



Polymer Sponge Replication Technology Derived Strontium-Substituted Apatite (Sr-HAP) Porous Scaffolds for Bone Tissue Engineering

Ramadas Munusamy¹ · Abimanyu Ravichandran¹ · Khalil El Mabrouk² · Ballamurugan M. Anbalagan¹

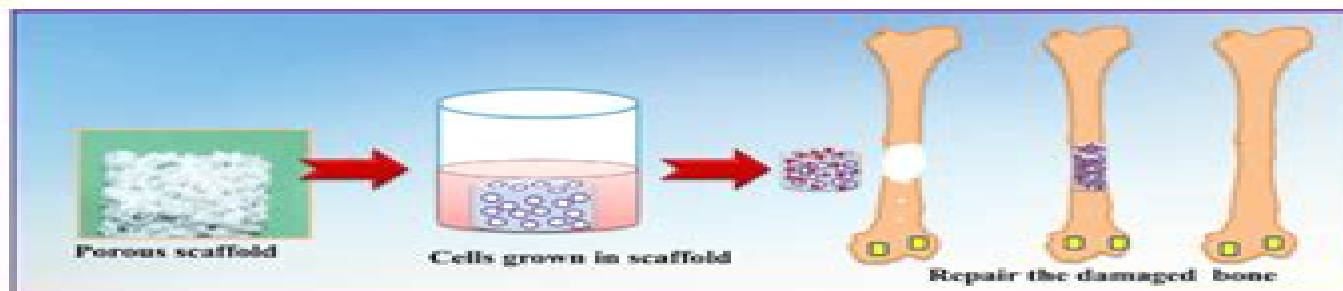
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Abstract

In this research, we developed strontium-substituted apatite (Sr-HAP) scaffolds using the polymeric sponge replication method. Tissue engineering is a potential new technology for replacing damaged tissue with biocompatible artificial templates. The scaffolds prepared with an interconnected porous microstructure with pore sizes ranging from 400 to 622 μm were created as engineering constructions. The physicochemical properties of the Sr-HAP scaffolds were characterized by various techniques such as X-ray diffraction (XRD), Field emission scanning electron microscopy (FE-SEM), and Energy dispersion spectroscopy (EDS). Immersion tests in simulated body fluid (SBF) solution was used to assess the surface reactivity of the resulting scaffolds. More critically, MTT assay tests were utilized to investigate the cell viability of porous Sr-HAP scaffold at varying doses of 10–1000 $\mu\text{g/mL}$ for 24 h. The porosity Sr-HAP scaffolds developed in this study are a potential tissue engineering candidate.

Graphical Abstract



Keywords Apatite · Porous · Scaffold · Biocompatibility · Tissue engineering

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Introduction

Accidental bone defects and fractures, as well as skeletal disorders and tumour resections, have become a world-wide problem and clinical concern. Tissue engineering and regenerative medicine have been establishing their potential value to transform critical fields of medicine,

Porous Materials For Tissue Engineering

**B.-L. Su, Clement Sanchez, Xiao-Yu
Yang**



Porous Materials For Tissue Engineering:

Porous Materials for Tissue Engineering Dean Mo Liu, Vivek Dixit, 1997-09-11 Tissue Engineering is an interdisciplinary field that involves the development of bio artificial organs and implants The main purpose of such prostheses is the repair regeneration and reconstruction of lost damaged or degenerated tissues and organs *Porous Polyurethane-based Materials for Tissue Engineering* Gaëtan Lutzweiler, 2019 Porous materials are an ideal solution in tissue engineering since they can provide a three dimensional environment to the cells that is close to their extracellular matrix while keeping suitable mechanical properties In the first part of this Thesis we develop porous materials made from polyurethane PU whose architecture is controlled to allow cells colonisation and growth These materials are subsequently surface treated polydopamine PDA coating and plasma treatment to enhance the adhesion of the cells We were able to show that the interconnection diameter i e the aperture connecting two adjacent pores has an important impact on the long term cell survival and organization in the material Polydopamine coating was shown to be efficient for fibroblasts whereas plasma treatment promoted mesenchymal stem cells MSCs colonisation Besides we also studied the influence of the PU formulation on the adhesion capacity of the cells We demonstrated that at a given ratio between the reactants cell adhesion could be allowed or prevented Finally we put a hydrogel of self assembled peptides inside the pores of the material to provide an environment close to the extracellular matrix for the cells We could show that the gel increases the proliferation ability of MSCs In summary this Thesis puts forward the important interplay between material properties and morphology of porous scaffolds **Porous Materials: Mechanics and Applications** Pasquale De Marco, 2025-03-08 Porous materials are a class

of materials with a large number of small pores typically ranging in size from a few nanometers to a few millimeters These pores can be interconnected or isolated and they can be filled with a variety of fluids such as air water or oil Porous materials are found in a wide variety of natural and synthetic materials and they have a wide range of applications in fields such as energy environmental science and biomedicine This book provides a comprehensive overview of the mechanics and applications of porous materials It covers a wide range of topics including the properties of porous materials the governing equations for fluid flow and heat transfer in porous media and the applications of porous materials in a variety of fields The book is divided into ten chapters The first chapter introduces the basics of porous materials including their definition classification and applications The second chapter discusses the mechanical behavior of porous materials including their elastic properties plasticity and failure mechanisms The third chapter covers fluid flow in porous media including Darcy s law and permeability The fourth chapter discusses heat transfer in porous media including conduction convection and radiation The fifth chapter covers mass transfer in porous media including diffusion and adsorption The sixth chapter discusses coupled processes in porous media such as thermo hydro mechanical coupling and chemo mechanical coupling The seventh chapter covers the applications of porous materials in energy applications such as fuel cells batteries and solar energy The

eighth chapter discusses the applications of porous materials in environmental applications such as water treatment and air pollution control The ninth chapter covers the applications of porous materials in biomedical applications such as tissue engineering and drug delivery The tenth chapter discusses emerging applications of porous materials such as sensors actuators and microelectronics This book is intended for researchers engineers and students who are interested in the mechanics and applications of porous materials It is also a valuable resource for professionals working in fields such as energy environmental science and biomedicine If you like this book write a review

Hierarchically Structured Porous Materials B.-L. Su, Clement Sanchez, Xiao-Yu Yang, 2012-04-06 This first book devoted to this hot field of science covers materials with bimodal trimodal and multimodal pore size with an emphasis on the successful design synthesis and characterization of all kinds of hierarchically porous materials using different synthesis strategies It details formation mechanisms related to different synthesis strategies while also introducing natural phenomena of hierarchy and perspectives of hierarchical science in polymers physics engineering biology and life science Examples are given to illustrate how to design an optimal hierarchically porous material for specific applications ranging from catalysis and separation to biomedicine photonics and energy conversion and storage With individual chapters written by leading experts this is the authoritative treatment serving as an essential reference for researchers and beginners alike

Advanced Functional Porous Materials Arya Uthaman, Sabu Thomas, Tianduo Li, Hanna Maria, 2021-11-13 This book presents synthesis characterization and applications of macroporous mesoporous nanoporous hierarchical porous porous metals and porous ceramics Special emphasis is given to the preparation of porous activated carbon materials and porous ionic liquid derived materials for CO₂ emissions mitigation Additionally a chapter includes the physical and mathematical modeling in porous media Many analytical techniques for characterization are discussed in this book Also the biomedical and industrial applications of porous materials in adsorption catalysis biosensors drug delivery nanotechnology are described The content helps solving fundamental and applied problems in porous materials with length scales varying from macro to nano level

Electrochemically Engineering of Nanoporous Materials Abel Santos, 2018-10-10 This book is a printed edition of the Special Issue Electrochemically Engineering of Nanoporous Materials that was published in Nanomaterials

Chemistry of Advanced Materials Sheenam Thatai, Christine Jeyaseelan, Parul Khurana, 2025-12-09 Chemistry of Advanced Materials is a cutting edge book exploring innovative materials shaping the future of technology medicine and sustainability It delves into nanomaterials smart materials and biomaterials highlighting their applications in energy storage healthcare and environmental solutions Authors discuss breakthroughs in material science driving industry transformations With insights into synthesis properties and uses this book is a vital resource for researchers engineers and students It bridges theory and practice showcasing how advanced materials push boundaries in technology and sustainability Perfect for those at the forefront of material innovation this book sparks new ideas for a high tech future

Ice Templating and Freeze-Drying for

Porous Materials and Their Applications Haifei Zhang, 2018-05-16 Filling a gap in the literature this is the first book to focus on the fabrication of functional porous materials by using ice templating and freeze drying Comprehensive in its scope the volume covers such techniques as the fabrication of porous polymers porous ceramics biomimic strong composites carbon nanostructured materials nanomedicine porous nanostructures by freeze drying of colloidal or nanoparticle suspensions and porous materials by combining ice templating and other techniques In addition applications for each type of material are also discussed Of great benefit to those working in the freeze drying field and researchers in porous materials materials chemistry engineering and the use of such materials for various applications both in academia and industry Advances in Bioceramics and Porous Ceramics VI, Volume 34, Issue 6 Roger Narayan, Paolo Colombo, 2013-12-02 Ceramic Engineering and Science Proceedings Volume 34 Issue 6 Advances in Bioceramics and Porous Ceramics VI A collection of 13 papers from The American Ceramic Society's 37th International Conference on Advanced Ceramics and Composites held in Daytona Beach Florida January 27 February 1 2013 This issue includes papers presented in Symposium 5 Next Generation Bioceramics and Biocomposites and Symposium 9 Porous Ceramics Novel Developments and Applications

Electrochemically Engineered Nanoporous Materials Dusan Losic, Abel Santos, 2015-07-18 This book provides in depth knowledge about the fabrications structures properties and applications of three outstanding electrochemically engineered nanoporous materials including porous silicon nanoporous alumina and nanotubular titania The book integrates three major themes describing these materials The first theme is on porous silicon reviewing the methods for preparation by electrochemical etching properties and methods for surface functionalization relevant for biosensing applications Biomedical applications of porous silicon are major focus described in several chapters reviewing recent developments on bioanalysis emerging capture probes and drug delivery The second theme on nanoporous alumina starts with describing the concept of self organized electrochemical process used for synthesis nanopore and nanotube structures of valve metal oxides and reviewing recent development and progress on this field The following chapters are focused mainly on optical properties and biosensing application of nanoporous alumina providing the reader with the depth of understanding of the structure controlled optical and photonic properties and design of optical biosensing devices using different detection principles such as photoluminescence surface plasmon resonance reflective spectrometry wave guiding Raman scattering etc The third theme is focused on nanotubular titania reviewing three key applications including photocatalysis solar cells and drug delivery The book represents an important resource for academics researchers industry professionals post graduate and high level undergraduate students providing them with both an overview of the current state of the art on these materials and their future developments

Porous Materials For Tissue Engineering Book Review: Unveiling the Power of Words

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