

Handbook of Polymer Applications in Medicine and Medical Devices

Edited by
Kayvon Modjarrad
Sina Ebnesajjad



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N Colangelo



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Handbook of Polymer Applications in Medicine and Medical Devices Sina Ebnesajjad, 2013-12-05 This chapter focuses on adhesives used in direct physiological contact in dental and medical procedures Activity in both areas has been quite extensive outside the United States for decades In contrast adhesive use in medical devices patches and plasters has been ongoing in the United States for a long time In the case of medical devices adhesion is concerned with the joining of materials such as plastics elastomers textiles metals and ceramics which are examined in other chapters of the present volume and are covered in various references 1 6 The coverage of this chapter is devoted to applications where adhesives are in direct contact with tissues and other live organs

Handbook of Polymer Applications in Medicine and Medical Devices Len Czuba, 2013-12-05 This chapter will present a look at the medical device market with a particular focus on the materials of construction of devices and what we can expect in new products looking ahead A deeper look at some other trends that have an effect on the direction of the medical device industry will be done Finally consideration will be given to a number of global factors that can have dramatic effects on our industry

Handbook of Polymer Applications in Medicine and Medical Devices Kayvon Modjarrad, Sina Ebnesajjad, 2013-12-05 While the prevalence of plastics and elastomers in medical devices is now quite well known there is less information available covering the use of medical devices and the applications of polymers beyond medical devices such as in hydrogels biopolymers and silicones beyond enhancement applications and few books in which these are combined into a single reference This book is a comprehensive reference source bringing together a number of key medical polymer topics in one place for a broad audience of engineers and scientists especially those currently developing new medical devices or seeking more information about current and future applications In addition to a broad range of applications the book also covers clinical outcomes and complications arising from the use of the polymers in the body giving engineers a vital insight into the real world implications of the devices they re creating Regulatory issues are also covered in detail The book also presents the latest developments on the use of polymers in medicine and development of nano scale devices Gathers discussions of a large number of applications of polymers in medicine in one place Provides an insight into both the legal and clinical implications of device design Relevant to industry academic and medical professionals Presents the latest developments in the field including medical devices on a nano scale

Handbook of Polymer Applications in Medicine and Medical Devices Vinny R. Sastri, 2013-12-05 Over the past 2000 years many devices have been developed and used in the mitigation and diagnosis of diseases The materials used in these devices have ranged from stone wood metal ceramics and most recently plastics Medical devices have also evolved in sophistication and complexity over time With the formalization of the scientific method in the seventeenth century such devices became more prevalent 1 Many medical devices were manufactured by doctors or small companies and sold directly to the public with no government standards or oversight With the explosion of medical technology in the early twentieth

century several intermediaries had evolved between the medical device industry and the public In 1879 Dr E R Squibb in an address to the Medical Society of the State of New York proposed the enactment of a national statute to regulate food and drugs 2 It was not until 27 years later that the Food and Drug Act of 1906 was introduced into the Congress and signed into law by President Theodore Roosevelt 3 At that time devices that were harmful to human safety and health proliferated the market but regulation of medical devices by the Bureau of Chemistry the precursor to the Food and Drug Administration FDA was limited to challenging commercial products only after they had been released into the market Devices in the marketplace that were defective adulterated or misbranded were seized and the device manufacturers were prosecuted in a court of law but only after the products were sold in the market and caused harm to the end users Thus there was a strong need for regulating the devices before they entered the marketplace An FDA report 4 issued in September 1970 detailed as many as 10 000 injuries and 731 deaths from ineffective medical devices The report recommended the formation of a regulatory system and body that would enforce the production and sale of safe and effective devices to the public All medical devices already on the market would be inventoried and classified into a three tiered system based on their criticality of end use It also detailed requirements for records and reports registration and inspection of establishments and uniform quality assurance programs called good manufacturing practices GMP After much lobbying by the FDA Senate bill SR 510 The Medical Device Amendments of 1973 was introduced by Senator Edward M Kennedy and was passed by the Senate in 1975 House bill HR 11124 introduced by Representative Paul Rogers was passed by the House in 1976 These bills eventually became the Medical Device Amendments of 1976 and were signed into law by President Nixon The Medical Device Amendments of 1976 became the basis for the medical device regulation in the United States to control and regulate the production of finished devices and thus the device manufacturers themselves

Handbook of Polymer Applications in Medicine and Medical Devices Laurence W. McKeen, 2013-12-05 Medical devices range from simple devices to test equipment to implants Plastics are used more and more in these devices for weight cost and performance purposes Examples of medical devices include surgical instruments catheters coronary stents pacemakers magnetic resonance imaging MRI machines X ray machines prosthetic limbs artificial hips knees surgical gloves and bandages

Handbook of Polymer Applications in Medicine and Medical Devices Zheng Zhang, Ophir Ortiz, Ritu Goyal, Joachim Kohn, 2013-12-05 The design and development of tissue engineered products has benefited from many years of clinical utilization of a wide range of biodegradable polymers Newly developed biodegradable polymers and modifications of previously developed biodegradable polymers have enhanced the tools available for creating clinically important tissue engineering applications Insights gained from studies of cell matrix interactions cell cell signaling and organization of cellular components are placing increased demands on medical implants to interact with the patient's tissue in a more biologically appropriate fashion Whereas in the twentieth century biocompatibility was largely equated with eliciting no harmful response the biomaterials of the twenty first

century will have to elicit tissue responses that support healing or regeneration of the patient's own tissue. This chapter surveys the universe of those biodegradable polymers that may be useful in the development of medical implants and tissue engineered products. Here we distinguish between biologically derived polymers and synthetic polymers. The materials are described in terms of their chemical composition, breakdown products, mechanism of breakdown, mechanical properties, and clinical limitations. Also discussed are product design considerations in processing of biomaterials into a final form, e.g., gel membrane matrix that will effect the desired tissue response.

Handbook of Polymer Applications in Medicine and Medical Devices Justin M. Saul, David F. Williams, 2013-12-05 Hydrogels are crosslinked polymeric networks containing hydrophilic groups that promote swelling due to interaction with water. 1 While hydrogels are heavily used in the field of regenerative medicine, their application to biomedical systems is not new. In fact, it has been suggested that they were truly the first polymer materials to be developed for use in man. 2 They have been in use for clinical applications since the 1960s, initially for use in ocular applications including contact lenses and intraocular lenses due to their favorable oxygen permeability and lack of irritation leading to inflammation and foreign body response, which was observed with other plastics. 3 Before the concept of tissue engineering and regenerative medicine had gained traction, hydrogels were used for cell encapsulation. 4 They have also been utilized extensively in the clinic for wound healing applications due to their oxygen permeability, high water content, and ability to shield wounds from external agents. Perhaps the largest research focus and utility of hydrogels has been found in their use as controlled release systems. This combination of controlled release and cell encapsulation has led to increasing uses of hydrogels in regenerative medicine applications.

Handbook of Polymer Applications in Medicine and Medical Devices Steven M. Kurtz, 2013-12-05 The orthopedic and biomaterials literature of the 1990s reflects an early academic curiosity in implant applications of polyaryletherketone (PAEK) biomaterials. 1, 2 However, widespread commercial applications for PAEK biomaterials in the human body were first realized with cage implants intended to promote intervertebral body interbody fusion of the lumbar spine. Success of PAEK with interbody implants would later inspire applications in a broad variety of spinal implant applications including posterior fusion, dynamic stabilization, and disc arthroplasty.

Handbook of Polymer Applications in Medicine and Medical Devices Zbigniew Nawrat, 2013-12-05 An explosion in multidisciplinary research combining mechanical, chemical, and electrical engineering with physiology and medicine during the 1960s created huge advances in modern health care. In cardiovascular therapy, lifesaving implantable defibrillators, ventricular assist devices, catheter-based ablation devices, vascular stent technology, and cell and tissue engineering technologies have been introduced. The latest and leading technology presents robots intended to keep the surgeon in the most comfortable, dexterous, and ergonomic position during the entire procedure. The branch of the medical and rehabilitation robotics includes the manipulators and robots providing surgery, therapy, prosthetics, and rehabilitation. This chapter provides an overview of research in cardiac surgery devices.

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and Medical Devices Paul Stoodley, Luanne Hall-Stoodley, Bill Costerton, Patrick DeMeo, Mark Shirtliff, Ellen Gawalt, Sandeep Kathju, 2013-12-05 The initial design criteria in the choice of indwelling materials for medical and dental purposes may be pragmatic and based on the necessary mechanical properties required to fashion a functional device Orthopedic implants require strong materials for weight bearing and articulating surfaces such as joints require durability and resistance to wear Stents and shunts require flexibility and patency and sutures require a high tensile strength yet also must be flexible enough for intricate manipulation As the devices became more sophisticated and developments in materials science provided more options for manufacture implants are being used more frequently and with longer anticipated lifetimes Concurrently the design process increasingly incorporated biocompatibility and comfort into the design criteria However with longer lifetimes the more frequent use of invasive surgical procedures involving indwelling devices and biologically friendly materials there has been a rise in the number of incidences of device related infection Urinary catheters have been estimated to account for 30% of all nosocomial infections 1 Between 66 and 88% of these occur after urinary catheterization 2 It is also reported that almost 100% of catheterized patients develop an infection in an openly draining indwelling catheter which has been in place for four days or more 2 For some procedures such as orthopedic joint arthroplasties the diagnosed surgical site infection rates are relatively low between 1% and 2% 3 however the increasing number of patients undergoing joint replacement surgery translates to large numbers of patients afflicted with the consequences of complicating infections per year Furthermore infection of artificial joints can be devastating since oral or IV antibiotic therapy frequently fails to resolve the infection with the only remaining course of action being surgical debridement or partial or total revision These two examples the first with very high numbers of patients but of lesser severity in terms of impact to the individual and the second low numbers but severe patient impact reflect the incentive to pursue a third design criteria that of infection resistance into materials and devices 4 In the following sections we will discuss the role of bacterial biofilms in infection and the growing literature highlighting biofilms as an important cause of device related infection

Handbook of Polymer Applications in Medicine and Medical Devices André Colas, Jim Curtis, 2013-12-05 Silicone materials have been widely used in medicine for over 60 years Available in a variety of material types they have unique chemical and physical properties that manifest in excellent biocompatibility and biodurability for many applications Silicone elastomers have remarkably low glass transition temperatures and maintain their flexibility over a wide temperature range enabling them to withstand conditions from cold storage to steam autoclaving They have high permeability to gases and many drugs advantageous respectively in wound care or in transdermal drug delivery They have low surface tension and remarkable chemical stability enabling biocompatibility and biodurability in many long term implant applications Handbook of Polymer Applications in Medicine and Medical Devices Wei He, Roberto Benson, 2013-12-05 Biomaterials are an indispensable element in improving human health and quality of life Applications of biomaterials include diagnostics gene arrays and biosensors medical supplies blood bags and

surgical tools therapeutic treatments medical implants and devices and emerging regenerative medicine tissue engineered skin and cartilage Polymers being organic offer a versatility that is unmatched by metals and ceramics The wide spectrum of physical mechanical and chemical properties provided by polymers has fueled the extensive research development and applications of polymeric biomaterials The significance of polymers as biomaterials is reflected in the market size of medical polymers estimated to be approximately 1 billion Many of these polymers were initially developed as plastics elastomers and fibers for nonmedical industrial applications but were later developed as biomedical specific materials With rapid growth in modern biology and interdisciplinary collaborative efforts polymeric biomaterials are being fashioned into bioactive and biomimetic materials with excellent biocompatibility

Handbook of Polymer Applications in Medicine and Medical Devices Sana S. Dastgheyb, John R. Eisenbrey, 2013-12-05 Microbubbles are small **Handbook of Polymer Applications in Medicine and Medical Devices** Thomas C. Mort, Jeffrey P. Keck, 2013-12-05 The earliest recorded use of airway

manipulation with an artificial device dates back to early Roman civilization when Asclepiades performed a tracheostomy for laryngeal edema Today it is clear that the role of the endotracheal tube ETT in medicine is as invaluable as that of any other medical device created to date The establishment of a definitive airway via the ETT in both elective and emergency situations has allowed for the delivery of immediate life sustaining therapies during resuscitation the maintenance of oxygenation and ventilation in prolonged illness and the temporary delivery of inhaled anesthesia 1 This chapter begins with a brief history of the development of the ETT It describes the various ETTs available along with their indications for use and respective limitations It reviews basic airway anatomy with regard to ETT placement proper positioning and stabilization of the ETT and complications attributed to its use Finally it addresses respiratory care of the intubated and mechanically ventilated patient

Handbook of Polymer Applications in Medicine and Medical Devices Kayvon Modjarrad, 2013-12-05 The history of plastics and medical devices traces a complex course of slowly evolving ideas punctuated by moments of intellectual revolution When viewed from the vantage of retrospect it becomes apparent that milestones in the progress of biomaterial science represent culminations of gradual shifts in theory and iterative experimentation This has been as true for methodological developments in polymer chemistry as it has for technological breakthroughs in medical equipment design The two disciplines though now inextricable from one another initially advanced along largely separate and occasionally redundant paths Until the latter decades of the twentieth century physicians and surgeons modified existing materials to create and refine devices according to their clinical needs while chemists and engineers synthesized materials de novo without specific attention to their potential medical applications In the modern era however the lines between the chemical and biological sciences have blurred paving way for an interdisciplinary approach toward the design and application of medical plastics

The Essential Handbook of Polymer Terms and Attributes Munmaya K Mishra, Biao Duan, 2024-07-30 The Essential Handbook of Polymer Terms and Attributes not only acts as an encyclopaedia of polymer

science but also fosters an appreciation for the significance of polymers in fields including materials science chemistry engineering and medicine This book serves as an excellent reference book covering every possible term and attribution associated with the vast and diverse field of polymers This comprehensive volume serves as a vital resource for researchers working in industry and academia offering a clear and concise exploration of polymer science with the most essential reference data available Each polymer term is defined in a straightforward manner ensuring that readers of all levels can grasp the concepts The book goes beyond mere definitions providing context and insights into the applications properties and synthesis Bringing polymer terms and attributes together in one place the book provides a broad knowledge of polymer science and facilitates idea generation for researchers and students embarking on projects related to a specific field of polymer science Key features This book covers all possible terms associated with the field of polymers and related areas granting readers a comprehensive understanding of the entire spectrum of polymers The organization of the book follows an alphabetical format enabling quick and convenient access to specific terms Each polymer term is clearly defined with a figure or scheme as needed allowing readers to visualize the structures processes and applications involved This book is written for science students chemists polymer scientists chemical engineers pharmaceutical scientists biomedical scientists biotechnologists product formulators materials scientists and scientists working on polymers

Green Sustainable Process for Chemical and Environmental Engineering and Science Tariq Altalhi, Inamuddin, 2022-06-28 Green Sustainable Process for Chemical and Environmental Engineering and Science the latest release in the Green Composites Preparation Properties and Allied Applications series deals with the most promising aspects of green composites The book presents in depth and updated literature related to the manufacturing of green composites and their properties and discusses special features of green composites and their applications in daily life All green composites covered in this work are polymeric and of bio origin The book also provides industrial applications of green composites Topics covered include the use of green composites vegetable packing foam blends rubber solar cells adhesives and 3D printing Focuses on the manufacturing of green composites Features green composites of bio origin Covers versatile applications of green composites in daily life Discusses various applications of green composites in industry Provides an overview of green composites for the packing industry Outlines the use of green composites as foam blends and adhesives

UHMWPE Biomaterials Handbook Steven M. Kurtz, 2015-09-16 UHMWPE Biomaterials Handbook Third Edition describes the science development properties and application of ultra high molecular weight polyethylene UHMWPE used in artificial joints UHMWPE is now the material of choice for joint replacements and is increasingly being used in fibers for sutures This book is a one stop reference for information on this advanced material covering both introductory topics and the most advanced developments The third edition adds six new chapters on a range of topics including the latest in anti oxidant technologies for stabilizing HXLPE and up to date systematic reviews of the clinical literature for HXLPE in hips and knees The book

chronicles the rise and fall of all metal hip implants as well as the increased use of ceramic biomaterials and UHMWPE for this application This book also brings orthopedic researchers and practitioners up to date on the stabilization of UHMWPE with antioxidants as well as the choices of antioxidant available for practitioners The book also thoroughly assesses the clinical performance of HXLPE as well as alternative bearings in knee replacement and UHMWPE articulations with polyether ether ketone PEEK Written and edited by the top experts in the field of UHMWPE this is the only state of the art reference for professionals researchers and clinicians working with this material The only complete reference for professionals researchers and clinicians working with ultra high molecular weight polyethylene biomaterials technologies for joint replacement and implants New edition includes six new chapters on a wide range of topics including the clinical performance of highly crosslinked polyethylene HXLPE in hip and knee replacement an overview of antioxidant stabilization for UHMWPE and the medical applications of UHMWPE fibers State of the art coverage of the latest UHMWPE technology orthopedic applications biomaterial characterization and engineering aspects from recognized leaders in the field

Management of Marine Plastic Debris Michael Niaounakis, 2017-07-04 Management of Marine Plastic Debris gives a thorough and detailed presentation of the global problem of marine plastics debris covering every aspect of its management from tracking collecting treating and commercial exploitation for handling this anthropogenic waste The book is a unique essential source of information on current and future technologies aimed at reducing the impact of plastics waste in the oceans This is a practical book designed to enable engineers to tackle this problem both in stopping plastics from getting into the ocean in the first place as well as providing viable options for the reuse and recycling of plastics debris once it has been recovered The book is essential reading not only for materials scientists and engineers but also other scientists involved in this area seeking to know more about the impact of marine plastics debris on the environment the mechanisms by which plastics degrade in water and potential solutions While much research has been undertaken into the different approaches to the increasing problem of plastics marine debris this is the first book to present evaluate and compare all of the available techniques and practices and then make suggestions for future developments The book also includes a detailed discussion of the regulatory environment including international conventions and standards and national policies Reviews all available processes and techniques for recovering cleaning and recycling marine plastic debris Presents and evaluates viable options for engineers to tackle this growing problem including the use of alternative polymers Investigates a wide range of possible applications of marine plastics debris and opportunities for businesses to make a positive environmental impact Includes a detailed discussion of the regulatory environment including international conventions and standards and national policies

The Effect of Creep and other Time Related Factors on Plastics and Elastomers Laurence W. McKeen, 2014-08-26 This reference guide brings together a wide range of critical data on the effect of creep and other long term effects on plastics and elastomers enabling engineers to make optimal material choices and design decisions The data are supported by

explanations of how to make use of the data in real world engineering contexts and provides the long term properties data that designers need to create a product that will stand the test of time This new edition represents a full update of the data removing all obsolete data adding new data and updating the list of plastics manufacturers Additional plastics have also been included for polyesters polyamides and others where available including polyolefins elastomers and fluoropolymers Entirely new sections on biodegradable polymers and thermosets have been added to the book The level of data included along with the large number of graphs and tables for easy comparison saves readers the need to contact suppliers and the selection guide has been fully updated giving assistance on the questions which engineers should be asking when specifying materials for any given application Trustworthy current data on creep stress strain and environmental stress cracking enabling easier and more effective material selection and product design Includes expert guidance to help practitioners make best use of the data Entirely new sections added on sustainable and biodegradable polymers and thermosets

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