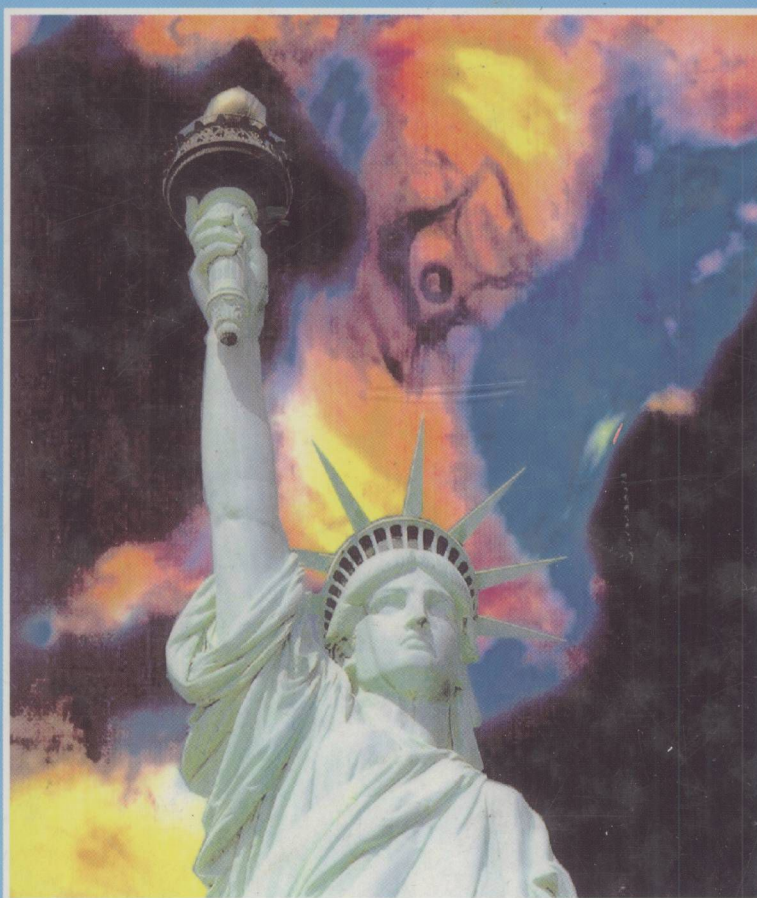

Racquel Zapanta LeGeros • John P. LeGeros

Bioceramics

Volume 11



New York City, New York, USA

World Scientific

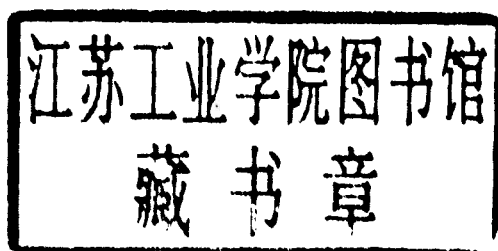
Proceedings of the 11th International Symposium on
Ceramics in Medicine

Bioceramics

Volume 11

New York City, New York, USA

5-8 November 1998



edited by

RZ LeGeros

JP LeGeros

New York University College of Dentistry



World Scientific

Singapore • New Jersey • London • Hong Kong

Published by

World Scientific Publishing Co. Pte. Ltd.

P O Box 128, Farrer Road, Singapore 912805

USA office: Suite 1B, 1060 Main Street, River Edge, NJ 07661

UK office: 57 Shelton Street, Covent Garden, London WC2H 9HE

British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library.

BIOCERAMICS 11

Proceedings of the 11th International Symposium on Ceramics in Medicine

Copyright © 1998 by World Scientific Publishing Co. Pte. Ltd.

All rights reserved. This book, or parts thereof, may not be reproduced in any form or by any means, electronic or mechanical, including photocopying, recording or any information storage and retrieval system now known or to be invented, without written permission from the Publisher.

For photocopying of material in this volume, please pay a copying fee through the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, USA. In this case permission to photocopy is not required from the publisher.

ISBN 981-02-3701-4

Proceedings of the 11th International Symposium on
Ceramics in Medicine

Bioceramics

Volume 11

Bioceramics 11

Executive Committee (1998)

President:	R. Z. LeGeros (USA)
Secretary General:	W. Bonfield (UK)
Treasurer:	T. Kokubo (Japan)
Members:	H. Ohgushi (Japan); A. Moroni (Italy); L. Sedel (France), L. Hench (UK/USA); P. Ducheyne (USA); S.F. Hulbert (USA); H. Oonishi (Japan); G. Hastings (Singapore); T. Yamamuro (Japan); J. Wilson (UK)

Scientific Committee

R. Bizios (USA)	A. Gatti (Italy)	A. Ravaglioli (Italy)
A. Boskey (USA)	U.M. Gross (Germany)	J. Reese (USA)
G. Daculsi (France)	S. Kim (Korea)	D. Tarnow (USA)
K. de Groot (Netherlands)	R. Kijkowska (Poland)	M. Vallet-Regi (Spain)
M. Filliagi (Canada)	D. Lee (USA)	A. Yli-Urpo (Finland)
C. Frondoza (USA)	S. Niwa (Japan)	

Local Organizing Committee

Chairpersons:	Racquel Z. LeGeros, John P. LeGeros
Editorial Assistants:	Alessandra LeGeros, Lena Rettig, Katherine LeGeros Barthe
Administrative Assistants:	Donna Broomfield, LaDebra Williams

Endorsing Societies

International Association for Dental Research	Ceramics Society of Japan
Society for Biomaterials	Korean Society for Biomaterials
European Society for Biomaterials	Japanese Society for Biomaterials

Supported by:

National Institute for Dental Research, NIH (Grant no. R13DE12804)
New York University College of Dentistry
L. Linkow Implant Research Fund

HOWMEDICA

OSTEONICS

JOHNSON & JOHNSON

BioPlant
Clarkson Chemicals

Sulzer-Calcitek
US Biomaterials

Block Drug
ETEX

HiMED

Biomatlante

CeraMED

Orthovita

Acknowledgements

Bioceramics 11 gratefully acknowledges the support from **the National Institute for Dental Research** (Conference Research Grant No. R13DE12804) of the National Institutes of Health; the **New York University College of Dentistry**; the support from the **Industrial Sponsors** and of the **L. Linkow Implant Research Fund**.

Bioceramics Symposia

<u>Year</u>	<u>Site</u>
1988	Kyoto, Japan
1989	Heidelberg, Germany
1990	Terre Haute, IND, USA
1991	London, England
1992	Kyoto, Japan
1993	Philadelphia, PA, USA
1994	Turku, Finland
1995	Ponte Vedra, FL, USA
1996	Otsu, Japan
1997	Paris, France
1998	New York, NY, USA

Preface

Bioceramics 11 held at New York University College of Dentistry in November 1998, continued the tradition of the preceding ten International Symposia on Ceramics in Medicine for serving as the forum for the sharing of research findings among scientists and clinicians coming from many disciplines and from academia and industry. The growing global nature of this series of symposia is reflected by participation from 25 countries compared to 9 countries in *Bioceramics 1*.

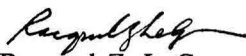
This book is a collection of papers presented at the *Bioceramics 11* symposium reflecting research on the cutting edge of developments for bioceramics and their medical and dental applications. The evolution of ceramic materials, bioinert and bioactive, has been remarkable, as shown by the research topics covered in this symposium. Research direction towards tissue engineering reflects the growing awareness to the need to develop materials which integrate biological functions to optimize tissue response. It is interesting to note that an early application of tissue engineering is recorded in a chapter of Genesis of the Bible: the creation of Eve from Adam's rib.

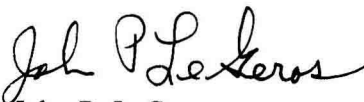
What can not be included, but only implied in these pages, is that the series of *Bioceramics* meetings result in the strengthening of information bonds between experienced researchers and encouragement to those researchers just entering the field.

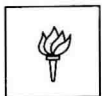
Putting together this book of Proceeding was a formidable task but was made possible with the valuable collaboration of the Local Organizing Committee, the Scientific Committee and the Executive Committee. The significant support of the New York University College of Dentistry, the National Institute of Dental Research of the National Institutes of Health, the Industrial Sponsors and the L. Linkow Implant Research Fund are gratefully acknowledged.

We hope that in this book you will find inspiration and vision for the advancement of ceramics in the field of medicine and dentistry to the ultimate goal of improving the quality of life.

God bless you.


Racquel Z. LeGeros


John P. LeGeros



NEW YORK UNIVERSITY
A private university in the public service

**DAVID B. KRISER DENTAL CENTER
COLLEGE OF DENTISTRY**

Office of the Dean

Arnold and Marie Schwartz Hall of Dental Sciences
345 East 24th Street, New York, NY 10010-4086
Telephone: (212) 998-9898
FAX: (212) 995-4080

November 5, 1998

Dear Colleagues:

On behalf of the New York University College of Dentistry, I am pleased to welcome you to Bioceramics 11, the Eleventh International Symposium on Ceramics in Medicine and Dentistry. For three days, the study of ceramics in the medical sciences will be the focus of your discussions here, but we hope that you will find time also to explore our facilities at the David B. Kriser Dental Center and to enjoy some of the spectacular attractions of New York City.

The College of Dentistry is delighted to host the Symposium's first visit to New York. The College is the third oldest and the largest dental education institution in the United States, and it currently instructs more dentists than any other school. From the beginning, our mission has been to train oral health practitioners in the most advanced treatment therapies and state-of-the-art techniques. It is particularly fitting, then, that the cutting-edge research of bioceramics should enhance our learning community for the next few days.

A special thank you goes to Drs. Racquel Z. LeGeros and John P. LeGeros for organizing this outstanding Symposium. Their efforts have resulted in a most interesting collection of speakers from universities and industries throughout the world. I am certain that the data presented will stimulate your scientific curiosity as well as result in collaborations that will continue to foster this exciting discipline.

Once again, welcome. Your work represents some of the most thrilling advancements for the medical and dental professions. It is an important manifestation of your commitment to research and to excellence.

Sincerely,

Michael C. Alfano, D.M.D., Ph.D.
Dean

CONTENTS

I. BONE BIOLOGY: GENERAL	1
Cellular and Molecular Events in Bone Repair <i>J.M. Schmitt, S.R. Winn, J.O. Hollinger</i>	3
Bioceramics, Cells and Signals in Tissue Engineering <i>A.H. Reddi</i>	9
Monocytes, Macrophages and Foreign Body Giant Cells on Biomaterial Surfaces: The Foreign Body Reaction <i>J.M. Anderson</i>	13
Cells and Materials Interactions <i>U. Gross, C. Muller-Mai, C. Voight</i>	17
Bone/Bioceramic Interface <i>H. Oonishi, T. Sugihara, E. Tsuji, L. L. Hench, J. Wilson</i>	23
II. BIOCERAMICS: PRESENT AND FUTURE	29
Bioactive Glasses <i>L.L. Hench, J. Wilson</i>	31
Composite Biomaterials: Present and Future <i>W. Bonfield</i>	37
Calcium Phosphate Coating: Alternatives to Plasma Spray <i>K. de Groot</i>	41
Calcium Phosphate Cements: Chemistry and Applications <i>L.-C. Chow</i>	45
Biomimetics Applied to Bioceramics <i>T. Kokubo</i>	51
Principles of Tissue Engineering Governing Osteogenic Devices <i>J.H. Brekke, J.M. Toth, E. Vögelin, N.F. Jones</i>	57
III. BIOCERAMICS: PREPARATION AND PROPERTIES	63
A. Alumina, Zirconia	
Sintered Bioactive Coating of Dense Alumina <i>J. Cavalheiro, M. Brás</i>	65
Ceramic Femoral Component of Knee Prosthesis <i>J. Cihlár, M. Trunec, V. Šída</i>	69

Ceramic-Ceramic Bearing Systems for THP with Zirconia Heads <i>F. Villiermaux, L. Blaise, J.M. Drouin, B. Calès</i>	73
Apatite-Forming Ability of Zirconia Gel in Modified SBF Solutions <i>M. Uchida, H.-M. Kim, F. Miyaji, T. Kokubo, T. Nakamura</i>	77
B. Calcium Phosphates	
Stability of Hydroxyapatite at Physiologic Temperature <i>P.W. Brown</i>	81
CO ₃ -Apatite Preparations with Solubility Gradient: Potential Degradable Biomaterials <i>M. Okazaki, T. Matsumoto, M. Taira, J. Takahashi, R.Z. LeGeros</i>	85
Processing of Porous Hydroxyapatite by Starch Consolidation <i>L.M. Rodriguez-Loreno, J.M.F. Ferreira, M. Vallet-Regi</i>	89
Crystal Growth and Structure Analyses of Carbonate Hydroxyapatite <i>Y. Suetsugu, M. Kikuchi, K. Sato, J. Tanaka</i>	93
Effects of Carbonate Substitution on the Strength of Single Crystal Hydroxyapatite <i>A. Ito, K. Teraoka, K. Maekawa, K. Onuma, T. Tateishi</i>	97
Chemistry and Critical Ageing of Hydroxyapatite Sol-Gel Solutions <i>C.-S. Chai, K.A. Gross, K. Kannagara, B. Ben-Nissan, L. Hanley, P. Layrolle</i>	101
Effect of Silicon Content on the Chemical and Phase Composition of Novel Silicon-Substituted Hydroxyapatites <i>I.R. Gibson, L.J. Jha, J.D. Santos, S.M. Best, W. Bonfield</i>	105
Synthesis, Sintering and Mechanical Characteristics of Non-Stoichiometric Apatite Ceramics <i>S. Raynaud, E. Champion, D. Bernache-Assollant</i>	109
Formation of Fluoridated Hydroxyapatite from Tricalcium Phosphate (TCP) in Organic Media <i>K. Sakamoto, Y. Tsunawaki, S. Yamaguchi, J. Ichihara, A. Nakahira, M. Okazaki</i>	113
Chemical Transformations of Biologically Relevant Calcium Phosphates in Aqueous Media During a Steam Sterilization <i>S.V. Dorozhkin, M. Schmitt, J.M. Bouler, G. Daculsi</i>	117
Solubility Tests of Commercial Apatite Products <i>G. Berger, R. Gildenhaar, U. Ploska</i>	121

C. Bioglass

- Relationship Between Bioactivity and Textural Parameters in Glasses 125
F. Balas, J. Pérez-Pariente, M. Vallet-Regí
- Long-Term Reactions *In Vitro* with Bioactive Glass S53P4 129
M. Peltola, J. Suonpää, K. Aitasalo, Ö. Andersson, H.A. Mänttinen, A. Yli-Urpo
- Chemical Reactivity of Experimental Bioactive Glasses 133
A.S. Rizkalla, D.W. Jones, T. Routledge, G.C. Hall, M. Langman
- Study of the Sol-Gel Processing of Glass-Ceramic Powders in the $\text{SiO}_2\text{-Al}_2\text{O}_3\text{-CaO-CaF}_2$ System. Part 2: Microstructure Evaluation 137
M.S. Zolotar, C.A.C. Zavaglia, L.P. Cardoso, J.A. Fraymann
- Influence of the Chemical Composition on the Mechanical Properties and *In Vitro* Solubility of Phosphate Glasses in the System $\text{P}_2\text{O}_5\text{-CaO-Na}_2\text{O}$ 141
J. Clément, L. Ekeberg, S. Martinez, M.P. Ginebra, F.J. Gil, J.A. Planell

D. Composites

- Novel Poly Lactic Acid Composites Containing $\beta\text{-Ca}(\text{PO}_3)_2$ Fibers 145
T. Kasuga, H. Fujikawa, Y. Ota, M. Nogami, Y. Abe
- Elastic Properties of Experimental Bioactive Glass Composites 149
D.W. Jones, A.S. Rizkalla, T. Routledge, G.C. Hall
- Changes in Mechanical Properties and GBR Application of TCP/CPLA Composite 153
M. Kikuchi, K. Sato, Y. Suetsugu, J. Tanaka, Y. Koyama, K. Takakuda
- Mechanical Strength and Dynamic Young's Modulus of Glass Reinforced Hydroxyapatite Biocomposites 157
M.A. Lopez, F.J. Monteiro, R.F. Silva, J.D. Santos
- The Formation of Hydroxyapatite and Hydroxyapatite-Based Composites 161
P.W. Brown, C. Durucan, Y. Greish
- Evaluation of Bioglass^R and Hydroxyapatite-Reinforced Polyethylene Composites After Ageing in Simulated Body Fluid 165
J. Huang, M. Wang, S. Best, K.E. Tanner, W. Bonfield
- Stiff and Bioactive Composites Based on Starch, Polyethylene and $\text{SiO}_2\text{-CaOP}_2\text{O}_5\text{-MgO}$ Glasses and Glass Ceramics 169
R.L. Reis, I.B. Leonor, M.T. Rego, A.M. Cunha, M.H. Fernandes, R.N. Correia

Physico-Chemical and Histological Behaviors of Homologous Hydroxyapatite/Polymer Composite Membranes	173
<i>R. Martinetti, N. Zaghini, L. Dolcini, A. Krajewski, A. Ravaglioli, P. Cerrai, G.D. Guerra, M. Tricoli, A. Piattelli, A. Scarano</i>	
E. Coatings	
Identification of the Amorphous Phase in Plasma Sprayed Apatite Coatings	177
<i>K.A. Gross, M. Phillips, B. Ben-Nissan, C.C. Berndt</i>	
HA/ACP Ratios in Calcium Phosphate Coatings on Dental and Orthopedic Implants: Effects on Properties	181
<i>R.Z. LeGeros, Y.-E. Kim, R. Kijkowska, V. Zurita, C. Bleiwas, B. Edwards, P.-Y. Huang, F. Dimaano, J.P. LeGeros</i>	
The Generation of a Dense (Mg^{2+} , CO_3^{2-})-Containing Apatite Film Chemically Bonded to Titanium Directly from Aqueous Solutions	185
<i>P. Li, F. Matthews</i>	
Superplastic Ti-Alloy Toughened Hydroxyapatite	189
<i>T. Nonami, H. Taoda, A. Kamiya, K. Naganuma, T. Sonoda, T. Kameyama</i>	
<i>In Vitro</i> Performance of Vacuum Plasma Sprayed Coatings on Carbon Fiber Reinforced Poly (Etheretherketone)	193
<i>S.-W. Ha, K.L. Eckert, F. Birchler, A. Gisepp, H. Gruner, E. Wintermantel</i>	
Hydroxyapatite-Zirconia Composite Coatings via Plasma Spraying Process	197
<i>V.J.P. Lim, K.A. Khor, L. Fu, P. Cheang</i>	
Synthesis of Tri-Calcium Phosphate Coatings Using Plasma-Enhanced Metalorganic Chemical Vapor Deposition	201
<i>Y. Gao, A.A. Campbell</i>	
Hydroxyapatite Coating by a Sol-Gel Process Containing an Intermediate Glass Layer	205
<i>C.-K. You, S.-Y. Kim</i>	
Hydroxyl Incorporation in Apatite Coatings Produced by Pulsed Laser Deposition	209
<i>M.B. Mayor, J.L. Arias, F.J. Garcia-Sanz, S. Chiussi, J. Pou, B. León, M. Pérez-Amor</i>	
Crystallinity, Roughness and Porosity Analysis of Hydroxyapatite Coatings Obtained by Plasma Spray Processing	215
<i>S.N. Silva, J.R.T. Branco, M.M. Pereira</i>	

Influence of Crystal Growth on Sputtered Films of Hydroxyapatite onto Titanium	219
<i>J. Hamagami, D. Kokubu, T. Umegaki, K. Yamashita</i>	
Conversion of Electrolytically Deposited Monetite to Hydroxyapatite	223
<i>M.H. Prado da Silva, G.D.A. Soares, C.N. Elias, I.R. Gibson, S.M. Best, W. Bonfield</i>	
Mechanical and Structural Characterisation of Bioactive Coating	227
<i>X.-Y. Yang, M. Wang, K.-A. Khor, Y. Wang</i>	
F. Cements	
Comparative Study of Some Experimental or Commercial Calcium Phosphate Bone Cements	231
<i>F.C.M. Driessens, M.G. Boltong, E.A.P. DeMaeyer, C.W.J. Vercrusse, R. Wenz, R.M.H. Verbeeck</i>	
Setting Contraction of VLC Composite Resins and Glass-Ionomer Cements	235
<i>V. Fano, W.-Y. Ma, I. Ortalli, I.K. Pozela</i>	
Influence of Reaction Kinetics on the Setting and Hardening Properties of DCP- α -TCP Bone Cements	239
<i>E. Fernandez, S.M. Best, F.J. Gil, M.P. Ginebra, F.C.M. Driessens, J.A. Planell, W. Bonfield</i>	
The Effect of Na ₂ HPO ₄ Addition on the Setting Reaction Kinetics of an α -TCP Cement	243
<i>M.P. Ginebra, E. Fernández, F.C.M. Driessens, J.A. Planell</i>	
Incorporation of a Controlled-Release Glass into a Calcium Phosphate Cement	247
<i>I. Khairoun, M.P. Ginebra, M.G. Boltong, S. Martinez, J.A. Planell, F.C.M. Driessens</i>	
New Hydroxyapatite Composite Resin as a Bioactive Bone Cement: Improvement of Handling and Mechanical Properties	251
<i>T. Shibuya, M. Saito, K. Kawagoe, K. Hino, T. Nakashima, A. Murakami, T. Ochi</i>	
Influence of Polysaccharides on Brushite Cement Properties	255
<i>P. van Landuyt, G. Pouchkine, J. Lemaître</i>	
IV. CELLS AND BIO CERAMICS INTERACTIONS IN VITRO	259
Al ₂ O ₃ Containing AW Glass Ceramic Stimulates <i>In Vitro</i> Bone Formation	261
<i>H. Ohgushi, T. Yoshikawa, H. Nakajima, S. Tamai, S. Tabata, Y. Dohi, K. Okunaga</i>	

Atomic and Molecular Mechanisms Underlying the Osteogenic Effects of Bioglass ^R Materials	265
<i>L. Chou, S. Al-Bazie, D. Cottrell, R. Giodano, D. Nathason</i>	
The Response of Human Osteoblast Cell Lines to Phosphate-Based Soluble Glasses	269
<i>V. Salih, I.J. Jalisi, D. Lee, K. Franks, G.W. Hastings, J.C. Knowles, I. Olsen</i>	
An <i>In Vitro</i> Evaluation of Nanophase Alumina for Orthopaedic/Dental Applications	273
<i>T.J. Webster, R.W. Siegel, R. Bizios</i>	
Cell Proliferation and Antigen Expression on Hydroxyapatite/CaO-P ₂ O ₅ Multi-Layered Coatings	277
<i>M.P. Ferraz, J.C. Knowles, I. Olsen, F.J. Monteiro, J.D. Santos</i>	
Study of Osteopontin Involvement in Osteoblast Differentiation for Allogenic Transplantation of <i>In Vitro</i> Cultured Bone	281
<i>A. Nemoto, T. Uemura, Y.-K. Liu, T. Yoshikawa, T. Ushida, T. Tateishi</i>	
Activity of Human Osteoblast-Like Cells on Bioglass ^R , Hydroxyapatite and Fluoride-Substituted Hydroxyapatite	285
<i>A.J.S. Peaker, K.-A. Hing, I.R. Gibson, L. Di-Silvio, S.M. Best, L.L. Hench, W. Bonfield</i>	
Effect of Bovine Bone-Derived Materials on Human Osteoclast-Like Cell <i>In Vitro</i>	289
<i>C. Frondoza, R.Z. LeGeros, D.S. Hungerford</i>	
Effect of Variation in Ca:P Ratio on Cellular Response of Primary Human Osteoblast-Like Cells to Hydroxyapatite-Based Ceramics	293
<i>K.-A. Hing, I.R. Gibson, L. Di-Silvio, S.M. Best, W. Bonfield</i>	
Effects of Biomaterials on Osteoarthritis and Rheumatoid Synovial Cells: Modulation of Eicosanoid and Proinflammatory Cytokine Production	297
<i>B. Liagre, J.L. Charissoux, P. Vergne, D. Bernache-Assollant, J.L. Beneytout</i>	
The Gene Expression of MT1-MMP, Cathepsin K, MMP-9 and TRAP in Highly Enriched Rabbit Osteoclasts Induced by Different Bone Matrix Proteins and Ivory at the Transcription Level	301
<i>H.-Y. Deng, T. Uemura, A. Nemoto, Y.-K. Liu</i>	
Sol-Gel Derived Titania Coatings for Cell-Culture Substrates	305
<i>J. Elbel, L. Polonchuk, K.L. Eckert, H. Eppenberger, E. Wintermantel</i>	
Effect of Silicon Nitride Ceramic on Human Osteoblast-Like Cells	309
<i>A. Sohrabi, R.C. Kue, J. Lin, D.C. Nagle, C.G. Frondoza, D.S. Hungerford</i>	

Flow Cytometry Analysis of Glass-Reinforced Hydroxyapatite-Induced Changes in Cell Proliferation and Function	313
<i>I. Olsen, M.A. Lopez, J.D. Santos, F.J. Monteiro, J.C. Knowles</i>	
Effects of a Bioactive Glass on Macrophages Activation	319
<i>M. Bosetti, L.L. Hench, J. Wilson, M. Cannas</i>	
Bioresorbable Bone Substitute Materials Made of Sintered Carbonate Apatites	323
<i>Y. Doi, S. Saku, K. Iwanaga, T. Kajimoto, Y. Moriwaki, K. Yamamoto, T. Shibutani, Y. Iwayama, Y. Mizuta, Y. Ikeda</i>	
55S Bioglass Promoted Differentiation of Cultured Rat Osteoblasts and Created a Template for Bone Formation	327
<i>C. Loty, J.M. Sautier, S. Loty, E. Jallot, N. Forest</i>	
Immunosuppressant FK506 Promotes Osteoblastic Differentiation of Marrow Stromal Cells	331
<i>H. Nakajima, T. Yoshikawa, H. Ohgushi, S. Tamai, Y. Dohi, K. Ichijima</i>	
<i>In Vitro</i> Interactions of Osteoclast-Like Cells and Hydroxyapatite Ceramics	335
<i>Y. Fujimori, H. Mishima, K. Sugaya, T. Sakae, R.Z. LeGeros, Y. Kozawa, H. Nagura</i>	
V. TISSUE RESPONSE TO BIO CERAMICS	339
Condensed Calcium Phosphates for Soft Tissue and Bone Repair/Regeneration	341
<i>M.J. Filiaggi, J.D. Wells, S.A.F. Peel, R.M. Pilliar, M.D. Grynpas, R.A. Kandel</i>	
Bioactivity and Biodegradability: Melt vs. Sol-Gel Derived Bioglass ^R <i>In Vitro</i> and <i>In Vivo</i>	345
<i>D.C. Greenspan, J.-P. Zhong, D.L. Wheeler</i>	
New Putty Composite Materials for Bone Defects in Dentistry	349
<i>A.M. Gatti, L.L. Hench, E. Monari, J. Thompson, D. Tanza</i>	
Degradation of Hydroxyapatite, Fluorapatite and Fluorhydroxyapatite-Coating of Dental Implants in Dogs	353
<i>P. Frayssinet, L. Gineste, M. Gineste, A. Ellefterion, A. Guilhem, N. Rouquet</i>	
α -BSM TM : A Resorbable Apatitic Calcium Phosphate Bone Substitute	357
<i>D. Knaack, M. Aioloa, A. Tofghi, A. Catalano, C. Rey, N. Nies, D.D. Lee</i>	

<i>In Vivo</i> Evaluation of Resorption, Bone Matrix Osteoclastic and Deposition and Estimation of Osteoblastic Activity of Biocement D in a Cancellous Bone Defect	363
<i>R. Wenz, F.C.M. Driessens, M.G. Boltong, M. Dard, B. Nies</i>	
<i>In Vivo</i> Reactions of β -Tricalcium Phosphate and Hydroxyapatite Single Crystals with Bone Marrow of Rats: I. Reactions of Hydroxyapatite Single Crystals	367
<i>T. Kobayashi, S. Nakamura, M. Ohgaki, K. Yamashita</i>	
Bioactive Composite: Comparison of Ceramic Fillers on Osteoconductivity and Bone-Bonding Strength	371
<i>M. Kobayashi, T. Nakamura, Y. Okada, S. Shinzato, T. Kokubo, T. Kikutani</i>	
<i>In Vivo</i> Histological Evaluation of HA/N-Carboxymethylchitosan Fillers	375
<i>C. Mangano, A. Scarano, M. Piattelli, A. Piattelli, R. Martinetti</i>	
Bioglass ^r -Dextran Composite Tested in the Rabbit Femur	379
<i>I. Thompson, C. Chan, P. Robinson, P. Revell, J. Wilson, L.L. Hench</i>	
Removal Pathway of Silicon Released from Bioactive Glass Granules <i>In Vivo</i>	383
<i>W. Lai, P. Ducheyne, J. Garino</i>	
Inflammatory Potential of <i>In Vivo</i> Aged Basic Calcium Phosphate (BCP) Crystals	387
<i>F. Prudhommeaux, C. Rey, A. Meunier, T. Bardin</i>	
Bone-Bonding Strength of Alumina Bead Composite	391
<i>S. Shinzato, M. Kobayashi, H. Fujita, K. Choji, T. Kokubo, T. Nakamura</i>	
Resorption of Collagen-Carbonate Apatite Complex in Skull Defects	395
<i>T. Kajimoto, T. Tanabe, K. Kondou, S. Saku, K. Yamamoto, Y. Doi</i>	
Preliminary <i>In Vivo</i> Evaluation of Synthetic Calcium Phosphate Materials	399
<i>A.M. Gatti, R.Z. LeGeros, E. Monari, D. Tanza</i>	
Bone Formation with Apatite-Collagen	403
<i>I. Toda, N. Kitayama, H. Oonishi, M. Muraoka, F. Sugihara, Y. Gonda, F. Suwa</i>	
Histological Study of Calcium Phosphate Ceramics Implanted in Human Long Bones	407
<i>P. Frayssinet, C. Schwartz, B. Beya</i>	
Comparison of Bone Growth Behaviour into Spaces of Hydroxyapatite and AW Glass Ceramic Particles	411
<i>H. Oonishi, N. Murata, M. Saito, S. Wakitani, K. Imoto, N. Kim, M. Matsuura</i>	

Bioglass [®] Surface Reactivity: From <i>In Vitro</i> to <i>In Vivo</i> <i>J.-P. Zhong, D.C. Greenspan</i>	415
Ultra-High-Strength Hydroxyapatite/Poly(L-Lactide) Composite Rods for Internal Fixation of Bone Fractures: <i>In Vivo</i> Study <i>T. Furukawa, Y. Matsusue, T. Yasunaga, M. Kobayashi, H. Fujita, Y. Shikinami, M. Okuno, T. Nakamura</i>	419
Bioactivity of Organically Modified Ceramics Film Coated on Polymer Substrate <i>K. Tsuru, S. Hayakawa, C. Ohtsuki, A. Osaka</i>	423
Osteoconductive Properties of Bioactive Glasses in a Bulk Form and as a Coating on Alumina <i>M. Hamadouche, R.S. Nizard, A. Meunier, C. Blanchat, P. Masquelier, L. Sedel</i>	427
Blast Coating Method-Tissue Response to Titanium Implant Coated with Hydroxyapatite at Room Temperature <i>T. Mano, Y. Ueyama, K. Ishikawa, T. Koyama, T. Matsumura, K. Suzuki</i>	431
<i>In Vivo</i> Evaluation of a Novel Calcium Phosphate Cement for Use in Repair and Reconstruction of Bone Tissue <i>S.J. Gadaleta, R.S. Sapienszko, E.M. Erbe</i>	435
Augmentation of Cancellous Screw Fixation with a Bioactive Cement (cap) <i>In Vivo</i> <i>K. Kawagoe, T. Shibuya, M. Saito, T. Nakashima, K. Hino, T. Ochi</i>	439
Histological Studies in Clinical Cases on Interface Bioactive Bone Cement Interposing HA Granules Between Bone and PMMA Bone Cement <i>H. Oonishi, N. Murata, M. Saito, S. Wakitani, K. Imoto, N. Kim, M. Matsuura</i>	443
Comparison of the Tissue Response to Calcium Phosphate Cements with Various Setting Accelerator <i>K. Ishikawa, Y. Miyamoto, K. Suzuki</i>	447
A Comparative Study of Ultrastructures of the Interfaces Between Three Kinds of Bioactive Bone Cement and Bone <i>Y. Okada, M. Kobayashi, H. Fujita, Y. Katsura, H. Takadama, T. Kokubo, T. Nakamura</i>	451