ranges and good display qualities. First, the characteristics of four types of EL devices are presented, and the physics of ac thin-film EL devices are detailed, including ideal models, measuring and evaluation methods, high-field electronic transport and properties of phosphor materials. The book emphasizes recent developments in phosphor materials for color thin-film EL devices based on ZnS, SrS, CaS and CaGa2S4, and multicolor thin-film EL panels in four-panel structures. Other important features discussed are drive methods and reliability issues. 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 This book discusses the evaporation mechanism in the wick of copper heat pipes. The investigations are based on recent visualization experiments for operating horizontal flat-plate heat pipes. As the heat flux increases, the thin film evaporation occurring in the evaporator plays a key role in a heat pipe. A better understanding of heat transfer characteristics in the evaporating thin film region will lead to optimizing the thin film region and enhancing the evaporating heat transfer in the heat pipe. An analytical model describing thin film evaporation is developed including the effects of frictional shear stress, surface tension, curvature variation in the thin film interface and disjoining pressure. A unique experimental system was constructed to investigate the effect of heat flux on film thickness in the thin film evaporation region. It has been found that the thin film evaporation is highly affected with the superheat, operation temperature, liquid type, disjoining pressure and thermal conductivity of the liquid. The prediction shows that the interface temperature is not constant at the liquid-vapor interface in the evaporating thin film region. Increasing the thermal conductivity of working fluid leads to directly increasing the heat flux through the evaporating thin film region. The film thickness of interline region was first measured using the experimental setup established in the current investigation. As the input power increases, the film thickness at interline decreases, which is similar to the theoretical prediction. Using this new information on thin film evaporation, a mathematical model predicting the temperature drops occurring in a grooved heat pipe was developed. Renowned international academicians and food industry professionals have collaborated to create Food Processing: Principles and Applications. This practical, fully illustrated resource examines the principles of food processing and demonstrates their application by describing the stages and operations for manufacturing different categories of basic food products. Ideal as an undergraduate text, Food Processing stands apart in three ways: The expertise of the contributing authors is unparalleled among food processing texts today. The text is written mostly by non-engineers for other non-engineers and is therefore user-friendly and easy to read. It is one of the rare texts to use commodity manufacturing to illustrate the principles of food processing. As a hands-on guide to the essential processing principles and their application, this book serves as a relevant primary or supplemental text for students of food science and as a valuable tool for food industry professionals. Supported by over 90 illustrations, this timely resource offers you a broad introduction to nanomaterials, covering basic principles, technology, and cutting-edge applications. From quantum mechanics, band structure, surface chemistry, thermodynamics, and kinetics of nanomaterials, to nanomaterial characterization, nanoparticle synthesis, nanoelectronics, NEMS, and Nano-Bio materials, this groundbreaking volume offers you a solid understanding of a wide range of fundamental topics and brings you up-to-date with the latest developments in the field. Thermal Desalination Processes is a component of Encyclopedia of Water Sciences, Engineering and Technology Resources in the global Encyclopedia of Life Support Systems (EOLSS), which is an integrated compendium of twenty one Encyclopedias. These volumes discuss matters of great relevance to our world on desalination which is a critically important as clearly the only possible means of producing fresh water from the sea for many parts of the world. The two volumes present state-of-the art subject matter of various aspects of Thermal desalination processes such as: Multi-Stage Flash evaporation (MSF) and Multi Effect Distillation (MED) and Mechanical / Thermal Vapor Compression, in addition to the Hybrid Desalination Systems. Chemical Dosing For Desalination; Control Scheme of the Plants; Steady-State Model; Steady-State Simulation; Dynamic Model; Economics and Performance of Desalination Plants. Theses volumes are aimed at the following five major target audiences: University and College Students Educators, Professional Practitioners, Research Personnel and Policy and Decision Makers. The Micro Loop Heat Pipe (LHP) is a self-circulating cooling device with extremely high thermal conductivity where heat is removed by phase change in micron pores of the evaporator and the working fluid circulates by means of the thermodynamic pressure difference developed between the evaporator and the condenser. There are several studies which have considered evaporation within very small diameter pores such as occurring within the evaporator of loop heat pipe. The significance of these results is that they can be used to determine whether the heat flux being supplied to each pore in the wick of an LHP exceeds any thermodynamic limit. Hamdan[4] developed a global model that predicts the temperatures and pressures in the loop heat pipe . It accounts for heat leak and loop performance. It predicts that if either nucleation or the capillary limit is exceeded, the maximum heat flux has been exceeded. The major disadvantage of this model is that it is 1-dimensional and assumes that the heat flux is uniformly distributed across the top of the wick. Heat distribution on the surface of the wick is non-uniform due to the lateral conduction of heat within the wick. This leaves many of the pores at the center unheated resulting in high temperature gradients from the side to the center of the wick. The power dissipation ability of the micro loop heat pipe is drastically affected by this non-uniform heat distribution. Without conduction pathways in the top cap, the energy must be transferred through the periphery of the primary wick. If the distance between conduction pads is too large, the pores in the center wick will not be heated, and will be non evaporating. The global model is conduction and convection controlled. It does not account for the evaporation that occur from the meniscus within the pores and hence no limit has been put on the amount of heat flux that can be supplied to the pores. If too few pores are used, there is some limit on the evaporation that occurs in the meniscus of the pores. The global LHP model does not predict the maximum amount of flux that can be supplied to each pore before it starts increasing the system temperature. The Oinuma [13] evaporation model accounted for thin film evaporation within the pores. Single pore analysis takes into account non uniform heat flux distribution in the pores. The present research work deals with application of the Oinuma[13] evaporation model to Hamdan[4] global LHP model. The goal was to include the interfacial phenomena in the pores. This helps in taking into account the evaporation from the meniscus and in predicting the evaporation limit for global LHP model. The evaporation rate was independent of the assumption of uniform heat flux distribution. The application also accounts for heat flux in each of the pores. In addition to the prediction of temperatures, pressures and maximum heat flux based on capillary limit and nucleation limit, it can also predict optimum number of pores per unit area based on evaporation limit. The evaporation limit was a function of temperature, vapor pressure and diameter of the pore. The working design should now satisfy the LHP limits, i.e. the capillary limit, nucleate boiling limit and the maximum evaporation limit. The LHP would operate efficiently if these three limitations are satisfied. This thesis focuses on the study of nitrogen doped p-type ZnO. The ZnO film is grown by thermal evaporation process in a tube furnace. Two processes and two nitrogen precursors are studied for nitrogen doping. The result shows the p-type ZnO:N films were formed by thermal evaporation for the first time. The Extended X-Ray Absorption of Fine Structure (EXAFS) study indicates that N atoms not only substitute the O atom directly, but some of them participate in N-N bonding. A reduction in electrical performance is observed for ZnO:N using 5% NO/N2 as dopant gas. This is probably due to the presence of more N-N diatoms in the film. The film conductivity depends not only on the dopant gas but also on the growth and annealing process. The photoluminence study indicates the correlation between optical property and conductivity. Heat exchangers are essential in a wide range of engineering applications, including power plants, automobiles, airplanes, process and chemical industries, and heating, air conditioning and refrigeration systems. Revised and updated with new problem sets and examples, Heat Exchangers: Selection, Rating, and Thermal Design, Third Edition presents a This book is about theories and applications of thermosyphons and heat pipes. It discusses the physical phenomena that drive the working principles of thermosyphons, heat pipes and related technologies.

Many applications are discussed in this book, including: rationalizing energy use in industry, solar heating of houses, decrease of water consumption in cooling towers, improvement of the thermal performance of industrial and domestic ovens and driers and new devices for heating stored oil and gas in petrochemical plants. Besides, the book also presents heat pipe and thermosyphon technologies for the thermal management of electronic devices, from portable equipment to airplanes and satellites. The first part of the book explores the physical working principles of thermosyphons and heat pipes, by explaining current heat transfer and thermal resistance models. The author discusses the new heat pipe and thermosyphon technologies that have been developed in the last decade for solving a myriad of electronic, environment and industrial heat and thermal problems. The focus then shifts to the thermosyphon technology applications, and the models and simulations necessary for each application – including vehicles, domestic appliances, water conservation technologies and the thermal control of houses and other structures. Finally, the book looks at the new technologies for heat pipes (mini/micro) and similar devices (loop heat pipes), including new models for prediction of the thermal performance of porous media. This book inspires engineers to adopt innovative approaches to heat transfer problems in equipment and components by applying thermosyphon and heat pipe technologies. It is also of interest to researchers and academics working in the heat transfer field, and to students who wish to learn more about heat transfer devices. Falling film evaporators is an essential equipment of dairy powder production facilities. Evaporation is one type of thermal separation processes which makes the evaporation plant fundamentally energy intensive. Hence, improvements to its operation can have a significant impact on the energy usage. The studied plant has a two-effect falling film evaporator. Based on the current setup of the studied evaporator, a helical heat exchanger is designed and installed in order to reduce the steam usage by recycling the heat from vapor. With the new heat exchanger, one extra heat exchange step is added for transferring heat from hot vapor to cold liquid product. The results demonstrate that the total usage of steam, cooling water and electricity have been reduced. Designed for undergraduates, graduate students, and industry practitioners, Bioseparations Science and Engineering fills a critical need in the field of bioseparations. Current, comprehensive, and concise, it covers bioseparations unit operations in unprecedented depth. In each of the chapters, the authors use a consistent method of explaining unit operations, starting with a qualitative description noting the significance and general application of the unit operation. They then illustrate the scientific application of the operation, develop the required mathematical theory, and finally, describe the applications of the theory in engineering practice, with an emphasis on design and scaleup. Unique to this text is a chapter dedicated to bioseparations process design and economics, in which a process simular, SuperPro Designer® is used to analyze and evaluate the production of three important biological products. New to this second edition are updated discussions of moment analysis, computer simulation, membrane chromatography, and evaporation, among others, as well as revised problem sets. Unique features include basic information about bioproducts and engineering analysis and a chapter with bioseparations laboratory exercises. Bioseparations Science and Engineering is ideal for students and professionals working in or studying bioseparations, and is the premier text in the field. Sculptured thin films (STFs) are a class of nanoengineered materials with properties that can be designed and realized in a controllable manner using physical vapor deposition. This text, presented as a course at the SPIE Optical Science and Technology Symposium, couples detailed knowledge of thin-film morphology with the optical response characteristics of STF devices. An accompanying CD contains Mathematica programs for use with the presented formalisms. Thus, readers will learn to design and engineer STF materials and devices for future applications, particularly with optical applications. Graduate students in optics and practicing optical engineers will find the text valuable, as well as those interested in emerging nanotechnologies for optical devices. Cooling demands of advanced electronics are increasing rapidly, often exceeding capabilities of conventional thermal management techniques. Thin film evaporation has emerged as one of the most promising thermal management solutions. High heat transfer rates can be achieved in thin films of liquids due to a small conduction resistance through the film to the evaporating interface. In this thesis, we investigated evaporation from nanoporous membranes. The capillary wicking of the nanopores supplies liquid to the evaporating interface, passively maintaining the thin film. Different evaporation regimes were predicted through modeling and were demonstrated experimentally. Good agreement was shown between the predicted and observed transitions between regimes. Improved heat transfer performance was demonstrated in the pore level evaporation regime over other regimes, with heat transfer rates up to one order of magnitude larger for a given superheat in comparison to the flooding regime. An improved experimental setup for investigating thin film evaporation from nanopores was developed, where a biphilic membrane, i.e., a membrane with two wetting behaviors, was used for enhanced experimental control to allow characterization of the importance of different design parameters. This improved setup was then used to demonstrate the dependence of thin film evaporation on the location of the meniscus within the nanopores. This dependence on meniscus location within the pore was also shown to increase with increasing superheat. We observed a 46% reduction in heat transfer rates at a superheat of 15 °C for an L^* of 14.67 compared to an L^* of 2, where L^* is the ratio of the depth of the meniscus within the pore to the pore radius. This work provides practical insights for the design of devices based on nanoporous evaporation. Heat transfer regimes can be predicted based on fluid supply conditions, evaporative heat flux, and membrane geometry. Furthermore, the biphilic membrane serves as a valuable experimental platform for testing the role of membrane geometry on heat transfer performance in the pore level evaporation regime. Future work will focus on demonstrating the importance of different parameters and using experimental results to either validate existing models for evaporation from nanopores or develop more suitable ones. “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. Microfluidics represent great potential for chemical processes design, development, optimization, and chemical engineering bolsters the project design of industrial processes often found in large chemical plants. Together, microfluidics and chemical engineering can lead to a more complete and comprehensive process. Process Analysis, Design, and Intensification in Microfluidics and Chemical Engineering provides emerging research exploring the theoretical and practical aspects of microfluidics and its application in chemical engineering with the intention of building pathways for new processes and product developments in industrial areas. Featuring coverage on a broad range of topics such as design techniques, hydrodynamics, and numerical modelling, this book is ideally designed for engineers, chemists, microfluidics and chemical engineering companies, academicians, researchers, and students. 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. In the Information Age, society has become accustomed to continuous, rapid advances in electronics technology. As the power density of these devices increases, heat dissipation threatens to become the limiting factor for growth in the electronics industry. In order to sustain rapid growth, the development of advanced thermal management strategies to efficiently dissipate heat from electronics is imperative. Porous wicks are of great interest in thermal management because they are capable of passively supplying liquid for thin film evaporation, a promising method to reliably dissipate heat in high-performance electronics. While the maximum heat flux that can be reliably sustained (the dryout heat flux) has been well-characterized for many wick configurations, key design information is missing as many previous models cannot determine the distribution of evaporator surface temperature nor temperature at the evaporator's interface with electronic components. Temperature gradients are inherent to the passive capillary pumping mechanism since the shape of the liquid-vapor interface is a function of the local liquid pressure, causing spatial variation of permeability and the heat transfer coefficient (HTC). Accounting for the variation of the liquid-vapor interface to determine the resulting temperature gradients has been a significant modeling challenge. In this thesis, we present a comprehensive modeling framework for thin film evaporation in micropillar wicks that can predict dryout heat flux and local temperature simultaneously. Our numerical approach captures the effect of varying interfacial curvature across the micropillar evaporator to determine the spatial distributions of temperature and heat flux. Heat transfer and capillary flow in the wick are coupled in a computationally efficient manner via incorporation of parametric studies to relate geometry and interface shape to local permeability and HTC. While most previous models only consider uniform thermal loads, our model offers the flexibility to consider arbitrary (non-uniform) thermal loads, making it suitable to guide the design of porous wick evaporators for cooling realistic electronic devices. We present case studies from our model that underscore its capability to guide design with respect to temperature and dryout heat flux. This model predicts notable variations of the HTC (-30%) across the micropillar wick, highlighting the significant effects of interfacial curvature that have not been considered previously. We demonstrate the model's capability to simulate non-uniform thermal loads and show that wick configuration with respect to the input thermal distribution has a significant effect on performance due to the distribution of the HTC and capillary pressure. Further, we are able to quantify the tradeoff associated with enhancing either dryout heat flux or the HTC by optimizing geometry. We offer insights into optimization and further analyze the effects of micropillar geometry on the HTC. Finally, we integrate this model into a fast, compact thermal model (CTM) to make it suitable for thermal/electronics codesign of high-performance devices and demonstrate a thermal simulation of a realistic microprocessor using this CTM. We discuss further uses of our model and describe an experimental platform that could validate our predicted temperature distributions. Lastly, we propose a biporous, area-enhanced wick structure that could push thermal performance to new limits by overcoming the design challenge typically associated with porous wick evaporators. This book provides a reference work on the design and operation of cane sugar manufacturing facilities.

It covers cane sugar decolorization, filtration, evaporation and crystallization, centrifugation, drying, and packaging, The present work consists of two major studies. The first study investigates the effects of surface energy or wettability on nucleate pool boiling and the second study investigates the thin-film evaporative cooling for near junction thermal management. For the first study, effects of surface energy or wettability on critical heat flux (CHF) and boiling heat transfer (BHT) of smooth heated surfaces was studied in saturated pool boiling of water at 1 atm. For this purpose hydrophilic and hydrophobic surfaces were created on one side of 1cm x 1cm double-side polished silicon substrates. A resistive heating layer was applied on the opposite side of each substrate. The surface energies of the created surfaces were characterized by measuring the static contact angles of water sessile drops. To provide a wide range of surface energies, surfaces were made of Teflon (hydrophobic), bare silicon (hydrophilic) and aluminum oxide (most hydrophilic). The measured contact angles on these surfaces were ~108, ~57 and ~13 degrees respectively. The results of pool boiling tests on these surfaces clearly illustrate the connection between surface energy and CHF. CHF was shown to linearly decrease with contact angle increase, from ~125 W/cm2 on aluminum oxide (most hydrophilic) to nearly one tenth of this value on Teflon (hydrophobic). The most hydrophilic surface also produced increasingly better BHT than plain silicon and Teflon as heat flux increased. However, below ~5 W/cm2 the hydrophobic surface demonstrated better heat transfer due to earlier onset of nucleate boiling, reducing surface superheats by up to ~5 degrees relative to the other two surfaces. Above ~5 W/cm2 the BHT of the hydrophobic surface rapidly deteriorated as superheat increased towards the value at CHF. To further understand the effect of surface energy on pool boiling performance, the growth and departure of bubbles from single nucleating sites on each surface were analyzed from high-speed video recordings. A distinct bubble behavior was observed in the hydrophobic surface where bubble growth and departure period was extremely long compared to plain silicon and aluminum oxide surfaces. This study also investigated the performance of thin-film evaporative cooling for near-junction thermal management. A liquid delivery system capable of delivering water in small volumes ranging 20~75 nl at frequencies of up to 600 Hz was established. On one side of the silicon chip, a resistive heating layer of 2 mm x 2 mm was fabricated to emulate the high heat flux hot-spot, and on the other side a superhydrophilic nanoporous coating (SHNC) was applied over an area of 1 cm x 1 cm. With the aid of the nanoporous coating, delivered droplets spread into thin films of thicknesses less than 10[mu]m. With this system, evaporative tests were conducted in ambient in an effort to maximize dryout heat flux and evaporative heat transfer coefficient. During the tests, heat flux at the hot spot was varied to values above 1000 W/cm2. Water was delivered at either given constant frequency (constant mass flow rate) or at programmed variations of frequency (variable mass flow rate), for a given nanoliter dose volume. Heat flux and hot spot surface temperatures were recorded upon reaching steady state at each applied heat flux increment. Relative to bare silicon surface, dryout heat flux of the SHNC surface was found to increase by ~5 times at 500~600 Hz. Tests were also conducted at various system pressures and temperatures in a micro-gap to emulate the actual embedded thermal management system. The micro-gap was made by positioning a top cover plate 500 [mu]m above the test surface. System temperature did not influence the hotspot temperature. This was due to the formation of near saturation temperature inside the micro-gap for all cases as a result of vapor accumulation. Increase in system pressure increased the hotspot temperature. At 1500 W/cm2, hotspot temperature increased by 6 C and 24 C by increasing the system pressure by 7.32 and 14.7 psi respectively. This was due to increase in saturation point as a result of increase in pressure. On the SHNC surface a mixed mode of heat transfer comprising of thin-film boiling and thin-film evaporation was observed particularly at moderate heat flux (~700 W/cm2). To further enhance the heat transfer coefficient, aluminum microporous coating was developed that increased the number of nucleation sites for thin-film boiling and also maintained the wettability for thin-film evaporation at higher heat fluxes. Test results showed a marginal improvement in dry-out heat flux compared to SHNC, however, significant reduction was achieved in hot-spot temperature at all heat flux levels. A net reduction of ~ 58oC was obtained at ~1600 W/cm2 by using aluminum based microporous coating. The book presents up-to-date thermal control film materials, technologies and applications in spacecraft. Commonly used thermal control film materials and devices for spacecraft are discussed in detail, including single-structure passive thermal control film materials, composite structure passive thermal control film materials, intelligent thermal control film materials, and microstructure thermal control thin film devices. The generation of concentrated heat loads in advanced microprocessors, power amplifiers, and concentrated photovoltaics present significant thermal management challenge for defense, space and commercial applications. Liquid to vapor phase-change strategies are promising due to the high latent heat of vaporization of the working fluid. In particular, capillary pumped thin-film evaporation from micropillar wicks has received significant attention owing to advances in micro/nano-fabrication and the potential to dissipate high heat fluxes by increasing the evaporative area. Yet, predictive tools to design various wicking structures are not available due to limited understanding of the thermal-fluidic transport. This thesis reports experimental characterization and modeling of capillary-limited thin-film evaporation from micropillar wicks. We fabricated test devices and experimentally characterized the thermal performance of well-defined silicon micropillar wicks. The experiments were designed to investigate the capillary-limited dryout heat flux by ensuring pure thin-film evaporation in the absence of nucleate boiling. The tests were performed in a temperature controlled saturated vapor environment to accurately control the operating conditions. We also developed a unified semi-analytical thermal-fluidic model that incorporates the capillary pressure, permeability, and thermal resistance to help explain the experimental results. We then extended this work to study capillary-limited thin-film evaporation for dissipating extreme heat fluxes. We experimentally dissipated =6 kW/cm2 from a 640x620 [mu]m2 footprint, the largest heat flux reported to date when compared to past thin-film evaporation studies with similar size hotspots. We also demonstrated the potential of our devices to cool concurrent hotspots as well as when moderate uniform background heat flux was superposed with a hotspot. Our thermal management strategy is self-regulating and provides on-demand cooling unlike existing thermal management solutions. To gain insight into the fundamental physics of fluidic and thermal transport within the micropillar wick and explain the ultra-high heat fluxes demonstrated in our experiments, we developed a semi-analytical thermal-fluidic model that can predict the capillary-limited dryout heat flux via thin-film evaporation. The model compares well with our experiments. The results of this investigation will assist to better understand the fluidic and thermal transport of thin liquid films in microstructured wicks during thin-film evaporation. These studies suggest that capillary-pumped thin-film evaporation is a promising thermal management strategy for the next generation of high performance electronics. The insights gained from this thesis can be used as guidelines to improve the design and optimize the heat transfer performance of wicking structures which are commonly used in phase-change based thermal management devices such as heat pipes, vapor chambers, and other closed-loop configurations. This research was to verify the hypothesis that resistivity of metal's thin film deposited in a low-pressure environment is the same as its solid material. Thermal Evaporation is a thin film deposition technique in which metal inside a vacuum is evaporated, then deposited onto a surface. Higher quality metal films are deposited when the vacuum pressure is lower. At higher pressures, more air molecules are trapped within the layers of metal, thus increasing scattering sites and increasing the resistance. However, reaching a lower pressure requires more time and effort. In this research, films were deposited at various pressures and resistivities were calculated for each film to determine an ideal pressure range that creates the least resistivity. In this Dissertation, the governing mechanisms of thermal energy transfer across solid-liquid interfaces and thin-film evaporation are investigated by means of classical molecular dynamics (MD) simulations. In an effort to steer the heat transfer community from heavily empirical techniques into more physically sound methods, significant attention was given to the formulation physics and chemistry informed interface modelling approaches in MD simulations of heat transfer and evaporation. MD simulations were carried out to characterize and analyze the parameters affecting interfacial heat transport, namely, the solid-liquid affinity, the interfacial vibrational compatibility, and the liquid structuring. Understanding and controlling heat transfer and evaporation is fundamental for various applications, such as photothermal therapy and diagnosis, water desalination, additive manufacturing, energy storage and conversion, and thermal management of high-power electronics. For water desalination, electronics cooling, and nanoparticle-mediated thermotherapy, materials featuring good chemical stability, wide band gap, and biological compatibility are necessary. Therefore, inspired by the current technological interests in solid-liquid interfaces, this Dissertation was dedicated to investigate aqueous interfaces of silicon carbide (SiC) and aluminum oxide (alumina). In addition, graphite-water interfaces were used as a reference framework, since this system has been extensively characterized and studied, and several interfacial modelling parameters are available in the literature. The surface wettability was theoretically and numerically characterized for SiC evaluating the effect of different crystallographic orientations and surface terminations. Anysotropy of wettability was found and analytical models based on Mean-Field theory could adequately describe the wetting behavior for compound materials. In addition, the calculations of the interfacial thermal conductance for SiC showed that the most hydrophilic surfaces were not the most conductive, opposing to the conventional notions that related efficient interfacial thermal transport with hydrophilic surfaces. By including additional parameters, such as the interfacial liquid depletion, a reconciliation of the interfacial thermal conductance was observed, indicating that the surface wettability is only one of the mechanisms involved in the thermal transport phenomena. The potential effect of the liquid structuring on the interfacial thermal transport was verified by the calculation of the thermal conductance at the graphite-water interface. The various interface parameters considered produced a wide spectrum of wetting conditions; nonetheless, no direct relationships between wetting parameters such as the contact angle, the work of adhesion, and the binding energy were observed. Similar to the observed for SiC, the liquid density depletion helped to reconcile the calculations of the interfacial conductance for the graphite-water interface. A more complex interfacial model accounting for surface chemistry and electrostatic interactions was developed to analyze the alumina-water interface. The results indicated that wetting and thin-film evaporation are significantly susceptible to interfacial modeling parameters. Moreover, the improper definition of the atomic interactions led to unphysical droplet spreading when using widely accepted modeling parameters for water-alumina interactions. The characterization of interfacial thermal transport for alumina demonstrated the exitance of an interplay between the solid-liquid affinity, the interfacial vibrational compatibility, and the formation of hydrogen bonds. Thin-film evaporation results showed significant variations in the evaporating film thickness and the evaporation mass fluxes with the different interface models, which demonstrated the crucial role of a robust interfacial modelling approach in capturing evaporation in MD simulations. This sequel to the 1978 classic, Thin Film Processes, gives a clear, practical exposition of important thin film deposition and etching processes that have not yet been adequately reviewed. It discusses selected processes in tutorial overviews with implementation guide lines and an introduction to the literature. Though edited to stand alone, when taken together, Thin Film Processes II and its predecessor present a thorough grounding in modern thin film techniques. Provides an all-new sequel to the 1978 classic, Thin Film Processes Introduces new topics, and several key topics presented in the original volume are updated Emphasizes practical applications of major thin film deposition and etching processes Helps readers find the appropriate technology for a particular application 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 depostition 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 book reviews the fruit juice and fruit beverage industry (including nectars) from grower to distributor, including fruit handling and processing, chemistry and characterization, analysis, quality control, nutritional value and packaging. Many changes have occurred in the fruit juice and beverage markets since the first edition of this book appeared, and these are reflected in a substantial revision of the original text, together with three new chapters. One of these covers the formulation and performance characteristics of sports drinks which have undergone rapid growth in recent years and now feature in beverage markets worldwide. The second new chapter on water and effluent treatment in juice processing addresses the concern of the beverage industry to obtain water of a suitable standard, despite the deterioration in water quality which has occurred in many countries. This chapter also covers the subject of effluent management and treatment. This book presents the fundamental fluid flow and heat transfer principles occurring in oscillating heat pipes and also provides updated developments and recent innovations in research and applications of heat pipes. Starting with fundamental presentation of heat pipes, the focus is on oscillating motions and its heat transfer enhancement in a two-phase heat transfer system. The book covers thermodynamic analysis, interfacial phenomenon, thin film evaporation, theoretical models of oscillating motion and heat transfer of single phase and two-phase flows, primary factors affecting oscillating motions and heat transfer, neutron imaging study of oscillating motions in an oscillating heat pipes, and nanofluid’s effect on the heat transfer performance in oscillating heat pipes. The importance of thermally-excited oscillating motion combined with phase change heat transfer to a wide variety of applications is emphasized. This book is an essential resource and learning tool for senior undergraduate, graduate students, practicing engineers, researchers, and scientists working in the area of heat pipes. This book also · Includes detailed descriptions on how an oscillating heat pipe is fabricated, tested, and utilized · Covers fundamentals of oscillating flow and heat transfer in an oscillating heat pipe · Provides general presentation of conventional heat pipes This book presents discussions regarding the design of the main components for steam generation plants, such as evaporators, steam generators for fossil-fueled and nuclear power plants, waste heat boilers for chemical and related field plants, and auxiliary components in steam cycle plants. Information regarding the manufacturing and operational phases of the plants, as well as quality control procedures and environmental requirements, is included. The book features the most advanced technology, in addition to special skills and tricks based on the field experience of some of the leading scientific and technical people in the field. Plant manufacturing and operation engineers, engineering companies, and instructors teaching advanced courses in mechanical and chemical engineering will find this text essential reading.

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