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Fundamentals of Interfacial Engineering Fundamentals of Interfacial Engineering Interfacial Engineering for Optimized Properties: Volume 458 Interfacial Engineering for Optimized Properties II: Volume 586 Interfacial Engineering in Functional Materials for Dye-Sensitized Solar Cells Interfacial Engineering for Optimized Properties III: Interfacial Engineering of Microstructured Materials Interfacial Engineering for Optimized Properties Center for Interfacial Engineering, University of Minnesota Bioelectrochemical Interface Engineering Fundamentals of Interface and Colloid Science Interfacial Engineering in Functional Materials for Dye-Sensitized Solar Cells Luminous Chemical Vapor Deposition and Interface Engineering Interfacial Engineering in Functional Materials for Dye-Sensitized Solar Cells Interface Engineering of Natural Fibre Composites for Maximum Performance Interfacial Engineering for Organic/inorganic Hybrid Bulk Bioelectrochemical Interface Engineering Interfacial Engineering of Organic and Inorganic Heterojuction for Solar Cell Application Materials and Processes for Surface and Interface Engineering Interfacial Engineering of Multi-junction Polymer Solar Cells Single-step Formation of Bilayer Structure by Interfacial Engineering for High Performance Complementary Resistive Memory Controlling Crystallization Via Interfacial Engineering Nanostructures for Cancer Therapy Interfacial Engineering and Structural Design of Organic-inorganic Interfaces for Next-generation Rechargeable Batteries Interfacial Engineering to Control Phase Transitions Assembling and Interfacial Engineering in Nanostructured Thermoelectric Materials Design of Novel

Functional Colloidal Suspensions and Gels by Interfacial Engineering of Multiphasic Systems Interfacial Engineering for Highly Efficient-Conjugated Polymer-Based Bulk Heterojunction Photovoltaic Devices Interfacial Transport Processes and Rheology Interfacial Science: An Introduction Interfacial Engineering for Highly Efficient Perovskite Solar Cells Computational Modeling for Fluid Flow and Interfacial Transport Interfacial Engineering of Inorganic Materials for Energy Storage and Conversion Applications Interface Engineering of Natural Fibre Composites for Maximum Performance Towards Impacting Electrochemical Phenomena Using Interfacial Engineering Scratching of Materials and Applications Interfacial Mechanics Hybrid Organic-Inorganic Interfaces Interfacial Phenomena Material-Tissue Interfacial Phenomena

One of the major reasons for composite failure is a breakdown of the bond between the reinforcement fibres and the matrix. When this happens, the composite loses strength and fails. By engineering the interface between the natural fibres and the matrix, the properties of the composite can be manipulated to give maximum performance. Interface engineering of natural fibre composites for maximum performance looks at natural (sustainable) fibre composites and the growing trend towards their use as reinforcements in composites. Part one focuses on processing and surface treatments to engineer the interface in natural fibre composites and looks in detail at modifying cellulose fibre surfaces in the manufacture of natural fibre composites, interface tuning through matrix modification and preparation of cellulose nanocomposites. It also looks at the characterisation of fibre surface treatments by infrared and raman spectroscopy and the effects of processing and surface treatment on the interfacial adhesion and mechanical properties of natural fibre composites.

Testing interfacial properties in natural fibre composites is the topic of part two which discusses the electrochemical characterisation of the interfacial properties of natural fibres, assesses the mechanical and thermochemical properties and moisture uptake behaviour of natural fibres and studies the fatigue and delamination of natural fibre composites before finishing with a look at Raman spectroscopy and x-ray scattering for assessing the interface in natural fibre composites With its distinguished editor and international team of contributors Interface engineering of natural fibre composites for maximum performance is an invaluable resource to composite manufacturers and developers, materials scientists and engineers and anyone involved in designing and formulating composites or in industries that use natural fibre composites. Examines characterisation of fibre surface treatments by infrared and raman spectroscopy and the effects of processing and surface treatment Reviews testing interfacial properties in natural fibre composites including the electrochemical characterisation of the interfacial properties of natural fibres Assesses the mechanical and thermochemical properties and moisture uptake behaviour of natural fibres and studies the fatigue and delamination of natural fibre composites This textbook is designed to provide the theory, methods of measurement, and principal applications of the expanding field of interfacial hydrodynamics. It is intended to serve the research needs of both academic and industrial scientists, including chemical or mechanical engineers, material and surface scientists, physical chemists, chemical and biophysicists, rheologists, physiochemical hydrodynamicists, and applied mathematicians (especially those with interests in viscous fluid mechanics and continuum mechanics). As a textbook it provides materials for a one- or two-semester graduate-level course in interfacial transport processes. It may also be noted that, while separate practical and theoretical

subdivisions of material have been introduced, a kind of cross-emphasis is often stressed: (i) to the academic scientist, or the importance of understanding major applications of interfacial transport; and (ii) to the industrial scientist, of the importance of understanding the underlying theory. The study of interfaces is one of the oldest areas of research in materials science. The presence of grain boundaries in materials has long been recognized, as has its crucial role in determining mechanical properties. Another long-recognized concept is that the properties of a surface are quite different from those of the bulk. Researchers have been able to study these interfaces, both internal and external, with a detail not before possible. These advances have stemmed from the ability to obtain atomic resolution images of interfaces, to measure accurate chemical compositions of interfaces, and to model these interfaces and their properties. This book goes a step further to explore how all of this information can be used. Significant attention is given to the crystallographic nature of grain boundaries and interfaces, and the relationship between this nature and the performance of a material. The EBSP in solving a number of interface-related problems is also featured. Topics include: introductory concepts and modelling; characterization - orientation and interfacial films; characterization - microscopy and chemistry; mechanical properties; general interfaces; composites, laminates and coatings and thin films. The aim of our proposal is to apply interface engineering approach to improve charge extraction, guide active layer morphology, improve materials compatibility, and ultimately allow the fabrication of high efficiency tandem cells. Specifically, we aim at developing: i. Interfacial engineering using small molecule self-assembled monolayers ii. Nanostructure engineering in OPVs using polymer brushes iii. Development of efficient light harvesting and high mobility materials for OPVs iv. Physical characterization of the nanostructured systems using electrostatic

force microscopy, and conducting atomic force microscopy v. All-solution processed organic-based tandem cells using interfacial engineering to optimize the recombination layer currents vi. Theoretical modeling of charge transport in the active semiconducting layer The material development effort is guided by advanced computer modeling and surface/ interface engineering tools to allow us to obtain better understanding of the effect of electrode modifications on OPV performance for the investigation of more elaborate device structures. The materials and devices developed within this program represent a major conceptual advancement using an integrated approach combining rational molecular design, material, interface, process, and device engineering to achieve solar cells with high efficiency, stability, and the potential to be used for large-area roll-to-roll printing. This may create significant impact in lowering manufacturing cost of polymer solar cells for promoting clean renewable energy use and preventing the side effects from using fossil fuels to impact environment. Icing and scale fouling affect the functioning of a number of industries. The problems due to ice accretion have been prevalent for decades in a number of systems including aircrafts, wind turbines and power lines. Similarly, scale formation is one of the major problems that currently plague a number of industries like oil and gas, power plants and desalination systems. The state-of- the-art techniques are either inefficient or expensive making them infeasible in practical applications. The fundamentals of icing and fouling are similar with nucleation, growth and adhesion regimes controlling both the phenomena. Using the tools of surface engineering, I suggest three approaches in this thesis to address these problems - superhydrophobicity, lubricant-impregnation and active electric fields. While micro-textured superhydrophobic surfaces have been shown to be bad for anti-icing due to the formation of frost between the surface textures, I

demonstrate low ice adhesion on nano-textured superhydrophobic surfaces because of the stability of vapor pockets even under frost forming conditions. On lubricant-impregnated surfaces, I observe low ice adhesion because of the presence of a liquid lubricant and a high density of crack-initiation sites. I investigated the effect of the surface texture and the properties of the impregnating lubricant on ice adhesion. With respect to scale fouling, I also find more than an order of magnitude decrease in the total amount of scale formed on lubricant-impregnated surfaces due to their extreme smoothness and low surface energy. I have developed a regime map based on the properties of the impregnating lubricant to impart scale-resistance to surfaces. I also utilize the benefits of surface engineering together with an active electric field to introduce defects at the interface of ice and the underlying substrate. Based on the polarity of the substrate, hydrogen or oxygen bubbles evolve during water electrolysis, which are trapped on the surface during freezing. By lowering the ice-substrate interfacial contact area, I observe more than 20 times reduction in ice adhesion using this approach. I establish the importance of understanding the effect of surface polarity, applied voltage and the substrate material on ice adhesion. The approaches suggested here could open up new domains for research in the field of anti-icing and anti-fouling. One of the major reasons for composite failure is a breakdown of the bond between the reinforcement fibres and the matrix. When this happens, the composite loses strength and fails. By engineering the interface between the natural fibres and the matrix, the properties of the composite can be manipulated to give maximum performance. Interface engineering of natural fibre composites for maximum performance looks at natural (sustainable) fibre composites and the growing trend towards their use as reinforcements in composites. Part one focuses on processing and surface treatments to engineer the

interface in natural fibre composites and looks in detail at modifying cellulose fibre surfaces in the manufacture of natural fibre composites, interface tuning through matrix modification and preparation of cellulose nanocomposites. It also looks at the characterisation of fibre surface treatments by infrared and raman spectroscopy and the effects of processing and surface treatment on the interfacial adhesion and mechanical properties of natural fibre composites. Testing interfacial properties in natural fibre composites is the topic of part two which discusses the electrochemical characterisation of the interfacial properties of natural fibres, assesses the mechanical and thermochemical properties and moisture uptake behaviour of natural fibres and studies the fatigue and delamination of natural fibre composites before finishing with a look at Raman spectroscopy and x-ray scattering for assessing the interface in natural fibre composites With its distinguished editor and international team of contributors Interface engineering of natural fibre composites for maximum performance is an invaluable resource to composite manufacturers and developers, materials scientists and engineers and anyone involved in designing and formulating composites or in industries that use natural fibre composites. Features the Center for Interfacial Engineering at the University of Minnesota in Minneapolis. The Center conducts cross-disciplinary research on interfaces of technology products. Posts contact information via street address, as well as telephone and fax numbers. Includes news items, a personnel list, and information on education-related activities. describes facilities, textbooks, and other publications. Offers information on current research activities. Volume V is the counterpart of Volume IV and treats hydrophilic colloids and related items. Contains edited contributions on steric stabilization, depletion, polyelectrolytes, proteins at interfaces, association colloids, microemulsions, thin films, foams and emulsions. J.

Lyklema is coauthor of two chapters and general editor. Other authors include: G.J. Fleer, F.A.M. Leermakers, M.A. Cohen Stuart, W. Norde, J.A.G. Buijs, J.C. Eriksson, T.Sottmann, R. Strey, D. Platikanov, D. Ekserova, V.Bergeron and P.Walstra. * This volume completes the prestigious series Fundamentals of Interface and Colloid Science * Together with Volume IV this book provides a comprehensive introduction to colloid science. * Explains and elaborates phenomena starting from basic principles and progresses to more advanced topics In recent decades, electronics, electric vehicles, and grid systems have evolved significantly but require more power and energy storage capacity for batteries as a power supplier. However, current battery technology has reached its physicochemical limit and cannot meet such demands from industry and society. Therefore, much effort has been devoted to developing next-generation rechargeable batteries, including lithium metal batteries, solid-state batteries, and multivalent-ion batteries. Nevertheless, they have not yet reached a practical level because of the severe issues in terms of cost, energy density, and reliability. Interfacial engineering and structural design of inorganic-organic interfaces could be a promising strategy to resolve the major issues of the next-generation rechargeable batteries, including solid-state electrolytes, metal anodes, and multivalent-ion batteries. The next-generation of batteries requires a thorough understanding of electrochemistry and the investigation of active materials and electrolytes. In particular, organic-inorganic interfaces such as electrodes/electrolytes, ceramics/polymers, or solids/liquids are the main research topics as they significantly impact the batteries' electrochemical performance. In this dissertation, detailed studies using electrochemical analysis, spectroscopy, and microscopy will be carried out to investigate the influence of interfacial modification on the electrochemical properties. The strategies involving hybrid

interphase, artificial interphase layer, or manipulated electrolyte will be carried out to address current issues for future battery technology. It is believed that the engineering chemistry and structural design at the organic-inorganic interfaces help to build a high power/energy-dense and superior cyclable next-generation rechargeable battery Hybrid organic-inorganic materials and the rational design of their interfaces open up the access to a wide spectrum of functionalities not achievable with traditional concepts of materials science. This innovative class of materials has a major impact in many application domains such as optics, electronics, mechanics, energy storage and conversion, protective coatings, catalysis, sensing and nanomedicine. The properties of these materials do not only depend on the chemical structure, and the mutual interaction between their nano-scale building blocks, but are also strongly influenced by the interfaces they share. This handbook focuses on the most recent investigations concerning the design, control, and dynamics of hybrid organic-inorganic interfaces, covering: (i) characterization methods of interfaces, (ii) innovative computational approaches and simulation of interaction processes, (iii) in-situ studies of dynamic aspects controlling the formation of these interfaces, and (iv) the role of the interface for process optimization, devices, and applications in such areas as optics, electronics, energy and medicine. Crystallization is ubiquitous in natural and anthropogenic environments; and can be detrimental or beneficial. For example, crystallization from sea-spray deposits is a leading contributor to rusting and fouling of coastal structures. However, crystallization can also be used as a purification technique for producing a variety of important chemicals. In this thesis, control of crystallization at interfaces is explored for improving sustainability across a variety of applications including pattering, anti-fouling, and as a separation process for recovery. Interfacial engineering is a natural starting

point for controlling crystallization due to a propensity of many forms of crystals to form at phase boundaries. Control of crystallization on solid substrates is accomplished by modification of the surface morphology, length scale of surface features, surface chemistry, and surface energy. In this thesis I demonstrate that interfacial engineering can be used to prevent mineral fouling across salts and salt mixture, to develop microparticles which promote recovery of nutrients from waste water, and to design a micro-scale water-soluble crystalline masks with applications for the fabrication of microdevices. Offers an Interdisciplinary approach to the engineering of functional materials for efficient solar cell technology Written by a collection of experts in the field of solar cell technology, this book focuses on the engineering of a variety of functional materials for improving photoanode efficiency of dye-sensitized solar cells (DSSC). The first two chapters describe operation principles of DSSC, charge transfer dynamics, as well as challenges and solutions for improving DSSCs. The remaining chapters focus on interfacial engineering of functional materials at the photoanode surface to create greater output efficiency. Interfacial Engineering in Functional Materials for Dye-Sensitized Solar Cells begins by introducing readers to the history, configuration, components, and working principles of DSSC It then goes on to cover both nanoarchitectures and light scattering materials as photoanode. Function of compact (blocking) layer in the photoanode and of TiCl4 post-treatment in the photoanode are examined at next. Next two chapters look at photoanode function of doped semiconductors and binary semiconductor metal oxides. Other chapters consider nanocomposites, namely, plasmonic nanocomposites, carbon nanotube based nanocomposites, graphene based nanocomposites, and graphite carbon nitride based nanocompositesas photoanodes. The book: Provides comprehensive coverage of the fundamentals through the

applications of DSSC Encompasses topics on various functional materials for DSSC technology Focuses on the novel design and application of materials in DSSC, to develop more efficient renewable energy sources Is useful for material scientists, engineers, physicists, and chemists interested in functional materials for the design of efficient solar cells Interfacial Engineering in Functional Materials for Dye-Sensitized Solar Cells will be of great benefit to graduate students, researchers and engineers, who work in the multi-disciplinary areas of material science, engineering, physics, and chemistry. The surface characterizations of engineering materials effects their scratch/abrasion/Mar resistance, coating adhesion/strength, and abrasive wear mechanism. Scratching of Materials and Applications has chapters devoted to direct industrial application and contains some of the important works that are being conducted. Scratch testing of materials has grown extensively since the earlier days of the Mohs Scale for ranking minerals according to their relative scratch resistance. This test has been used on metals, ceramics, glasses, polymers and coatings of various types and thicknesses. The chapters are grouped according to the type of the engineering materials used. The beginning chapters relate mostly to bulk polymers, which are followed by different types of coatings (hard wear resistant to the diamond-like carbon coatings) and finally, chapters on the application of scratching technique to metals and ceramics are included at the end of the book. Thus, the book covers a fairly wide spectrum of engineering materials which are useful to engineers and researchers. * Balances theoretical science with practical application * Demonstrates real-life applications within industry * Written experts in the fields of materials, tribology and surface mechanics Providing in-depth coverage of the technologies and various approaches, Luminous Chemical Vapor Deposition and

Interface Engineering showcases the development and utilization of LCVD procedures in industrial scale applications. It offers a wide range of examples, case studies, and recommendations for clear understanding of this innovative science. The book comprises four parts. Part 1 describes the fundamental difference between glow discharge of an inert gas and that of an organic vapor, from which the concepts of Luminous Gas Phase derive. Part 2 explores the various ways of practicing Luminous Vapor Disposition and Treatment depending on the type and nature of substrates. Part 3 covers some very important aspects of surface and interface that could not have been seen clearly without results obtained by application of LCVD. Part 4 offers some examples of interface engineering that show very unique aspects of LCVD interface engineering in composite materials, biomaterial surface and corrosion protection by the environmentally benign process. Timely and up-to-date, the book provides broad coverage of the complex relationships involved in the interface between a gas/solid, liquid/solid, and a solid/solid. The author presents a new perspective on low-pressure plasma and describes key aspects of the surface and interface that could not be shown without the results obtained by LCVD technologies. Features Provides broad coverage of complex relationships involved in interface between a gas/solid, a liquid/solid, and a solid/solid Addresses the importance of the initial step of creating electrical glow discharge Describes the principles of creating chemically reactive species and their growth in the luminous gas phase Focuses on the nature of surface-state of solid and on the creation of imperturbable surface-state by the contacting phase or environment, which is vitally important in creating biocompatible surface, providing super corrosion protection of metals by environmentally benign processes, etc. Offers examples on how to use LCVD in the interface engineering process Presents a new view on low-

pressure (low-temperature) plasma and emphasizes the importance of luminous gas phase and chemical reactions that occur in the phase About the author: Dr. Yasuda is one of the pioneers who explored low-pressure plasma for surface modification of materials and deposition of nano films as barrier and perm-selective membranes in the late 1960s. He obtained his PhD in physical and polymer chemistry working on transport properties of gases and vapors in polymers at State University of New York, College of Environmental Science and Forestry at Syracuse, NY. He has over 300 publications in refereed journals and books, and is currently a Professor Emeritus of Chemical Engineering, and Director, Center for Surface Science & Plasma Technology, University of Missouri-Columbia, and is actively engaged in research on the subjects covered by this book. Interfacial Science: An Introduction is an accessible text introducing readers to the chemistry of interfaces, a subject of increasing relevance and popularity due to the emergence of nanoscience. "Fundamentals of Interfacial Engineering" provides chemical, electronic, mechanical, and biomedical engineers with a coherent, integrated introduction to the fundamental concepts that relate to interfacial phenomena with applications to different processes and product situations. This book emphasizes the importance of intermolecular forces in holding materials together within a bulk phase or across an interface. It outlines the fundamental intermolecular interactions that occur in all interfacial systems. The work also describes the properties, processing, and behavior of fluid interfacial systems and treats solid surfaces and interfaces. In addition to being of direct industrial relevance, this book will provide engineering instructors with an excellent starting point for planning curriculum development in this important area. An introduction to the fundamental concepts and rules in bioelectrochemistry and explores latest advancements in the field

Bioelectrochemical Interface Engineering offers a guide to this burgeoning interdisciplinary field. The authors—noted experts on the topic—present a detailed explanation of the field's basic concepts, provide a fundamental understanding of the principle of electrocatalysis, electrochemical activity of the electroactive microorganisms, and mechanisms of electron transfer at electrode-electrolyte interfaces. They also explore the design and development of bioelectrochemical systems. The authors review recent advances in the field including: the development of new bioelectrochemical configurations, new electrode materials, electrode functionalization strategies, and extremophilic electroactive microorganisms. These current developments hold the promise of powering the systems in remote locations such as deep sea and extra-terrestrial space as well as powering implantable energy devices and controlled drug delivery. This important book: • Explores the fundamental concepts and rules in bioelectrochemistry and details the latest advancements • Presents principles of electrocatalysis, electroactive microorganisms, types and mechanisms of electron transfer at electrode-electrolyte interfaces, electron transfer kinetics in bioelectrocatalysis, and more • Covers microbial electrochemical systems and discusses bioelectrosynthesis and biosensors, and bioelectrochemical wastewater treatment • Reviews microbial biosensor, microfluidic and lab-on-chip devices, flexible electronics, and paper and stretchable electrodes Written for researchers, technicians, and students in chemistry, biology, energy and environmental science, Bioelectrochemical Interface Engineering provides a strong foundation to this advanced field by presenting the core concepts, basic principles, and newest advances. Materials and Processes for Surface and Interface Engineering, which has been written by experts in the fields of deposition technology and surface modification techniques, offers

up to date tutorial papers on the latest advances in surface and interface engineering. The emphasis is on fundamental aspects, principles and applications of plasma and ion beam processing technology. A handbook for the engineer and scientist as well as an introduction for students in several branches of materials science and surface engineering. This book focuses on the structure-property relationship of interfaces in materials. Rather than concentrating on a specific class of materials, it brings together a diverse group of researchers with varied interests to seek a common foundation on which to build future efforts in interfacial engineering. Both experimental and simulation contributions address the details of how interface character and the interfacial network topology in polycrystals influence mechanical properties like yield, ductility, creep and cracking resistance, as well as electronic or magnetic properties like superconductivity or ferroaelectricity. A number of contributions deal specifically with the need for more detailed understanding of the structure of individual interfaces, the statistical distribution of their character, and their connectivity in a polycrystalline structure. Topics include: the role of interfaces and deformation and fracture; chemical and environmental effects; surfaces, thin films and functional materials; structure and migration of interfaces; and interface structure, networks and correlations. Material-Tissue Interfacial Phenomena: Contributions from Dental and Craniofacial Reconstructions explores the material/tissue interfacial phenomena using dental and craniofacial reconstructions as a model system. As the mouth is a particularly caustic environment, the synthetic and/or bio-enabled materials used to repair damaged tissues and restore form, function, and esthetics to oral structures must resist a variety of physical, chemical, and mechanical challenges. These challenges are magnified at the interface between dissimilar structures such as the tooth/material interface.

Interfacial reactions at the atomic, molecular, and nano-scales initiate the failure of materials used to repair, restore, and reconstruct dental and craniofacial tissues. Understanding the phenomena that lead to failure at the interface between dissimilar structures, such as synthetic materials and biologic tissues, is confounded by a variety of factors that are thoroughly discussed in this comprehensive book. Provides a specific focus on the oral environment Combines clinical views and basic science into a useful reference book Presents comprehensive coverage of material-interfacial phenomena within the oral environment Offers an Interdisciplinary approach to the engineering of functional materials for efficient solar cell technology Written by a collection of experts in the field of solar cell technology, this book focuses on the engineering of a variety of functional materials for improving photoanode efficiency of dye-sensitized solar cells (DSSC). The first two chapters describe operation principles of DSSC, charge transfer dynamics, as well as challenges and solutions for improving DSSCs. The remaining chapters focus on interfacial engineering of functional materials at the photoanode surface to create greater output efficiency. Interfacial Engineering in Functional Materials for Dye-Sensitized Solar Cells begins by introducing readers to the history, configuration, components, and working principles of DSSC It then goes on to cover both nanoarchitectures and light scattering materials as photoanode. Function of compact (blocking) layer in the photoanode and of TiCl4 post-treatment in the photoanode are examined at next. Next two chapters look at photoanode function of doped semiconductors and binary semiconductor metal oxides. Other chapters consider nanocomposites, namely, plasmonic nanocomposites, carbon nanotube based nanocomposites, graphene based nanocomposites, and graphite carbon nitride based nanocompositesas photoanodes. The book: Provides

comprehensive coverage of the fundamentals through the applications of DSSC Encompasses topics on various functional materials for DSSC technology Focuses on the novel design and application of materials in DSSC, to develop more efficient renewable energy sources Is useful for material scientists, engineers, physicists, and chemists interested in functional materials for the design of efficient solar cells Interfacial Engineering in Functional Materials for Dye-Sensitized Solar Cells will be of great benefit to graduate students, researchers and engineers, who work in the multi-disciplinary areas of material science, engineering, physics, and chemistry. Nanostructures for Cancer Therapy discusses the available preclinical and clinical nanoparticle technology platforms and their impact on cancer therapy, including current trends and developments in the use of nanostructured materials in chemotherapy and chemotherapeutics. In particular, coverage is given to the applications of gold nanoparticles and quantum dots in cancer therapies. In addition to the multifunctional nanomaterials involved in the treatment of cancer, other topics covered include nanocomposites that can target tumoral cells and the release of antitumoral therapeutic agents. The book is an up-to-date overview that covers the inorganic and organic nanostructures involved in the diagnostics and treatment of cancer. Provides an examination of nanoparticle delivery systems for cancer treatment, illustrating how the use of nanotechnology can help provide more effective chemotherapeutic treatments Examines, in detail, the different types of nanomaterials used in cancer therapy, also explaining the effect of each Provides a cogent overview of recent developments in the use of nanostructured materials in chemotherapeutics, allowing readers to quickly familiarize themselves with this area This volume introduces the fundamental concepts related to interfacial phenomena, with applications to different processes and product

situations. The emphasis is on the importance of intermolecular forces in holding materials together within a bulk phase or across an interface. The fundamental intermolecular interactions occurring in all interfacial systems are outlined, and the properties, processing, and behaviour of fluid interfacial systems are described. This text should provide engineering instructors with a starting point for planning curriculum development in this area. Electrochemical phenomena can be broadly defined as any process that involves transfer of electrons, concurrently with a measurable and quantifiable chemical change. Interfacial engineering, on the other hand, can be defined as the altering of surface chemistry and texture across various length scales to impact electro-chemo-mechanical interactions between two or more surfaces. In this thesis, the role of interfacial engineering in impacting two specific electrochemical phenomena has been studied: corrosion and electrochemical reduction of CO 2 In the first part of this thesis, lubricant-impregnated surfaces (LISs) consisting of thin films of lubricant held stably in micro-textures by means of capillary forces have been systematically designed and studied for reducing corrosion. Corrosion is a detrimental process that can impact the performance and lifetime of many infrastructural systems and structures. In this work, we fabricate microposts on silicon using photolithography, varying inter-post spacing systematically from 5 pm to 50 pm, and conformally sputter coat a thin layer of iron to study the corrosion phenomena electrochemically in an aqueous 3.5 wt% sodium chloride solution, and we show that the corrosion rate on LIS is drastically reduced by three orders of magnitude. Using electrochemical impedance spectroscopy, we develop model circuits for various LIS configurations and show that the measured resistances and capacitances agree with a theoretical model, and discuss in detail where deviations may occur. Similarly, we study the role of

lubricant layers towards reducing hydrogen embrittlement. Using a Devanathan-Stachurski electrochemical permeation cell we show that under accelerated conditions, the effective diffusion coefficient of hydrogen on steel is reduced by an order of magnitude using LIS. Furthermore, we apply LIS to heal zirconia coatings on steel. Zirconia, that grows natively on zirconium alloys used as cladding for fuel in nuclear reactors, is known to serve as a hydrogen barrier but the presence of grain boundaries or macroscopic surface defects can provide pathways for hydrogen entry. We show that LIS improves the effective diffusion coefficient of a defective zirconia film on steel by an order of magnitude. Finally, we develop aerophilic surfaces to trap CO2 bubbles in close proximity to a CO2 electro-reduction catalyst. Electrochemical reduction of CO2 (CO2RR) to valuable fuels is a promising approach towards reducing the ever-growing atmospheric CO2 levels, and efficient delivery and replenishment of CO2 remains a fundamental challenge that can impact CO 2RR current density and product distribution. When CO2 bubbles are trapped near the catalyst in a plastron layer, the local co 2 concentration available to the catalyst is enhanced and maintained, thereby increasing the magnitude of current density associated with CO2 reduction by close to two times as compared to the conventional CO2 heads pace mode of delivery. We confirm the enhancement in local CO2 concentration using sensitive pH probes as well as colorimetric techniques. Furthermore, we find that hydrogen co-evolution is suppressed from 33% in the heads pace case to 13% with the plastron at -1.1 V vs RHE. We demonstrate that the increase in the CO2RR current density can be scaled up to an array of copper catalysts that possess a higher surface area, while maintaining current density and CO2 concentration close to the catalyst for over an hour. We also demonstrate that CO2RR performance can be enhanced on a porous, nano-structured catalyst using these

plastron layers. Since the publication of the first edition of Interfacial Phenomena, the interest in interfaces and surfactants has multiplied, along with their applications. Experimental and theoretical advances have provided scientists with greater insight into the structure, properties, and behavior of surfactant and colloid systems. Emphasizing equilibrium phenomena, flow, transport, and stability, Interfacial Phenomena: Equilibrium and Dynamic Effects, Second Edition presents a concise and current summary of the fundamental principles governing interfacial interactions. This new edition features updated and expanded topics in every chapter. It highlights key experimental techniques that have expanded the scope of our understanding, such as in mass transfer, microstructure determination in colloidal dispersions, and surfactant–polymer interactions. Interfacial Phenomena, Second Edition reflects the progress scientists have made in understanding the surface chemistry and interfacial dynamics of colloid and surfactant systems. The book also illustrates the growing applicability of these systems in a variety of fields including pharmaceuticals, cosmetics, detergents, paints, agricultural chemicals, and foods. Offers an Interdisciplinary approach to the engineering of functional materials for efficient solar cell technology Written by a collection of experts in the field of solar cell technology, this book focuses on the engineering of a variety of functional materials for improving photoanode efficiency of dye-sensitized solar cells (DSSC). The first two chapters describe operation principles of DSSC, charge transfer dynamics, as well as challenges and solutions for improving DSSCs. The remaining chapters focus on interfacial engineering of functional materials at the photoanode surface to create greater output efficiency. Interfacial Engineering in Functional Materials for Dye-Sensitized Solar Cells begins by introducing readers to the history, configuration, components, and working principles of DSSC It then

goes on to cover both nanoarchitectures and light scattering materials as photoanode. Function of compact (blocking) layer in the photoanode and of TiCl4 post-treatment in the photoanode are examined at next. Next two chapters look at photoanode function of doped semiconductors and binary semiconductor metal oxides. Other chapters consider nanocomposites, namely, plasmonic nanocomposites, carbon nanotube based nanocomposites, graphene based nanocomposites, and graphite carbon nitride based nanocompositesas photoanodes. The book: Provides comprehensive coverage of the fundamentals through the applications of DSSC Encompasses topics on various functional materials for DSSC technology Focuses on the novel design and application of materials in DSSC, to develop more efficient renewable energy sources Is useful for material scientists, engineers, physicists, and chemists interested in functional materials for the design of efficient solar cells Interfacial Engineering in Functional Materials for Dye-Sensitized Solar Cells will be of great benefit to graduate students, researchers and engineers, who work in the multi-disciplinary areas of material science, engineering, physics, and chemistry. Practical applications and examples highlight this treatment of computational modeling for handling complex flowfields. It also functions as a text for learning essential computation elements. 1994 edition. Since the micrometer-sized bulk materials have reached their inherent limits, development of new materials with high performance is essential for low cost and environmentally friendly electrochemical energy storage and conversion devices. One approach is to take advantage of interfacial engineering in order to modify currently developed materials, thus improving their properties for specific applications. The advantage of interfacial engineering is that it can also be applied to newly developed materials to further improve their properties for the specific

applications. In first part of this dissertation, a systematic study is performed to investigate the effect of annealing in reducing atmospheres with different oxygen partial pressures and presence of other species (Ar, H2, N2, vacuum or hydrocarbon) on visible-light photocatalytic activity of TiO2. In second part, a facile nitridation method is used to improve the rate capability of TiO2 as anode material for Li ion batteries. The enhanced high-rate capacities are attributed to moderate surface nitridation with less-disordered nitridated regions, which may enhance the surface electronic conductivity without forming discrete, nanoscale, and surface amorphous films to block the lithium transport. In third part, pseudocapacitive properties of V2O5-based adsorbates supported on TiO2 nanoparticles is systematically measured. Surface amorphous films (SAFs), which form naturally at thermodynamic equilibria at 550-600 °C with self-regulating or "equilibrium" thicknesses on the order of 1 nm, exhibit superior electrochemical performance at moderate and high scan rates (20-500 mV/s) that are of prime importance for supercapacitor applications, as compared with submonolayer and monolayer adsorbates formed at lower equilibration temperatures. In fourth part, we perform a combined experimental and computational investigation into the effects of aliovalent doping in NASICON on both bulk and grain boundary ionic conductivity. Our results show that the dopants with low solid solubility limits in NASICON solid solution lead to the formation of a conducting secondary phase at grain boundaries, thereby improving effective grain boundary conductivity that is otherwise hindered by the poorly-conducting Na3PO4 and ZrO2 secondary phases in undoped NASICON. In fifth part, inline electron holography technique is used to directly observe and investigate the space charge layers at grain boundaries of Y-doped BaZrO3. Interfaces control the properties of many technologically important materials. For many years, however,

alloys have primarily been designed with the focus on optimizing bulk properties. Recently, much more attention has been paid to designing interfaces to improve the performance of materials. This idea has been central in the development of nanoscale devices in the electronics industry, but now these concepts have also been applied to both grain boundaries and phase boundaries in structural materials. There has been a breakthrough in the area of advanced experimental tools, such as the analysis of electron backscattering patterns and in the improved simulation capabilities of interfaces in complex engineering alloys. Third has been the recognition that failures often are associated with interfaces and that materials can be processed to improve the properties. This book, first published in 2000, concentrates on the preparation and processing of interfaces, the relationships between chemistry and structure and the properties and behavior of interfaces, particularly in relation to strength and bonding. An introduction to the fundamental concepts and rules in bioelectrochemistry and explores latest advancements in the field Bioelectrochemical Interface Engineering offers a guide to this burgeoning interdisciplinary field. The authors—noted experts on the topic—present a detailed explanation of the field’s basic concepts, provide a fundamental understanding of the principle of electrocatalysis, electrochemical activity of the electroactive microorganisms, and mechanisms of electron transfer at electrode-electrolyte interfaces. They also explore the design and development of bioelectrochemical systems. The authors review recent advances in the field including: the development of new bioelectrochemical configurations, new electrode materials, electrode functionalization strategies, and extremophilic electroactive microorganisms. These current developments hold the promise of powering the systems in remote locations such as deep sea and extra-terrestrial space as well as powering

implantable energy devices and controlled drug delivery. This important book: • Explores the fundamental concepts and rules in bioelectrochemistry and details the latest advancements • Presents principles of electrocatalysis, electroactive microorganisms, types and mechanisms of electron transfer at electrode-electrolyte interfaces, electron transfer kinetics in bioelectrocatalysis, and more • Covers microbial electrochemical systems and discusses bioelectrosynthesis and biosensors, and bioelectrochemical wastewater treatment • Reviews microbial biosensor, microfluidic and lab-on-chip devices, flexible electronics, and paper and stretchable electrodes Written for researchers, technicians, and students in chemistry, biology, energy and environmental science, Bioelectrochemical Interface Engineering provides a strong foundation to this advanced field by presenting the core concepts, basic principles, and newest advances. Understanding the characteristics of material contact and lubrication at tribological interfaces is of great importance to engineering researchers and machine designers. Traditionally, contact and lubrication are separately studied due to technical difficulties, although they often coexist in reality and they are actually on the same physical ground. Fast research advancements in recent years have enabled the development and application of unified models and numerical approaches to simulate contact and lubrication, merging their studies into the domain of Interfacial Mechanics. This book provides updated information based on recent research progresses in related areas, which includes new concepts, theories, methods, and results for contact and lubrication problems involving elastic or inelastic materials, homogeneous or inhomogeneous contacting bodies, using stochastic or deterministic models for dealing with rough surfaces. It also contains unified models and numerical methods for mixed lubrication studies, analyses of interfacial frictional and

thermal behaviors, as well as theories for studying the effects of multiple fields on interfacial characteristics. The book intends to reflect the recent trends of research by focusing on numerical simulation and problem solving techniques for practical interfaces of engineered surfaces and materials. This book is written primarily for graduate and senior undergraduate students, engineers, and researchers in the fields of tribology, lubrication, surface engineering, materials science and engineering, and mechanical engineering.

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