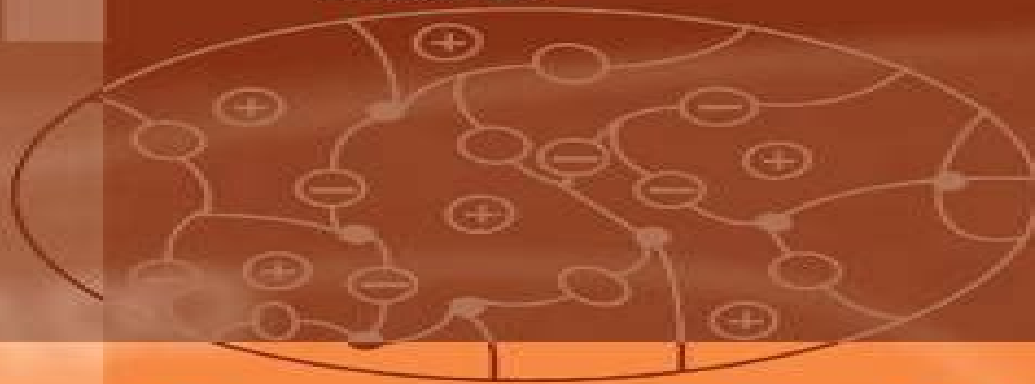


Hua Li



# Smart Hydrogel Modelling



Springer

# Smart Hydrogel Modelling

**Pooyan Makvandi, Ehsan Nazarzadeh  
Zare**



## Smart Hydrogel Modelling:

*Smart Hydrogel Modelling* Hua Li, 2010-01-26 The science of mathematical modelling and numerical simulation is generally accepted as the third mode of scientific discovery with the other two modes being experiment and analysis making this field an integral component of cutting edge scientific and industrial research in most domains This is especially so in advanced biomaterials such as polymeric hydrogels responsive to biostimuli for a wide range of potential BioMEMS applications where multiphysics and multiphase are common requirements These environmental stimuli responsive hydrogels are often known as smart hydrogels In the published studies on the smart or stimulus responsive hydrogels the literature search clearly indicates that the vast majority are experimental based In particular although there are a few published books on the smart hydrogels none is involved in the modelling of smart hydrogels For the few published journal papers that conducted mathematical modelling and numerical simulation results were far from satisfactory and showed significant discrepancies when compared with existing experimental data This has resulted in ad hoc studies of these hydrogel materials mainly conducted by trial and error This is a very time consuming and inefficient process and certain aspects of fundamental knowledge are often missed or overlooked resulting in off tangent research directions

Computational Modeling of Intelligent Soft Matter Mostafa Baghani, Majid Baniassadi, Yves Rémond, 2023-02-15 Computational Modelling of Intelligent Soft Matter Shape Memory Polymers and Hydrogels covers the multiphysics response of various smart polymer materials such as temperature sensitive shape memory polymers and temperature chemosensitive hydrogels Several thermochemo mechanical constitutive models for these smart polymers are outlined and their real world applications are highlighted The numerical counterpart of each introduced constitutive model is also presented empowering readers to solve practical problems requiring thermomechanical responses of these materials as well as design and analyze real world structures made of them Introduces constitutive models based on continuum thermodynamics for intelligent soft materials Presents calibration methods for identifying material model parameters as well as finite element implementation of the featured models Allows readers to solve practical problems requiring thermomechanical responses from these materials as well as the design and analysis of real world structures made of them

**Analysis and Modelling of Advanced Structures and Smart Systems** Holm Altenbach, Erasmo Carrera, Gennady Kulikov, 2017-11-27 This book presents selected papers presented at the 8th International Conference Design Modeling and Experiments of Advanced Structures and Systems DeMEASS VIII held in Moscow Russia in May 2017 and reflects the modern state of sciences in this field The contributions contain topics like Piezoelectric Ferroelectric Ferroelastic and Magnetostrictive Materials Shape Memory Alloys and Active Polymers Functionally Graded Materials Multi Functional Smart Materials and Structures Coupled Multi Field Problems Design and Modeling of Sensors and Actuators Adaptive Structures

**Intelligent Hydrogels** Gabriele Sadowski, Walter Richtering, 2014-01-28 This volume of Progress in Colloid and Polymer Science assembles original contributions and invited

reviews from the priority research program Intelligent Hydrogels funded by the German Science Foundation DFG since 2006 with about 25 contributing research groups In the center of interest of this program and the present book are responsive hydrogels i e hydrophilic polymer or polyelectrolyte networks that are able to respond to environmental stimuli such as changes in temperature pH additive concentration or electrical field The activities focus on different aspects on hydrogel synthesis on the modeling and simulation of thermophysical hydrogel properties as well as on innovative new hydrogel applications as smart materials The present book summarizes the highlights in the results of the priority program in original contributions and invited reviews

Modeling, Characterization, and Processing of Smart Materials Kumar, Ajay, Kumar, Parveen, Srivastava, Ashish Kumar, Goyat, Vikas, 2023-08-07 The development processing and applications of smart materials presents many challenges including performance correlations to the nature of their reinforcement and the sustainability of such materials through their recyclability durability and reparability Experts have identified the challenge of achieving sustainable development and in this book highlight how smart materials can provide a solution to the problem It emphasizes the multidisciplinary nature of smart materials and their potential for enhancing product functionalities and capabilities in different sectors including the biomedical pharmaceutical aerospace construction automotive and food industries Modeling Characterization and Processing of Smart Materials proposes a comprehensive guide to addressing the challenges associated with smart materials including the need for optimization and sustainability and provides various nature inspired algorithms computational and simulation approaches and artificial intelligence based strategies for developing innovative smart materials It also presents potential solutions for the limitations of smart materials and emphasizes the role of Industry 4 0 in maintaining their sustainability Overall this book offers a valuable problem solution perspective on the development and applications of smart materials making it an essential reference guide for academic researchers and industrial engineers in the fields of material science chemical engineering and environmental engineering

**Carrier-mediated Gene and Drug Delivery for Dermal Wound Healing** Pooyan Makvandi, Ehsan Nazarzadeh Zare, 2023-08-11 Wound healing following trauma illness or surgery is a complex process and is comprised of a particularly fragile sequence of biochemical events that are susceptible to interruption or failure which can lead to non healing chronic wounds scarring and other issues Non healing wounds are also commonly associated with diabetes arterial disease infection and the metabolic deficiencies of aging Treatment of dermal wounds can therefore be challenging and as such the ability to localise the effect of drugs and treatments to promote healing through protective materials is an attractive area of research This book introduces the essential areas of skin anatomy and the wound healing process and how this can be disrupted by various pathologies and proceeds to outline how biomaterials and devices for dermal drug delivery including controlled delivery via stimuli responsive devices can be utilised in effective wound management This book is an ideal companion for postgraduates and researchers in a variety of disciplines including biomedical engineering biomaterials drug development and delivery

formulation science and tissue engineering      *Organoid Technology: Disease Modelling, Drug Discovery, and Personalized Medicine* Manash K. Paul, 2025-07-23 Organoid Technology Disease Modelling Drug Discovery and Personalized Medicine covers organoid technology emerging as a transformative platform in biomedical research Chapters explain in detail the physiologically relevant in vitro 3D models that closely mimic human tissues and organs This book provides a comprehensive overview of the development application and future potential of organoids in modern life sciences It highlights the critical applications in disease modeling regenerative medicine and high throughput drug screening Key Features Covers organ specific organoid development and bioengineering methods Discusses integration with emerging technologies such as nanotechnology Includes insights into personalized medicine using patient derived organoids Covers details about the current regulatory and ethical landscapes in organoids based research      *Computational and Mathematical Models in Biology* Carla M.A. Pinto, Clara Mihaela Ionescu, 2023-12-08 This book provides the most valuable and updated research on computational and mathematical models in biological systems from influential researchers around the world and contributes to the development of future research guidelines in this topic Topics include but are not limited to modeling infectious and dynamic diseases regulation of cell function biological pattern formation biological networks tumor growth and angiogenesis complex biological systems Monte Carlo methods Control theory optimization and their applications      *Synthesis of Novel Hydrogels with Unique Mechanical Properties* Yi Cao, Kerstin G. Blank, Fei Sun, 2020-12-23 This eBook is a collection of articles from a Frontiers Research Topic Frontiers Research Topics are very popular trademarks of the Frontiers Journals Series they are collections of at least ten articles all centered on a particular subject With their unique mix of varied contributions from Original Research to Review Articles Frontiers Research Topics unify the most influential researchers the latest key findings and historical advances in a hot research area Find out more on how to host your own Frontiers Research Topic or contribute to one as an author by contacting the Frontiers Editorial Office [frontiersin.org/about/contact](mailto:frontiersin.org/about/contact)      **Natural and Synthetic Hydrogels** Ravin Narain, 2024-11-11 Natural and Synthetic Hydrogels Rational Design Synthesis and Biomedical Applications provides a comprehensive text on hydrogels and their biomedical uses covering both fundamental and applied aspects of hydrogels Hydrogels are three dimensional network of cross linked polymers or particles that contain a large amount of water They have received tremendous attention for applications in biomedicine which has led to significant progress in the design and engineering of the hydrogels to meet the needs for such applications The book covers the recent developments that have been made in this field including new applications of hydrogels providing a new and fresh overview of hydrogels and their applications Natural and Synthetic Hydrogels Rational Design Synthesis and Biomedical Applications is valuable to upper level undergraduate and graduate students researchers and professors teaching fundamental and applied aspects of hydrogels Provides a complete description for design approaches synthetic strategies and their characterizations Covers responsive hydrogels from the synthesis and application point of view Evaluates modern

techniques to prepare hydrogels and their characterizations      *Smart Materials for Smart Devices and Structures* Marcin Leonowicz, Dariusz Oleszak, 2009-04-16 Selected peer reviewed papers from the Symposium C European Materials Research Society Fall Meeting Warsaw University of Technology September 15 19 2008      **Sustainable Hydrogels** Sabu

Thomas, Bhasha Sharma, Purnima Jain, Shashank Shekhar, 2023-01-11 Sustainable Hydrogels Synthesis Properties and Applications highlights the development of sustainable hydrogels from various perspectives and covers a range of topics including the development and utilization of abundant and or inexpensive biorenewable monomers to create hydrogels the mimicry of variable properties inherent to successful commercial hydrogels and the creation of bio based hydrogels that are functional equivalents of fossil fuel derived hydrogels with respect to their properties yet are capable of benign degradation over much shorter timescales Some of the challenges facing sustainable polymer chemistry are also discussed Shifts the focus from theory to practice and demonstrates how the cradle to cradle approach support sustainability Includes discussion of life cycle assessments in the production and use of hydrogels Presents various materials for the production of hydrogels

**Environmentally-Responsive Biomaterials for Major Diseases Treatment** Donglin Xia, Jingwei Xie, Yao Luo, 2025-05-07 The applications of environmentally responsive biomaterials in the treatment and management of major diseases have demonstrated remarkable potential in improving therapeutic outcomes These biomaterials are meticulously engineered to exhibit a tailored response to specific environmental cues within the body enabling targeted and controlled drug delivery effective tissue regeneration and real time disease monitoring Understanding the intricate interplay between the biomaterials and the surrounding microenvironment is paramount to maximizing their efficacy and achieving optimal patient outcomes This research topic focuses on delving into the current advancements and challenges associated with the use of environmentally responsive biomaterials for addressing major diseases highlighting groundbreaking strategies for targeted drug delivery exploring the exciting possibilities of biomaterials for tissue engineering and regeneration and discussing the immense potential of environmentally responsive biomaterials for disease monitoring This research topic aims to explore the various achievements in the field of smart nanomaterials for disease treatment and injury repair The objective is to gather experts specializing in hydrogel light cured materials 3D DNA origami and blood cell based drug carriers to discuss the application of these advancements in major disease treatments such as tumor therapy bone repair and teeth restoration Additionally we encourage the inclusion of topics related to the current status general trends challenges strategies and future directions of environmentally responsive biomaterial construction technology as well as highlight current and emerging biomaterials platforms with potential medical applications Both Original Research articles and Review articles are welcome Preferred subtopics include but are not limited to Controlled release Drug delivery systems Stimuli responsive materials for organ on a chip Stimuli responsive materials for biocompatible implants and prosthetics Stimuli responsive materials for wound healing and regeneration Stimuli responsive materials for bone and cartilage repair Stimuli

responsive materials for nerve regeneration Stimuli responsive hydrogels      **Adaptronics and Smart Structures** Hartmut Janocha, 2013-11-11 Adaptronics is the term encompassing technical fields that have become known internationally under the names smart materials intelligent structures and smart structures Adaptronics contributes to the optimisation of systems and products It bridges the gap between material and system or product and incorporates the search for multi functional materials and elements and their integration in systems or structures The authors of this book have taken on the task of displaying the current state of the art in this fascinating field The system components actuators sensors and controllers technical fundamentals materials design rules and practical solutions are all described Selected sample applications are also presented and current development trends are demonstrated      *Meshless Methods and Their Numerical Properties* Hua Li, Shantanu S. Mulay, 2013-02-22 Meshless or meshfree methods which overcome many of the limitations of the finite element method have achieved significant progress in numerical computations of a wide range of engineering problems A comprehensive introduction to meshless methods *Meshless Methods and Their Numerical Properties* gives complete mathematical formulations for the most important and classical methods as well as several methods recently developed by the authors This book also offers a rigorous mathematical treatment of their numerical properties including consistency convergence stability and adaptivity to help you choose the method that is best suited for your needs Get Guidance for Developing and Testing Meshless Methods Developing a broad framework to study the numerical computational characteristics of meshless methods the book presents consistency convergence stability and adaptive analyses to offer guidance for developing and testing a particular meshless method The authors demonstrate the numerical properties by solving several differential equations which offer a clearer understanding of the concepts They also explain the difference between the finite element and meshless methods Explore Engineering Applications of Meshless Methods The book examines how meshless methods can be used to solve complex engineering problems with lower computational cost higher accuracy easier construction of higher order shape functions and easier handling of large deformation and nonlinear problems The numerical examples include engineering problems such as the CAD design of MEMS devices nonlinear fluid structure analysis of near bed submarine pipelines and two dimensional multiphysics simulation of pH sensitive hydrogels Appendices supply useful template functions flowcharts and data structures to assist you in implementing meshless methods Choose the Best Method for a Particular Problem Providing insight into the special features and intricacies of meshless methods this is a valuable reference for anyone developing new high performance numerical methods or working on the modelling and simulation of practical engineering problems It guides you in comparing and verifying meshless methods so that you can more confidently select the best method to solve a particular problem      **Functional Biopolymers** Vijay Kumar Thakur, Manju Kumari Thakur, 2017-10-25 This book presents the synthesis processing and application of selected functional biopolymers as new advanced materials It reviews theoretical advances as well as experimental results opening new avenues

for researchers in the field of polymers and sustainable materials The book covers various aspects including the structural analysis of functional biopolymers based materials functional biopolymer blends films fibers foams composites and different advanced applications A special emphasis is on cellulose based functional polymers but other types of functional biopolymers e g from chitosan starch or plant oils are also described **Frontiers in Sensing** Friedrich G. Barth, Joseph A. C.

Humphrey, Mandyam V. Srinivasan, 2011-09-29 Biological sensory systems fine tuned to their specific tasks with remarkable perfection have an enormous potential for technical industrial and medical applications This applies to sensors specialized for a wide range of energy forms such as optical mechanical electrical and magnetic to name just a few This book brings together first hand knowledge from the frontiers of different fields of research in sensing It aims to promote the interaction between biologists engineers physicists and mathematicians and to pave the way for innovative lines of research and cross disciplinary approaches The topics presented cover a broad spectrum ranging from energy transformation and transduction processes in animal sensing systems to the fabrication and application of bio inspired synthetic sensor arrays The various contributions are linked by the similarity of what sensing has to accomplish in both biology and engineering **Intelligent**

**Biomaterials** Zhe Liu, 2025-07-10 This book presents the latest advances in intelligent biomaterials a fast developing area for disease diagnosis and treatments health management and rehabilitations In particular this book focuses on versatile types of emerging intelligent biomaterials as well as their multiple roles in smart biosensors tissue engineering medical meta data analysis micro nanorobotics and artificial intelligence based theranostics These state of the art technologies and updated knowledge are expected to reshape the future trend of biomaterials and more importantly integrate biomaterials and intelligence together as a single entity to serve human health improvements On this basis this book aims to elucidate the concept and domain of intelligent biomaterials and discuss on their cutting edge applications It will provide a vast readership including students scientists researchers and professional staff in the trans disciplinary community with a brand new viewpoint to learn about the frontiers of intelligent biomaterials **Cartilage Tissue and Knee Joint Biomechanics**

Amirsadegh Rezazadeh Nochehdehi, Fulufhelo Nemavhola, Sabu Thomas, Hanna J. Maria, 2023-09-05 Cartilage Tissue and Knee Joint Biomechanics Fundamentals Characterization and Modelling is a cutting edge multidisciplinary book specifically focused on modeling characterization and related clinical aspects The book takes a comprehensive approach towards mechanics fundamentals morphology and properties of Cartilage Tissue and Knee Joints Leading researchers from health science medical technologists engineers academics government and private research institutions across the globe have contributed to this book This book is a very valuable resource for graduates and postgraduates engineers and research scholars The content also includes comprehensive real world applications As a reference for the total knee arthroplasty this book focuses deeply on existing related theories including histology design manufacturing and clinical aspects to assist readers in solving fundamental and applied problems in biomechanical and biomaterials characterization modeling and



simulation of human cartilages and cells For biomedical engineers dealing with implants and biomaterials for knee joint injuries this book will guide you in learning the knee anatomy range of motion surgical procedures physiological loading and boundary conditions biomechanics of connective soft tissues type of injuries and more Provides a comprehensive resource on the knee joint and its connective soft tissues content included spans biomechanics biomaterials biology anatomy imaging and surgical procedure Covers ISO and FDA based regulatory control and compliance in the manufacturing process Includes discussions on the relationship between knee anatomical parameters and knee biomechanics      **Microencapsulation for Biomedical Applications** Raffaele Vecchione,Filippo Causa,Aurelio Salerno,Concepcion Domingo,2022-04-29

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