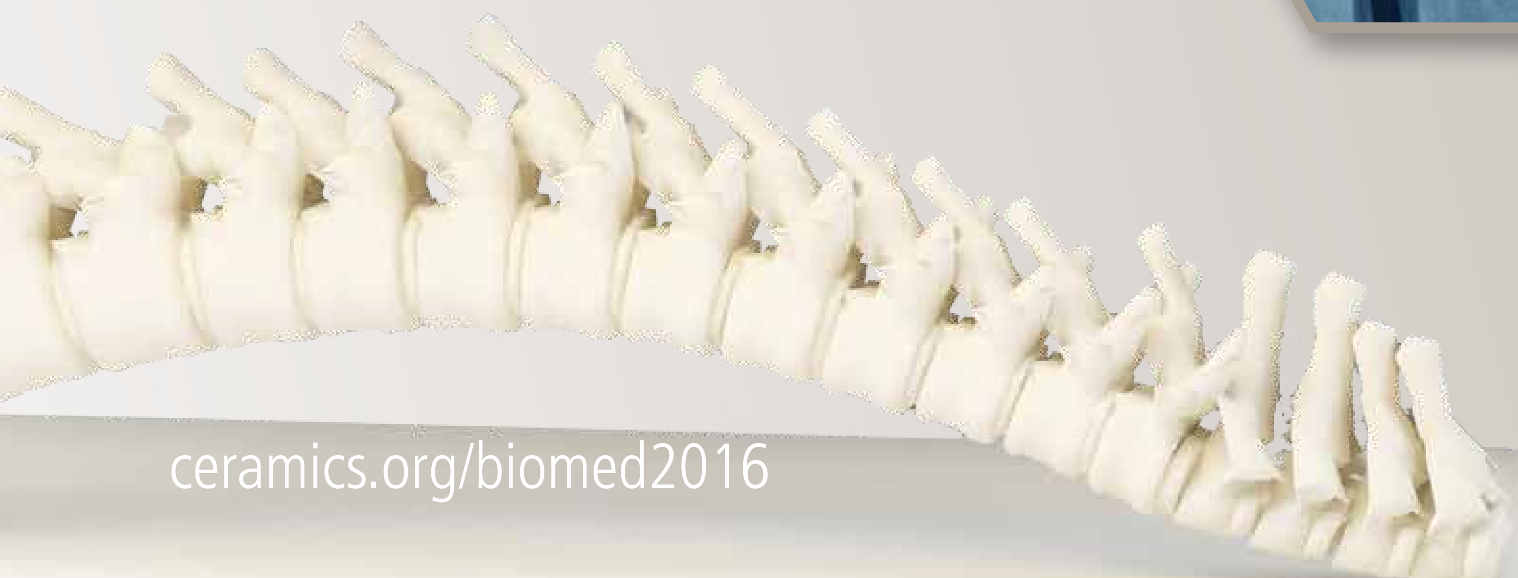
CONFERENCE PROGRAM

INNOVATIONS IN BIOMEDICAL MATERIALS 2016

July 29-31, 2016
Hyatt Rosemont, Chicago, Ill.



ceramics.org/biomed2016

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ECERS

Society For Biomaterials

Ceramic and Glass Materials for Medical Implants, Medical Devices, and Tissue Engineering

INNOVATIONS IN BIOMEDICAL MATERIALS 2016

WELCOME

Welcome to the Innovations in Biomedical Materials 2016 Meeting. This is the third in a series of biomaterial meetings organized by The American Ceramic Society that emphasize collaboration between R&D, medical practitioners, and biomedical materials manufacturers/marketers to better develop emerging technologies into marketable products.

This year's meeting highlights five Plenary Speakers including:

- Robert M. Streicher, Universita dell'Insubria, Varese, presenting Periprosthetic Joint Infection: Is There a Role for Oxide Ceramics in its Prevention?
- Prashant N. Kumta, University of Pittsburgh, presenting 3-D Printing of Resorbable Calcium Phosphate Cement Scaffolds for Bone Regeneration – Myth or Reality?
- Daniel G. Anderson, Massachusetts Institute of Technology, presenting Combinatorial Development of Materials for Islet Transplantation
- Ming H. Wu, Edwards Lifesciences Corporation, presenting Transcatheter Heart Valve Biomaterials
- Joshua J. Jacobs, Midwest Orthopaedics, Rush University Medical Center, presenting Tribocorrosion of Orthopaedic Implants: Current Concepts and Clinical Ramifications

Immediately following the final three plenary presentations will be an expert panel session where the audience can interact with renowned experts in the biomedical field.

The meeting also includes a robust technical program consisting of the below five tracks

- Track 1: Orthopedic Application – Where Are We? Where Do We Need To Go
- Track 2: Dental and Maxillofacial Applications
- Track 3: Material Needs for Medical Devices
- Track 4: Advanced Manufacturing Technologies
- Track 5: Power Sources, Energy Harvesting, Power Transmission and Telemetry

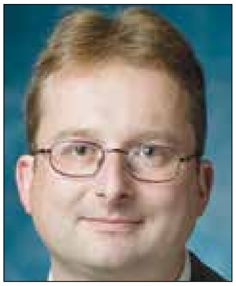
This meeting is endorsed by the European Ceramic Society and the Society for Biomaterials. A special thanks to our sponsor Oxy-Gon Industries, Inc.

Thank you for joining us. We hope you have a rewarding and beneficial meeting experience.

PROGRAM CHAIRS

Roger Narayan
Univ. of North Carolina, USA

Alessandro Alan Porporati
CeramTec GmbH, Germany



Markus Reiterer
Medtronic, PLC, USA

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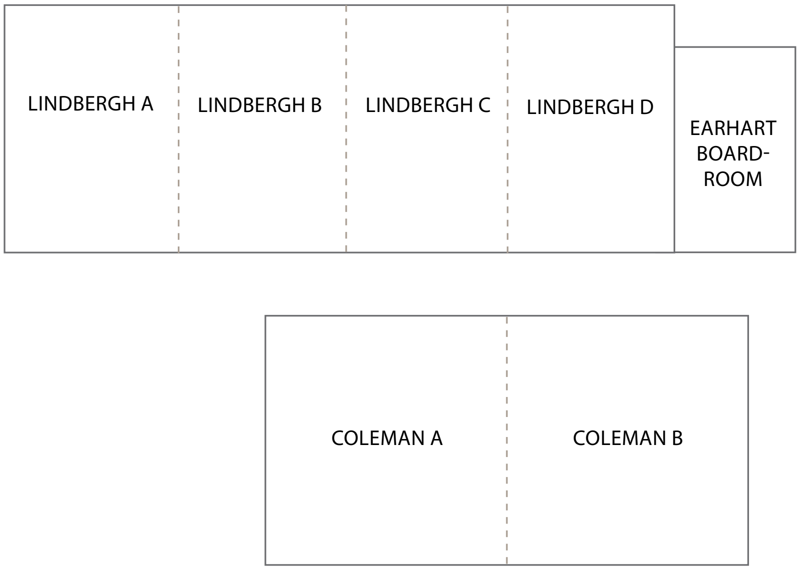
HYATT ROSEMONT
BANQUET LEVEL



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SCHEDULE AT A GLANCE

THURSDAY, JULY 28, 2016

Registration	3:00 p.m. – 6:00 p.m.	Lindbergh Ballroom Foyer

FRIDAY, JULY 29, 2016

Registration	7:30 a.m. – 5:00 p.m.	Lindbergh Ballroom Foyer
Opening Remarks & Plenary Session	8:00 a.m. – 9:25 a.m.	Coleman A/B
Break	9:25 a.m. – 9:40 a.m.	Lindbergh Ballroom Foyer
Concurrent Technical Sessions	9:40 a.m. – 12:00 p.m.	Lindbergh A, B, C, D
Networking Lunch provided	12:10 p.m. – 1:30 p.m.	Coleman A/B
Concurrent Technical Sessions	1:30 p.m. – 2:50 p.m.	Lindbergh A, B, C, D
Break	2:50 p.m. – 3:30 p.m.	Lindbergh Ballroom Foyer
Concurrent Technical Sessions	3:30 p.m. – 5:20 p.m.	Lindbergh A, B, C, D
Poster Session and Reception	6:00 p.m. – 8:00 p.m.	Coleman A/B

SATURDAY, JULY 30, 2016

Registration	7:30 a.m. – 5:00 p.m.	Lindbergh Ballroom Foyer
Plenary Session	8:00 a.m. – 9:00 a.m.	Coleman A/B
Expert Panel Session	9:00 a.m. – 10:00 a.m.	Coleman A/B
Break	10:00 a.m. – 10:20 a.m.	Lindbergh Ballroom Foyer
Concurrent Technical Sessions	10:20 a.m. – 12:00 p.m.	Lindbergh A, B, C, D
Networking Lunch provided	12:00 p.m. – 1:30 p.m.	Coleman A/B
Plenary Session	1:30 p.m. – 2:30 p.m.	Coleman A/B
Expert Panel Session	2:30 p.m. – 3:30 p.m.	Coleman A/B

SUNDAY, JULY 31, 2016

Registration	7:30 a.m. – 10:00 a.m.	Lindbergh Ballroom Foyer
Plenary Session	8:00 a.m. – 9:00 a.m.	Coleman A/B
Expert Panel Session	9:00 a.m. – 10:00 a.m.	Coleman A/B

PLENARY SPEAKERS

Friday, July 29 | 8:00 – 8:45 a.m.

Robert M. Streicher, Faculty of Medicine and Surgery, Universita dell'Insubria, Varese

Title: ***Periprosthetic joint infection: Is there a role for oxide ceramics in its prevention?***

Biography: Streicher studied polymer science in Vienna, Austria. After holding positions in research and production in Austria and Italy, he joined Sulzer Medizinaltechnik in 1981. There, he held various research positions and introduced several new technologies. He received his Ph.D. degree in mechanical engineering with his thesis "Tribology of artificial joints," in 1993. In 1996, he joined Stryker in the position of director strategic research. Since 2013 he is vice-president of scientific and clinical affairs at CeramTec GmbH. He has published more than 350 abstracts, papers, and book chapters and edited a book on tribology in arthroplasty. He teaches biomaterials and biomechanics at the Universities of Varese ("Insubria", Italy) and Zurich ("ETHZ" Switzerland) and, among other positions, he served as secretary general and as president of the International Society of Technology in Arthroplasty (ISTA).

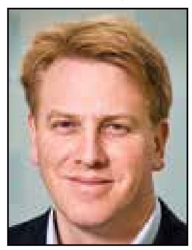
Friday, July 29 | 8:45 – 9:25 a.m.

Prashant N. Kumta, University of Pittsburgh

Title: ***3-D Printing of Resorbable Calcium Phosphate Cement Scaffolds for Bone Regeneration – Myth or Reality?***

Biography: Prashant Kumta obtained his bachelor of technology with honors in metallurgical engineering from the Indian Institute of Technology, Bombay, India in 1984. This was followed by M.S. and Ph.D. degrees in materials science and engineering from the University of Arizona in 1987 and 1990, respectively. He joined the department of materials science and engineering at Carnegie Mellon University following his graduation in 1990 as an assistant professor and was promoted to full professor with tenure in 1999. He also held joint faculty appointment in the biomedical engineering department. He joined the University of Pittsburgh in 2007. Kumta is the author and co-author of more than 150 refereed journal publications and has given more than 200 conference presentations with more than 66 invited presentations. He was also the recipient of the research initiation award from the National Science Foundation in 1993 and has been continuously listed in Who's Who in Science and Engineering, Who's Who in America, Who's Who in the World and Who's Who in American Education since 1999. He was the founding organizer of the first symposium on "electrochemically active materials for energy storage and devices" for the annual meeting of the American Ceramic Society held in Indianapolis in 1995, and has been actively involved in its organization and execution to date. He is currently the editor-in-chief of *Materials Science and Engineering: B, Advanced Functional Solid-State Materials*, an international journal by Elsevier Publications.

Saturday, July 30 | 8:00 – 9:00 a.m.



Daniel G. Anderson, Associate Professor, Massachusetts Institute of Technology

Title: ***Combinatorial Development of Materials for Islet Transplantation***

Biography: Daniel G. Anderson is the Samuel A. Goldblith professor of applied biology, associate professor, chemical engineering and Institute for Medical Engineering and Science, and member of the Koch Institute for Integrative Cancer Research at MIT. He received his PhD in molecular genetics from the University of California at Davis. At MIT, he pioneered the use of robotic methods for the development of smart biomaterials for drug delivery and medical devices. His work has led to the first methods rapid synthesis, formulation, analysis, and biological evaluation of large libraries of biomaterials for use in medical devices, cell therapy and drug delivery. In particular, the advanced drug delivery systems he has developed provide new methods for nanoparticulate drug delivery, non-viral gene therapy, siRNA delivery, and vaccines. His work has resulted in the publication of over 230 papers, patents and patent applications. These patents have led to a number of licenses to pharmaceutical, chemical and biotechnology companies, and a number of products that have been commercialized or are in clinical development.

Saturday, July 30 | 9:00 – 10:00 a.m.

EXPERT PANEL DISCUSSION

- **Daniel G. Anderson**, Massachusetts Institute of Technology
- **Shawn Kelley**, Medtronic, PLC
- **Roger Narayan**, University of North Carolina, Chapel Hill

PLENARY SPEAKERS (continued)

Saturday July 30 | 1:30 – 2:30 p.m.

Ming H. Wu, Vice President of Engineering, Edwards Lifesciences Corporation

Title: ***Transcatheter heart valve biomaterials***

Biography: Wu is vice president engineering at Edwards Lifesciences Corporation in Irvine, California, a leading company in heart valve and hemodynamic monitoring technologies, where he manages the advanced materials technology, Global CAD Engineering and Packaging Development Organizations. Before joining Edwards in 2006, Wu had more than twenty years of experience at Memry Corporation, a Nitinol materials and device development and manufacturing company in Bethel, Connecticut. During his career at Memry, he held a variety of technical and senior level management positions including chief metallurgist, director of engineering, vice president general manager, and vice president technology.

Wu received his BS in materials science and engineering from National Tsinghua University, Taiwan, in 1977. From 1980 to 1985, he went on to earn his Master and Ph.D. degrees in materials science and engineering from the University of Illinois at Urbana-Champaign.

Wu is a member of the American Society of Materials (ASM) International, the ASM Shape Memory and Superelastic Technologies Society (SMST) and the American Society for Testing and Materials (ASTM). In addition to these affiliations, he served as a board member of the SMST Society and was a member and chair in the ASM MPMD strategic committee. Wu is currently an editorial board member for the Journal of Shape Memory and Superelasticity. He also participated in the external advisory boards for the materials science and engineering programs at the University of California at Los Angeles (UCLA) and the Fairfield University at Fairfield, Connecticut.

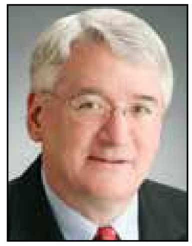
Wu has more than 60 publications in scientific journals and conference proceedings as well as numerous pending and issued patents.

Saturday, July 30 | 2:30 – 3:30 p.m.
EXPERT PANEL DISCUSSION

- **Ming H. Wu,** Edwards Lifesciences Corporation
- **Jeremy Schaffer**, Fort Wayne Metals Research Products Corporation
- **Narendra Vyavahare**, Clemson University

Sunday, July 31 | 8:00 – 9:00 a.m.

ORS Orthopaedic Research Society



Joshua J. Jacobs, Hip and Knee Replacement Orthopedic Surgeon, Midwest Orthopaedics, Rush University Medical Center

Title: ***Tribocorrosion of Orthopaedic Implants: Current Concepts and Clinical Ramifications***

Biography: Joshua J. Jacobs, M.D. received a BS in Materials Science and Engineering from Northwestern University and an MD from the University of Illinois Medical School. He completed his orthopaedic residency at the Combined Harvard Orthopaedic Residency Program and a fellowship in Adult Reconstructive Orthopaedic Surgery at Rush.

Dr. Jacobs is the William A. Hark, M.D./Susanne G. Swift Professor and Chairman of the Department of Orthopaedic Surgery and the Associate Provost for Research at Rush University. Dr. Jacobs' research focuses on the biological consequences of material degradation from joint replacement implants. He has received several research awards including the Kappa Delta Award of the AAOS. He is Past President of the ORS and the AAOS.

Sunday, July 31 | 9:00 – 10:00 a.m.
EXPERT PANEL DISCUSSION

- **Joshua Jacobs**, Rush University Medical Center
- **Robert M. Streicher**, Universita dell'Insubria, Varese
- **Bryan McEntire**, Amedica Corp.
- **Helen Reveron**, University of Lyon
- **Giorgio Perino**, Hospital for Special Surgery
- **Christina Esposito**, Hospital for Special Surgery
- **Caryn Etkin**, AJRR

INVITED SPEAKERS

ORS Orthopaedic Research Society

Christina Esposito, Hospital for Special Surgery

Title: ***Zirconia Phase Transformation in Retrieved BIOLOX Delta Femoral Heads in Total Hip Arthroplasty***

Tolou Shokuhfar, PhD., University of Illinois

Title: ***Analysis of Ferritin for Inhibition of Caries Progression***

Title: ***Gold-Coated Iron Nanoparticle Surface Area Optimization for Increased Implant Drug Delivery***

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Oral Presenters

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Friday, July 29, 2016

Plenary Session I

Room: Coleman A/B

8:00 AM

Opening Remarks

8:05 AM

(BIO-PL- 01-2016) Periprosthetic Joint Infection: Is there a role for oxide ceramics in its prevention?

R. M. Streicher*[1]; 1. Università degli Studi dell'Insubria, Italy

8:45 AM

(BIO-PL- 02-2016) 3D Printing of Resorbable Calcium Phosphate Cement (CPC) scaffolds for Bone Regeneration – Myth or Reality?

P. N. Kumta*[1]; 1. University of Pittsburgh, USA

9:25 AM

Break

Track 1: Orthopedic Application - Where are we? Where do we need to go?

Role of Ceramics in Ortho Today

Room: Lindbergh A

Session Chair: Alessandro Porporati, CeramTec GmbH

9:40 AM

(BIO-01-2016) Adverse local tissue reactions to hip implants: Histological and particle elemental analysis (Invited)

G. Perino*[1]; B. Ricciardi[2]; 1. Hospital for Special Surgery, USA; 2. Hospital for Special Surgery, USA

10:20 AM

(BIO-02-2016) Arthroplasty Registries: A Critical Element for Assuring Patient Safety (Invited)

C. D. Etkin*[1]; 1. American Joint Replacement Registry, USA

11:00 AM

(BIO-03-2016) Zirconia Phase Transformation in Retrieved BIOLOX® Delta Femoral Heads in Total Hip Arthroplasty (Invited)

T. Nguyen[1]; C. Esposito*[1]; S. Boydston-White[3]; C. Koch[1]; D. Padgett[2]; T. Wright[1]; C. Ranawat[2]; 1. Hospital for Special Surgery, USA; 2. Hospital for Special Surgery, USA; 3. City University of New York, Borough of Manhattan Community College, USA

Track 2: Dental and Maxillofacial Applications

Dental and Maxillofacial Applications I

Room: Lindbergh B

Session Chair: Yurdanur Ucar, Cukurova University College of Dentistry

9:40 AM

(BIO-04-2016) Laser Sintering and Other Layered Manufacturing Techniques in Dental Applications (Invited)

Y. Ucar*[1]; 1. Cukurova University College of Dentistry, Turkey

10:20 AM

(BIO-05-2016) Degradation and Mechanical Properties of Zirconia for Dental Prostheses

C. Elias*[1]; H. Elias[1]; C. dos Santos[2]; 1. Instituto Militar de Engenharia, Brazil; 2. Universidade do Estado do Rio de Janeiro, Brazil

10:40 AM

(BIO-06-2016) A New Dry Type of Hydrophilic Surface for Dental Implants

R. Bamola*[1]; 1. Surface Modification Systems Inc., USA

11:00 AM

(BIO-07-2016) Process-Structure Optimization of Dental Implant Surfaces during Manufacturing Process Development

P. Verghese*[1]; M. Wong[2]; 1. Exponent, Inc., USA; 2. Keystone Dental, Inc., USA

11:20 AM

(BIO-08-2016) In situ Monitoring of Porphyromonas Gingivalis on Chemistry-Modulated Silicon Nitride Bioceramics

G. Pezzotti[2]; R. M. Bock[1]; B. J. McEntire*[1]; E. Jones[1]; M. Boffelli[2]; W. Zhu[2]; L. Puppulin[3]; T. Adachi[4]; T. Yamamoto[4]; N. Kanamura[4]; Y. Marunaka[3]; B. Bal[5]; 1. Amedica Corporation, USA; 2. Kyoto Institute of Technology, Japan; 3. Kyoto Prefectural University of Medicine, Japan; 4. Kyoto Prefectural University of Medicine, Japan; 5. University of Missouri, Columbia, USA

11:40 AM

(BIO-09-2016) The improved osseointegration of titanium implants by microarc oxidation and steam-hydrothermal treatment

Y. Zhou*[1]; R. Zhou[1]; D. Wei[1]; 1. Harbin Institute of Technology, China

Track 4: Advanced Manufacturing Technologies

Advanced Manufacturing I

Room: Lindbergh D

Session Chair: Roger Narayan, North Carolina State University

9:40 AM

(BIO-10-2016) Tantalum and Tantalum-based Ceramic Coatings for Increasing the Biocompatibility of Conventional Metal Implant Alloys (Invited)

J. Stiglich*[2]; B. Williams[2]; R. Narayan[1]; 1. North Carolina State University, USA; 2. Ultramet, USA

10:20 AM

(BIO-11-2016) Additive manufacturing of active medical devices (Invited)

R. Narayan*[1]; 1. North Carolina State University, USA

11:00 AM

(BIO-12-2016) Novel manufacturing processes for biomedical materials (Invited)

M. Edirisinghe*[1]; 1. University College London, United Kingdom

11:40 AM

(BIO-13-2016) Manufacturing of macroporous scaffolds via 3D-printing using a new bioactive glass (F18)

M. C. Crovace*[1]; M. T. Souza[1]; A. M. Rodrigues[1]; O. Peitl[1]; E. D. Zanotto[1]; C. A. Fortulan[2]; C. Chinaglia[1]; 1. UFSCar, Brazil; 2. University of São Paulo, Brazil

Track 5: Power Sources, Energy Harvesting, Power Transmission and Telemetry

Medical Component and Device Systems

Room: Lindbergh C

Session Chair: Chao Hu, Iowa State University

9:40 AM

(BIO-14-2016) Enhancing the Energy Density of a Flexible Supercapacitor with Redox-mediated Polymer Electrolyte (Invited)

X. Tang[1]; S. Hu*[1]; 1. Iowa State University, USA

10:20 AM

(BIO-15-2016) On-Board Analysis of Degradation Mechanisms of Lithium-Ion Battery using Differential Voltage Analysis

C. Hu*[1]; M. Hong[2]; Y. Li[1]; H. Jeong[1]; 1. Iowa State University, USA; 2. Iowa State University, USA

10:40 AM

(BIO-16-2016) Bio-Degradable Triboelectric Nanogenerators for Self-Powered Implantable Medical Devices (Invited)
W. Wu*[1]; 1. Purdue University, USA

Track 1: Orthopedic Application - Where are we? Where do we need to go?

Development of New Structural Ceramics in Ortho

Room: Lindbergh A

Session Chair: Alessandro Porporati, CeramTec GmbH

1:30 PM

(BIO-17-2016) Advances in the development of ceramic dental implants and intervertebral prostheses thanks to a novel class of zirconia-based composites (Invited)
H. Reveron*[1]; M. Fornabaio[2]; P. Palmero[2]; L. Montanaro[2]; C. Olagnon[1]; J. Chevalier[1]; 1. Univ Lyon, MATEIS UMR5510, Insa de Lyon, France; 2. Politecnico di Torino, Italy

2:10 PM

(BIO-18-2016) Improvement of Tribological Performance of Hip Replacement Implants using Carbide Derived Carbon (CDC)
M. McNallan*[1]; K. Cheng[1]; M. Mathew[2]; 1. University of Illinois at Chicago, USA; 2. University of Illinois College of Medicine at Rockford, USA

2:30 PM

(BIO-19-2016) 29 year performance of a first generation alumina ceramic total hip arthroplasty in an Iron Man athlete
S. Nelson*[1]; K. Keggi[1]; 1. Yale New Haven Hospital, USA

2:50 PM

Break

Anti-bacterial Strategies

Room: Lindbergh A

Session Chair: Alessandro Porporati, CeramTec GmbH

3:30 PM

(BIO-20-2016) Engineering Bacteriostatic Behavior into Implantable Medical Devices (Invited)
B. J. McEntire*[1]; E. Jones[1]; R. M. Bock[1]; G. Pezzotti[2]; B. Bal[3]; 1. Amedica Corporation, USA; 2. Kyoto Institute of Technology, Japan; 3. University of Missouri, Columbia, USA

4:10 PM

(BIO-21-2016) Silver Containing Multifuncional Bioactive Glass Scaffold for Bone Tissue Engineering
S. K. Arepalli*[1]; H. Tripathi[1]; R. Pyare[1]; S. Singh[2]; 1. Indian Institute of Technology(BHU), India; 2. Indian Institute of Technology (BHU), India

4:30 PM

(BIO-22-2016) Synthesis and Characterisation of Hydrogel/ Bioceramic composites for bone regeneration applications
T. Geever*[1]; M. Canillas Perez[3]; K. Vieira[2]; M. A. Rodríguez Barbero[3]; D. M. Devine[1]; M. J. Nugent[1]; 1. Athlone Institute of Technology, Ireland; 2. Laboratório de Avaliação e Desenvolvimento de Biomateriais, Brazil; 3. Institution Instituto de Cerámica y Vidrio, Spain

4:50 PM

(BIO-23-2016) Surface Mediated Polymer Electrolyte and Nanostructured Ceramic Composites on degradable and non-degradable substrates for non-viral gene delivery
S. Shekhar*[1]; P. S. Murugavel[1]; A. Roy[1]; P. N. Kumta[1]; 1. University of Pittsburgh, USA

Track 2: Dental and Maxillofacial Applications

Dental and Maxillofacial Applications II

Room: Lindbergh B

Session Chair: Liisa Kuhn, Upon Health

1:30 PM

(BIO-24-2016) Multi-layer Polyelectrolyte/Calcium Phosphate Coatings on Scaffolds for Temporal Control of Multiple Growth Factor Delivery (Invited)
L. Kuhn*[1]; 1. UConn Health, USA

2:10 PM

(BIO-25-2016) Marginal fit of CAD/CAM-fabricated implant-fixed titanium and zirconia complete dentures
B. Yilmaz*[2]; H. Al-meraikhi[1]; E. McGlumphy[1]; W. A. Brantley[1]; 1. Ohio State University, USA; 2. The Ohio State University College of Dentistry, USA

2:30 PM

(BIO-26-2016) Analysis of Ferritin for Inhibition of Caries Progression
S. Narayanan[1]; E. Firlar[2]; R. S. Yassar[3]; C. Sukotjo[4]; T. Shokuhfar*[1]; 1. University of Illinois, USA; 2. University of Illinois at Chicago, USA; 3. University of Illinois, USA; 4. University of Illinois, USA

2:50 PM

(BIO-27-2016) Nanostructured commercially pure titanium with high strength for dentistry applications
C. Elias*[1]; D. J. Fernandes[1]; Y. R. Fonseca[1]; 1. Instituto Militar de Engenharia, Brazil

Track 3: Material Needs for Medical Devices

Medical Devices I

Room: Lindbergh C

Session Chair: Markus Reiterer, Medtronic, PLC

1:30 PM

(BIO-28-2016) Functional Tuning of Medical Metals to Solve Emerging Device Demands (Invited)
J. E. Schaffer*[1]; A. J. Griebel[1]; S. Cai[1]; 1. Fort Wayne Metals Research Products Corp, USA

2:10 PM

(BIO-29-2016) Microstructure-property-process of Metallic wire as Leads Conductor in Medical Devices (Invited)
B. Li*[1]; 1. Medtronic, USA

2:50 PM

(BIO-30-2016) Evolution of mechanical behavior and microstructure of MP35N thin wire during aging
C. Xu*[1]; B. Li[1]; W. Li[1]; K. Sun[1]; Z. Song[1]; 1. Cixi Biomedical Engineering Institute, Ningbo Institute of Industrial Technology, China

3:10 PM

Break

3:40 PM

(BIO-31-2016) Fabrication and optimization of vertically aligned platinum wire aptasensor arrays (VAPAA) for impedimetric detection of cardiac biomarkers
M. S. Patil*[1]; P. N. Kumta[1]; 1. University of Pittsburgh, USA

4:00 PM

(BIO-32-2016) Accelerated Durability Testing of Next Generation Feedthroughs for Implantable Medical Devices
A. Thom*[2]; G. O. Munns[2]; B. Tischendorf[2]; M. Reiterer[1]; A. Knudsen[3]; H. Makino[4]; H. Otomaru[4]; J. Wagner[5]; S. Lundberg[5]; 1. Medtronic, PLC, USA; 2. Medtronic Energy and Component Center, USA; 3. Kyocera America, Inc, USA; 4. Kyocera Corporation, Japan; 5. Medtronic Energy and Component Center, USA

4:20 PM

(BIO-34-2016) Annealing Effect of TiO_2 Nanostructure Synthesized by Sol-Gel for Biomedical Applications

A. H. Ramelan*[1]; S. Wahyuningsih[1]; S. Gomez-Ruiz[2]; 1. Sebelas Maret University, Indonesia; 2. Rey Juan Carlos University, Spain

4:40 PM

(BIO-35-2016) Mechanical characterization of PLDLLA/bioactive glass composite, bioactivity and in vivo characterization

E. Perrin*[1]; J. Chenal[1]; R. Seguela[1]; J. Chevalier[1]; S. Meille[1]; A. Maazouz[2]; K. Lamnawar[2]; Y. Fredholm[3]; 1. INSA de Lyon, France; 2. IMP, INSA de Lyon, France; 3. NORAKER, France

5:00 PM

(BIO-36-2016) In vitro biodegradation behavior, mechanical properties, and cytotoxicity of biodegradable Zn–Zr alloys

Z. Song*[1]; L. Yang[1]; P. Guo[1]; Z. Niu[1]; C. Xu[1]; 1. Cixi Biomedical Engineering Institute, Ningbo Institute of Industrial Technology, China

Track 4: Advanced Manufacturing Technologies

Advanced Manufacturing II

Room: Lindbergh D

Session Chair: Roger Narayan, North Carolina State University

1:30 PM

(BIO-37-2016) Capabilities of SLA/DLP Printers for Bioprinting (Invited)

C. Venter*[1]; 1. Autodesk Research, USA

2:10 PM

(BIO-38-2016) A New Class of 3D Printable Particle-Laden Inks for Biomedical Application (Invited)

R. N. Shah*[1]; A. Jakus[2]; 1. Northwestern University, USA; 2. Northwestern University, USA

2:50 PM

(BIO-39-2016) Development and Characterization of graphene embedded electro conductive Bio-ink for extrusion printing of living cells

S. Shafiee*[1]; T. Shokuhfar[1]; 1. UIC, USA

3:10 PM

Break

Poster Session

Room: Coleman A/B

6:00 PM

(BIO-P01-2016) In-vitro Biological Response of The Sol-gel Derived Alumina-bovine Hydroxyapatite (BHA) Composite Powders

A. Yelten[1]; O. Karal-Yilmaz[2]; G. Cetinkaya[2]; S. Yilmaz*[1]; 1. Istanbul University, Turkey; 2. TUBITAK, Marmara Research Centre, Turkey

(BIO-P02-2016) Novel Treatment Methods for Producing 45S5 and 45S Solgel Glasses with High Surface Areas

C. M. Goldbach*[1]; G. Pomrink[1]; L. Howell[2]; 1. NovaBone Products, USA; 2. Particle Solutions, USA

(BIO-P03-2016) Effect of Ceramic Femoral Head Material Composition on Polyethylene Structure and Oxidation in Total Hip Bearings

G. Pezzotti[2]; L. Puppulin[3]; N. Sugano[4]; B. J. McEntire[1]; W. Zhu[4]; B. Bal*[5]; 1. Amedica Corporation, USA; 2. Kyoto Institute of Technology, Japan; 3. Kyoto Prefectural University of Medicine, Japan; 4. Osaka University, Japan; 5. University of Missouri, Columbia, USA

(BIO-P04-2016) Bioactive calcium phosphate cement for bone defect repair

D. K. Mills*[1]; U. Jammalamadaka[1]; K. Tappa[1]; 1. Louisiana Tech University, USA

(BIO-P05-2016) Synthesis of Hydroxyapatite by Room-temperature Reaction between Eggshell and Phosphoric Acid under Various pH and Acid Concentration

S. Lee*[1]; T. Kang[1]; 1. Mokpo National University, Republic of Korea

(BIO-P06-2016) Bactericidal visible-light responsive photocatalyst in medical environments

M. Wong*[1]; Y. Hsu[1]; J. Huang[1]; H. Chang[2]; 1. National Dong Hwa University, Taiwan; 2. Tzu-Chi University, Taiwan

(BIO-P07-2016) 3D Composite Scaffolds Based on Rapid-Prototyped PCL/β-TCP Struts and Electrospun PCL Coated with Collagen and HA for Bone Regeneration

M. Yeo[1]; H. Lee[1]; M. Kim[1]; G. Yang[1]; J. Lee[1]; Y. Koo[1]; G. Kim*[1]; 1. Sungkyunkwan University, Republic of Korea

(BIO-P08-2016) The Gene Expression Profile of the Normal Human Osteoblasts Exposed to Bioactive Glass

M. Demir*[1]; G. Pomrink[1]; 1. NovaBone Products, USA

(BIO-P09-2016) Gold-Coated Iron Nanoparticle Surface Area Optimization for Increased Implant Drug Delivery

D. J. Banner[1]; T. Shokuhfar*[1]; E. Firlar[1]; R. S. Yassar[2]; 1. University of Illinois at Chicago, USA; 2. University of Illinois at Chicago, USA

(BIO-P10-2016) Properties of novel biodegradable Zn-Mg-Ca alloys: structure, mechanical properties and cytotoxicity

L. Yang*[1]; 1. Cixi Institute of Biomedical Engineering, Ningbo Institute of Industrial Technology, China

(BIO-P11-2016) Composites dental modified hydroxyapatite

Z. Kula*[1]; H. Szymanowski[1]; 1. Lodz University of Technology, Poland

Saturday, July 30, 2016

Plenary Session II and Expert Panel on The Role of Materials Science for Diabetes Care

Room: Coleman A/B

8:00 AM

(BIO-PL- 03-2016) Combinatorial development of materials for islet transplantation

D. G. Anderson*[1]; 1. Massachusetts Institute of Technology, USA

9:00 AM

Expert Panel:

- **Daniel G. Anderson, Massachusetts Institute of Technology**
- **Shawn Kelley, Medtronic, LLC**
- **Roger Narayan, University of North Carolina**

10:00 AM

Break

Track 1: Orthopedic Application - Where are we? Where do we need to go?

Improved Osseointegration

Room: Lindbergh A

Session Chair: Alessandro Porporati, CeramTec GmbH

10:20 AM

(BIO-40-2016) Enhanced Osteoconductivity on Surface-Modulated Silicon Nitride Bioceramics Monitored by in situ Raman Spectroscopy

G. Pezzotti[2]; B. J. McEntire[1]; R. M. Bock[1]; W. Zhu[2]; E. Marin[2]; Y. Marunaka[4]; T. Adachi[5]; T. Yamamoto[5]; N. Kanamura[5]; B. Bal*[6]; 1. Amedica Corporation, USA; 2. Kyoto Institute of Technology, Japan; 4. Kyoto Prefectural University of Medicine, Japan; 5. Kyoto Prefectural University of Medicine, Japan; 6. University of Missouri, Columbia, USA

10:40 AM

(BIO-41-2016) Effect of calcium phosphate reinforcement on Gelatin-Chitosan for developing a 3D porous scaffold for bone tissue engineering: A comparative study

K. Maji*[1]; S. Dasgupta[2]; 1. National Institute of Technology (NIT), India; 2. National Institute of Technology (NIT) Rourkela, India

11:00 AM

(BIO-42-2016) Structural characterisation of calcium / strontium substituted phosphate based glasses

U. Patel*[1]; E. Barney[1]; A. Hannon[2]; A. Kennedy[1]; I. Ahmed[1]; 1. University of Nottingham, United Kingdom; 2. Science and Technology Council ISIS, United Kingdom

11:20 AM

(BIO-43-2016) Effect of titanium incorporation on the physical and biological properties of $CaSiO_3$ ceramics

C. Ning*[1]; J. Guo[1]; H. Yu[1]; 1. Shanghai Institute of Ceramics, Chinese Academy of Sciences, China

11:40 AM

(BIO-44-2016) Comparative Study of Mechanical Strength and Bioactivity in Gelatin-Chitosan/Bioactive Ceramic Based Composite Scaffolds for Bone Regeneration

S. Dasgupta*[1]; 1. National Institute of Technology (NIT) Rourkela, India

Track 3: Material Needs for Medical Devices

Medical Devices II

Room: Lindbergh C

Session Chair: Markus Reiterer, Medtronic, PLC

10:20 AM

(BIO-45-2016) Novel Irreversible Chemistry Produces Structurally More Stable Tissue Based Biomaterials (Invited)

N. Vyavahare*[1]; 1. Clemson University, USA

11:00 AM

(BIO-46-2016) Evaluation of Bioactive Borate Glass Fibers in a Partial and Full Thickness Porcine Wound Model (Invited)

S. Jung*[1]; 1. Mo-Sci Corporation, USA

11:40 AM

(BIO-47-2016) Novel Highly Bioactive Glass Fibers as a Potential Biomaterial for Nerve Regeneration

M. T. Souza*[1]; O. Peitl[2]; E. D. Zanotto[2]; A. R. Boccaccini[4]; 1. Universidade Federal de São Carlos, Brazil; 2. Federal University of Sao Carlos, Brazil; 4. University of Erlangen-Nuremberg, Germany

12:00 PM

(BIO-48-2016) Ezechbone®: A resorption-adjustable calcium-based bone void-filling device developed by a NCKU/JMD joint project

J. Chern Lin*[1]; J. Lee[2]; J. Hong[3]; S. Lan[4]; C. Ju[1]; B. Yang[1]; W. Chin[5]; P. Chen[5]; C. Lin[5]; 1. National Cheng-Kung University, Taiwan; 2. National Cheng-Kung University Medical College and Hospital, Taiwan; 3. Wei-En Dental Clinic, Taiwan; 4. National Cheng-Kung University Medical Center Dou-Liou Branch, Taiwan; 5. Joy Medical Devices Corp., Taiwan

Track 4: Advanced Manufacturing Technologies

Advanced Manufacturing III

Room: Lindbergh D

Session Chair: Roger Narayan, North Carolina State University

10:20 AM

(BIO-49-2016) How 3D Printing is Changing Patient Care (Invited)

D. Beski*[1]; 1. Materialise, USA

11:00 AM

(BIO-50-2016) Spherical polymer and glass composite particles for laser sintering of 3D scaffolds

F. Schmidt*[1]; D. Karl[1]; M. Bekheet[1]; F. Zemke[1]; B. Jastram[2]; O. Goerke[1]; H. Schwandt[2]; A. Gurlo[1]; 1. Technische Universität Berlin, Germany; 2. Technische Universität Berlin, Germany

11:20 AM

(BIO-51-2016) Novel Porous Resorbable Calcium Phosphate Microspheres for Biomedical Applications

I. Ahmed*[1]; U. Patel[1]; Z. Hossain[1]; V. Sottile[2]; D. Grant[1]; B. Scammell[3]; 1. University of Nottingham, United Kingdom; 2. University of Nottingham, United Kingdom; 3. University of Nottingham, United Kingdom

11:40 AM

(BIO-52-2016) Novel graphenated self-oriented nanofiber scaffolds for oriented mesenchymal cell growth

I. Hussainova*[1]; R. Ivanov[1]; J. Kazantseva[2]; G. Michael[3]; 1. Tallinn University of Technology, Estonia; 2. Cellin Technologies, Estonia; 3. AALTO University Foundation, Finland

Plenary Session III and Expert Panel on The Role of Materials Science on Vascular and Cardiac Therapy

Room: Coleman A/B

1:30 PM

(BIO-PL- 04-2016) Transcatheter Heart Valve Biomaterials

M. H. Wu*[1]; 1. Edwards Lifesciences LLC, USA

2:30 PM

Expert Panel:

- **Ming H. Wu, Edwards Lifesciences Corporation**
- **Jeremy Schaffer, Fort Wayne Metals Research Products Corporation**
- **Narendra Vyavahare, Clemson University**

Sunday, July 31, 2016

Plenary Session IV and Expert Panel on The Role of Material Science in Orthopedics

Room: Coleman A/B

8:00 AM

(BIO-PL-05-2016) Tribocorrosion of Orthopaedic Implants: Current Concepts and Clinical Ramifications

J. J. Jacobs*[1]; 1. Rush University Medical Center, USA

9:00 AM

Expert Panel:

- **Joshua J. Jacobs, Rush University Medical Center**
- **Robert M. Streicher, Universita dell Ínsubria, Varese**
- **Bryan McEntire, Amedica Corp.**
- **Helen Reveron, University of Lyon**
- **Giorgio Perino, Hospital for Special Surgery**
- **Christina Esposito, Hospital for Special Surgery**
- **Caryn Etkin, AJRR**

Friday, July 29, 2016

Plenary Session I

Room: Coleman A/B

8:05 AM

(BIO-PL- 01-2016) Periprosthetic Joint Infection: Is there a role for oxide ceramics in its prevention?

R. M. Streicher*[1]; 1. Università degli Studi dell'Insubria, Italy

The presence of an implant reduces 100'000x the bacteria concentration needed to induce infection, since bacteria are able to survive in periprosthetic environment adhering to the implant. Periprosthetic Joint Infection (PJI) is a rare, but devastating problem with a high risk of mortality. It often requires multiple readmissions and invasive surgeries, where also the emotional health of the patient is compromised. The PJI care costs are substantially more than that of a primary surgery, which with its increasingly higher incidence is causing an economic burden in United States. PJI is caused by antibiotic resistance bacteria biofilm, strongly resistant to common pharmaceutical treatment. One of the key factors in preventing PJI is to decrease bacterial adhesion affecting implants surface: this is a very complex process, influenced by materials features and close local environment. Oxide ceramics for arthroplasty with their chemico-physical surface properties may be able to favor protein adsorption. Such feature might be correlated with biofilm adhesion and growth. Oxide ceramic surfaces have shown in recent in-vitro and ex-vivo studies to be less prone to be colonized by bacterial strains in comparison to metal and polymer surfaces. Hip arthroplasty registries in their latest analyses are confirming the capability of oxide ceramic bearings to be beneficial in terms of reduced PJI incidence.

8:45 AM

(BIO-PL- 02-2016) 3D Printing of Resorbable Calcium Phosphate Cement (CPC) scaffolds for Bone Regeneration – Myth or Reality?

P. N. Kumta*[1]; 1. University of Pittsburgh, USA

Bone fractures exceeding a critical size require bone replacement materials or bone grafts to successfully heal the bony defects in an acceptable time. Among the various synthetic bone grafts explored, CPCs are clinically preferred due to the excellent handling and setting characteristics in addition to their chemical similarity to natural bone. It is extremely challenging within the operating room (OR) environment to create CPC based scaffolds in-situ, matching the arbitrary and complex 3D anatomical shapes with hierarchical porous structures mimicking the macroscopic and the internal microstructure of bony tissues, while providing the temporary mechanical function and mass transport properties. These problems are obviated by 3D printing of customized patient specific implants. This presentation describes 3D printing of novel CPC scaffolds with predesigned architecture and macro-pores. The regenerative capabilities of these printed CPC constructs were tested in a rabbit critical sized ulnar model and the results show union of the defects and formation of new bone on the printed scaffolds with or without the addition of any exogenous growth factors such as BMP-2. Successful outcome was potentially attributed to nanostructured CPC rendering rapid resorption yielding high Ca^{2+} concentration in the bone regeneration environment.

Track 1: Orthopedic Application - Where are we? Where do we need to go?

Role of Ceramics in Ortho Today

Room: Lindbergh A

Session Chair: Alessandro Porporati, CeramTec GmbH

9:40 AM

(BIO-01-2016) Adverse local tissue reactions to hip implants: Histological and particle elemental analysis (Invited)

G. Perino*[1]; B. Ricciardi[2]; 1. Hospital for Special Surgery, USA; 2. Hospital for Special Surgery, USA

OBJECTIVE Description of the histological patterns and wear particles observed in the periprosthetic tissue of failed THA in three different implant classes due to ALTR and their association with clinical features of implant failure METHODS Conventional histology and light microscopy examination. Particle analysis: Scanning electron microscopy (SEM), backscatter scanning electron microscopy (BSEM), BSEM-energy-dispersive X-ray spectroscopy (EDS) element mapping examination, transmission electron microscopy (TEM), RESULTS ALTR encompasses three main histological patterns: 1) macrophage predominant, 2) mixed lymphocytic and macrophagic, and 3) predominant sarcoid-like granulomas. Duration of implantation and composition of periprosthetic cellular infiltrates was significantly different among the three implant types examined. Distinct differences in the size, shape, and element composition of the metallic particulate material were detected in each implant class. CONCLUSIONS ALTR encompasses a diverse range of histological patterns, which are reflective of both the implant configuration independent of manufacturer and clinical features such as duration of implantation. Distinct differences in the metallic particulate material can contribute to explain the histological features of the ALTR and variability of performance of the implants.

10:20 AM

(BIO-02-2016) Arthroplasty Registries: A Critical Element for Assuring Patient Safety (Invited)

C. D. Etkin*[1]; 1. American Joint Replacement Registry, USA

Maintaining quality care for total joint arthroplasty (TJA) patients, and understanding implant performance is imperative given the recent recall of a hip implant system which affected nearly 100,000 patients globally. The American Joint Replacement Registry (AJRR) is the first national, multi-stakeholder clinical data registry designed to improve the quality of TJA care. Incorporated in 2009, AJRR began enrollment in 2012. The initial focus on Level I procedural data assesses implant survivorship and reoperation rates. AJRR has expanded rapidly, progressing to Level II (comorbidities and complications) and Level III (PROMs) modules for registry reporting, hospital, and other reporting needs. Hospitals submit data via secure electronic file transfer of procedural metrics extracted from their electronic health record. AJRR internally monitors and externally audits data completeness and accuracy; hospital cases performed vs submitted; time delays from initial contact, contract completion, and data submission. As of April 2016, AJRR has enrolled 675 hospitals, 60 practice groups and 15 surgery centers representing over 360,000 procedures and 4,500 surgeons. While still in its early stages, AJRR is developing a solid foundation to become the standard bearer for understanding patterns of early implant failure and revision burden in the United States.

11:00 AM

(BIO-03-2016) Zirconia Phase Transformation in Retrieved BIOLOX® Delta Femoral Heads in Total Hip Arthroplasty (Invited)

T. Nguyen[1]; C. Esposito*[1]; S. Boydston-White[3]; C. Koch[1]; D. Padgett[2]; T. Wright[1]; C. Ranawat[2]; 1. Hospital for Special Surgery, USA; 2. Hospital for Special Surgery, USA; 3. City University of New York, Borough of Manhattan Community College, USA

BIOLOX® Delta, a zirconia-platelet toughened alumina ceramic composite, is a widely used material for femoral heads in total hip arthroplasty (THA). The tetragonal phase of zirconia is desirable since it can resist the initiation and propagation of cracks. However, the tetragonal phase may transform spontaneously to the monoclinic phase in an aqueous environment, resulting in an increase in grain volume. Zirconia phase change in THA is a clinical concern, since expanding grains have been shown to increase surface roughness of the femoral heads, and therefore increase polyethylene wear of the articulating acetabular liners. Therefore, we analyzed zirconia phase change transformation in 33 retrieved BIOLOX® Delta femoral heads (in vivo < 1 year), and compared the results to measurements on 5 pristine and 5 in vitro aged (134°C, 2 bar water vapor pressure, 10 hours) heads. Raman spectroscopy and surface roughness profilometry were performed. Raman spectroscopy showed evidence of the monoclinic phase in all heads. Femoral heads experienced greater zirconia phase transformation in vivo than in vitro. No correlation was found between surface roughness values and the extent of zirconia phase transformation. With minimal changes in phase change and surface roughness in these retrieved femoral heads, our results suggest that BIOLOX® Delta is a viable material for femoral heads in THA.

Track 2: Dental and Maxillofacial Applications

Dental and Maxillofacial Applications I

Room: Lindbergh B

Session Chair: Yurdanur Ucar, Cukurova University College of Dentistry

9:40 AM

(BIO-04-2016) Laser Sintering and Other Layered Manufacturing Techniques in Dental Applications (Invited)

Y. Ucar*[1]; 1. Cukurova University College of Dentistry, Turkey

The draw points of currently used dental casting and CAD/CAM techniques have led to the introduction of the layered manufacturing (LM) techniques in dental applications. Different LM techniques have been used in many different industries for more than 30 years. Laser sintering, laser melting, 3D printing and lithography are the LM techniques that are most commonly used in dental applications. The number of the papers published in dental literature regarding the applications and success of layered manufacturing techniques has been increasing enormously since 2008. This is not surprising since the techniques are used more commonly. Brief background information will be provided on what LM is, different LM techniques, the materials used and industries using LM. However, the talk will mainly focus on dental applications of LM. Additionally, a summary of the research completed by our group on laser sintering and lithography will be covered. Comparison of the traditional casting vs. laser sintering conducted on base metal alloys will be presented. Layered manufacturing of dental ceramic will be covered as well. Future directions of dental research on LM will be pointed.

10:20 AM

(BIO-05-2016) Degradation and Mechanical Properties of Zirconia for Dental Prostheses

C. Elias*[1]; H. Elias[1]; C. dos Santos[2]; 1. Instituto Militar de Engenharia, Brazil; 2. Universidade do Estado do Rio de Janeiro, Brazil

Available zirconia for fixed dental prostheses (FDPs) machined by a CAD-CAM system is commercially supplied as presintered blocks whose mechanical properties are determined after sintering using standardized specimens. When the FDPs and standardized specimens for mechanical test are prepared from the same blocks, it is possible to observe that the later have a better surface finishing than FDPs. These surface morphological features may influence the mechanical properties and the hydrothermal degradation, as well the development of residual stresses in a thin surface layer. The purpose of this study was to compare the mechanical properties of FDPs machined by CAD-CAM and with those of standardized samples. The results showed a difference in bending strength between machined (911.19 MPa) and polished FDPs (573.84 MPa). ANOVA statistical analysis did not show a difference in flexural strength between nondegraded (911.19 MPa) and degraded (871.94 MPa) FDPs. No differences were found in the bending strength and toughness of standardized samples and FDPs.

10:40 AM

(BIO-06-2016) A New Dry Type of Hydrophilic Surface for Dental Implants

R. Bamola*[1]; 1. Surface Modification Systems Inc., USA

A new technique has been developed to provide high hydrophilicity to dental implants in a dry environment. This research was aimed at developing tissue-compatible implants by modifying the titanium implant's surface. This process provides cost-effective, long term stabilization and storage in "dry" sterile packaging. It is well established that cell behavior on a hydrophilic surface is significantly different from that on a hydrophobic one, and that a hydrophilic surface is much better for osteoblasting process than the hydrophobic surface. Therefore, dental implants are developed with high hydrophilic properties for enhancing osseointegration and decreasing healing times. Currently, wet-packaging of implants has been the proven method to maintain the hydrophilic properties once provided. Wet packaging is provided using specialized packaging, and contains saline or other modified solutions. This is disadvantageous in terms of cost, handling, and time required to insert an implant. Surface Modification Systems, Inc. (SMS) has developed a new technique of ion charging which allows the implant to retain its hydrophilicity in conventional sterile packing, and circumvents the deficiencies of wet type treatments. This study reports on the process, properties and current aging trials that are ongoing.

11:00 AM

(BIO-07-2016) Process-Structure Optimization of Dental Implant Surfaces during Manufacturing Process Development

P. Verghese*[1]; M. Wong[2]; 1. Exponent, Inc., USA; 2. Keystone Dental, Inc., USA

Surface modification of commercially pure titanium dental implants can effect improvements in osseointegration compared to as-turned surfaces. Manufacturing processes often rely on multiple steps to engineer the surface topography at several length scales and to present a favorable surface chemistry in order to achieve these improvements. Realizing consistent surface properties at commercially viable manufacturing volumes becomes a complex process-structure optimization challenge. Material characterization provides an efficient and informative means of mapping the process parameter space, developing detailed process-structure relationships, and troubleshooting errant outcomes. In this talk, we will present the development of an optimized commercial manufacturing process for surface modification of titanium dental implants through a sequence of media blasting, wet etching, anodic oxidation, anodic

spark deposition, and an alkaline treatment. In optimizing the multi-step process, a variety of material characterization techniques were employed to understand process relationships, sensitivity to process parameters, effects of implant geometry, and contamination control. Several examples will be given to demonstrate the important role of material characterization in optimization and validation of a complex dental implant surface modification process.

11:20 AM

(BIO-08-2016) In situ Monitoring of Porphyromonas Gingivalis on Chemistry-Modulated Silicon Nitride Bioceramics

G. Pezzotti[2]; R. M. Bock[1]; B. J. McEntire*[1]; E. Jones[1]; M. Boffelli[2]; W. Zhu[2]; L. Puppulin[3]; T. Adachi[4]; T. Yamamoto[4]; N. Kanamura[4]; Y. Marunaka[3]; B. Bal[5]; 1. Amedica Corporation, USA; 2. Kyoto Institute of Technology, Japan; 3. Kyoto Prefectural University of Medicine, Japan; 4. Kyoto Prefectural University of Medicine, Japan; 5. University of Missouri, Columbia, USA

One of the key challenges in modern dentistry is the development of effective methods to prevent periodontitis. Improved personal hygiene is important, but so also are new biomaterials that inherently resist biofilm formation. Raman spectroscopy has been widely used to study bacteria and it offers the potential of examining metabolic changes in situ. In this study, the metabolism of Porphyromonas gingivalis (PG) was assessed both before and after exposure to chemically-modulated silicon nitride bioceramics. Dense polished silicon nitride discs containing Y_2O_3 and Al_2O_3 were used. To examine the effect of surface chemistry, the polished surfaces of some Si_3N_4 disks were modified either by wet chemical etching or by oxidation. PG (ATCC33227) was grown in brain heart infusion at 37°C for one week under anaerobic conditions and harvested. After dilution, the final density of the bacteria applied to the samples was set at 10^{10} CFU/mml. The bacteria were investigated with respect to their Raman spectra before and after 6-days of exposure to the Si_3N_4 surfaces. Si_3N_4 resistance to PG was found to be mainly the result of chemically driven principles. Lytic activity was observed due to the ceramic's pH-dependent surface chemistry with the formation of peroxynitrite within the bacterium itself. The use of Si_3N_4 as a dental biomaterial may be an effective strategy against periodontitis.

11:40 AM

(BIO-09-2016) The improved osseointegration of titanium implants by microarc oxidation and steam-hydrothermal treatment

Y. Zhou*[1]; R. Zhou[1]; D. Wei[1]; 1. Harbin Institute of Technology, China

Microarc oxidation (MAO) coating containing Ca, P, Si, and Na elements on a titanium (Ti) implant has been steam-hydrothermally treated (ST-MAO) to improve its osseointegration. The bone regeneration, bone-implant contact, and biomechanical push-out force of the modified Ti implants are discussed thoroughly in this work. Because of the microscale porous surface structure and bioactive coating, the biocompatibility and biomechanical property of the MAO coating covered Ti implant have been obviously improved when compared with that of the Ti implant. After steam-hydrothermal treatment, it is clear that the HA nanowires and Ti–OH group are formed on the surface of the ST-MAO coating showing a hierarchical surface structure (nanoscale wires/dots on microscale porous surface), which can promote the formation of new bone. The best in vivo performances for the steam-hydrothermally treated one is attributed to the synergistic effects of surface chemistry and topologic structure. Attributed to the excellent in vivo performance of the surface-modified Ti implant, the hybrid technique of microarc oxidation and steam-hydrothermal treatment could be a promising strategy to improve the osseointegration of the Ti implant.

Track 4: Advanced Manufacturing Technologies

Advanced Manufacturing I

Room: Lindbergh D

Session Chair: Roger Narayan, North Carolina State University

9:40 AM

(BIO-10-2016) Tantalum and Tantalum-based Ceramic Coatings for Increasing the Biocompatibility of Conventional Metal Implant Alloys (Invited)

J. Stiglich*[2]; B. Williams[2]; R. Narayan[1]; 1. North Carolina State University, USA; 2. Ultramet, USA

Tantalum has long been used as an implant material in bone and soft tissue, and Ultramet developed and licensed a process for fabricating open-cell tantalum metal foam bone implants that is approved by the FDA. Under NASA funding, Ultramet developed a process to diffuse highly corrosion-resistant tantalum metal into the surface of conventional stainless steels and superalloys to improve acid corrosion resistance of precision valve components. A thin, metallurgically bonded surface layer was established that graded from pure tantalum to a mixture of tantalum and the substrate elements. The tantalum surface layer precisely replicates intricate substrate features and does not require machining. This diffusion coating can increase the biocompatibility of conventional metal implant alloys, and the ability to harden the surface via partial or full conversion to tantalum nitride has been demonstrated. Additional surface treatments to alter texture may be used to improve the biological functionality of dental and orthopedic implants (e.g. enhance bone formation).

10:20 AM

(BIO-11-2016) Additive manufacturing of active medical devices (Invited)

R. Narayan*[1]; 1. North Carolina State University, USA

Over the past decade, we have examined use of several additive manufacturing technologies, including digital micromirror device-based stereolithography and two photon polymerization, to prepare microstructured and nanostructured materials for medical applications. For example, we have use these additive manufacturing techniques to create small-scale hypodermic needle-shaped structures known as hollow microneedles, which may enable direct interaction between a sensor and subsurface tissues. We have integrated various types of electrochemical sensors with hollow microneedles. These "microneedle sensors" are envisioned for transdermal detection of many types of physiologically-relevant analytes. Current efforts to improve the device design and facilitate clinical translation will also be considered.

11:00 AM

(BIO-12-2016) Novel manufacturing processes for biomedical materials (Invited)

M. Edirisinghe*[1]; 1. University College London, United Kingdom

The key to increasing both enhancement and usage of biomedical materials is to create and develop novel manufacturing methods which are amenable to mass production. This talk will illustrate how the engineering principles of microfluidics, electrohydrodynamics and gyration have helped to create a new generation of biomedical materials manufacture for key areas, such as ultrasound imaging, drug delivery, tissue engineering, orthopaedics, vital for modern healthcare. Examples described will include the creation of novel manufacturing methods for bubbles, vesicles, particles, capsules and fibres.

11:40 AM

(BIO-13-2016) Manufacturing of macroporous scaffolds via 3D-printing using a new bioactive glass (F18)

M. C. Crovace*[1]; M. T. Souza[1]; A. M. Rodrigues[1]; O. Peitl[1]; E. D. Zanotto[1]; C. A. Fortulan[2]; C. Chinaglia[1]; 1. UFSCar, Brazil; 2. University of São Paulo, Brazil

3D-printing has emerged as a key technology for the production of customized bone grafts. Using this technique, it is possible to produce scaffolds exhibiting complex shapes and controllable internal architecture. In the past decade, different technologies have been adapted to use bioactive glasses and glass-ceramics due to their unique biological properties. In this work, a new bioactive glass named "F18" is presented. It is showed that this glass exhibit low tendency to crystallize and enhanced sintering window. The F18 glass also combines a high bioactivity level with a high antibacterial activity, an important property not often remembered. The F18 glass was used to produce macroporous scaffolds via 3D-printing. The scaffolds were subjected to in vitro bioactivity tests using the standard SBF-K9 solution. The compressive strength was measured and compared with literature values for other glass-ceramic scaffolds produced by different techniques. This new bioactive glass is a promissory alternative for bone tissue engineering applications.

Track 5: Power Sources, Energy Harvesting, Power Transmission and Telemetry

Medical Component and Device Systems

Room: Lindbergh C
Session Chair: Chao Hu, Iowa State University

9:40 AM

(BIO-14-2016) Enhancing the Energy Density of a Flexible Supercapacitor with Redox-mediated Polymer Electrolyte (Invited)

X. Tang[1]; S. Hu*[1]; 1. Iowa State University, USA

Flexible supercapacitors have great potential in portable power and wearable electronics due to their low profile and flexibility. However, low-energy density limits their use in the areas that need high-energy. How to enhance their energy density while retaining their high power density and long cycle life is a critical challenge for flexible supercapacitor development. Here we propose to improve the energy density of a flexible supercapacitor with redox-mediated polymer electrolyte. The proposed supercapacitor consists of two graphene electrodes coated with different polymer electrolyte thin films. The electrolyte at the positive electrode (i.e. catholyte) is polyvinyl alcohol doped with lithium bromide (PVA-LiBr), whereas the anolyte is pure PVA. During charge, Br^- is converted to Br_2 at the surface of positive electrode, and Li^+ moves to the negative electrode to form electric double layer. During discharge the reverse happens. With the redox-mediated electrolyte, the positive electrode show ultra-high specific capacitance of 938 F/g at 2A/g discharge current, which provides a device-level specific capacitance of 156 F/g considering the total mass of active materials at both electrodes. With current cell voltage of 1.3V, high device-level energy density of 37 Wh/kg is obtained. Future work is to increase cell voltage to 4V by eliminating water from the polymer electrolyte.

10:20 AM

(BIO-15-2016) On-Board Analysis of Degradation Mechanisms of Lithium-Ion Battery using Differential Voltage Analysis

C. Hu*[1]; M. Hong[2]; Y. Li[1]; H. Jeong[1]; 1. Iowa State University, USA; 2. Iowa State University, USA

Reliability of lithium-ion (Li-ion) rechargeable batteries has been recognized as of high importance from a broad range of stakeholders, including manufacturers of battery-powered devices, regulatory agencies, researchers and the general public. Failures of Li-ion batteries could result in enormous economic losses and catastrophic events. To enable early identification and resolution of reliability issues and proactive prevention of failures, it is important to be able to diagnose, in a quantitative manner, degradation mechanisms of individual battery cells while the cells are in operation. This paper proposes a methodological framework for on-board quantitative analysis of degradation mechanisms of Li-ion battery using differential voltage analysis. In the framework, the task of on-board degradation analysis is decomposed into two phases: 1) offline high precision characterization of half-cell differential voltage (dV/dQ) behavior, which collects high precision voltage (V) and capacity (Q) data from positive and negative electrode half-cells; and 2) online (on-board) quantitative analysis of degradation mechanisms, which adopts recursive Bayesian filtering to online estimate degradation parameters based on measurement of full-cell dV/dQ curve. Simulation results obtained from $LiCoO_2$/graphite Li-ion cells verify the effectiveness of the proposed framework.

10:40 AM

(BIO-16-2016) Bio-Degradable Triboelectric Nanogenerators for Self-Powered Implantable Medical Devices (Invited)

W. Wu*[1]; 1. Purdue University, USA

Emerging applications in implantable devices demand appropriate power sources that can sustainably operate. Currently, powering electronics still relies on batteries, which may be difficult and expensive to replace in medical applications. Self-powered nanosystem that harvests energy from its environment (i.e. the human body) holds promise to address this issue. Triboelectric nanogenerator (TENG) has emerged as a promising technology for efficiently harvesting mechanical energy. It utilizes contact electrification to generate surface charges and electricity. However, materials synthesis in TENG often involves expensive and elaborate processing, and these materials are usually not bio-compatible, presenting challenges for physiological-relevant applications. Another factor affecting the TENG performance is materials properties and topography of contact surfaces. Current techniques for modifying these characteristics of TENG lack the potential for developing scalable processes. In this research, we will manufacture large scale TENG using controllably patterned biocompatible materials (e.g. PVA) with modifiable properties. These flexible TENG can be used to harvest mechanical energy from human body, e.g. muscle stretching and body motion. The converted electricity can be utilized to power small electronic devices, e.g. sensors that measure physiological-relevant parameters.

Track 1: Orthopedic Application - Where are we? Where do we need to go?

Development of New Structural Ceramics in Ortho

Room: Lindbergh A
Session Chair: Alessandro Porporati, CeramTec GmbH

1:30 PM

(BIO-17-2016) Advances in the development of ceramic dental implants and intervertebral prostheses thanks to a novel class of zirconia-based composites (Invited)

H. Reveron*[1]; M. Fornabaio[2]; P. Palmero[2]; L. Montanaro[2]; C. Olagnon[1]; J. Chevalier[1]; 1. Univ Lyon, MATEIS UMR5510, Insa de Lyon, France; 2. Politecnico di Torino, Italy

Interest in zirconia for biomedical applications has increased over the last past years because of their high wear and mechanical resistance coupled with high biocompatibility and aesthetics. Yttria-stabilized zirconia is particularly attractive due to its remarkable strength that can meet mechanical resistance requirements for many applications. However, its relatively low toughness, sensitivity to phase transformation/ageing and to become rough and micro-cracked are

limiting its use. Hence, research is now focusing on the development of new strong, tough and stable zirconia-based ceramics suitable for guaranteeing a perfect reliability with a long lifetime. We recently showed that stable ceria-doped zirconia composites containing two second phases can be prepared through a surface coating route. Here we report and analyse the outstanding strength, toughness, fatigue resistance and plasticity properties observed on such fully-dense multi-phasic ceria-doped zirconia ceramics used on the development of dental implants and intervertebral prostheses prototypes. The plasticity and low strength dispersion characterizing this novel class of zirconia-based composites would be the starting point for changing the paradigm of employing ceramics as structural biomedical materials.

2:10 PM

(BIO-18-2016) Improvement of Tribological Performance of Hip Replacement Implants using Carbide Derived Carbon (CDC)

M. McNallan*[1]; K. Cheng[1]; M. Mathew[2]; 1. University of Illinois at Chicago, USA; 2. University of Illinois College of Medicine at Rockford, USA

Although total hip implant replacement is a common orthopedic surgery in the United States, with more than 250,000 operations performed, these implants may be subject to failure due to wear and corrosion on the joint's contact surfaces. Currently, these implants are produced from metal alloys of cobalt and chromium, or titanium, ultra high molecular weight polyethylene, or oxide ceramics. Carbide derived carbon (CDC) is a nanoporous structure of carbon that can be produced on surfaces of carbide ceramics by chemical extraction of the metal component of the carbide, and which has improved tribological performance in several industrial systems. We propose the use of CDC on contact surfaces of hip replacement implants to increase operating lifetimes of implants and reduce the need for multiple surgeries. CDC can be grown on hard ceramic carbides, such as SiC or TiC by removal of the metal component by reaction with chlorine at elevated temperatures. In-vitro tests were performed to verify the biocompatibility of the CDC after growth of tribologically significant coatings on carbide parts. The coatings were then subjected to tribological testing in simulated biological fluids, and the results were compared with the performance of conventional hip implant materials. The CDC layers showed lower friction coefficients and slower wear compared with the alternative materials.

2:30 PM

(BIO-19-2016) 29 year performance of a first generation alumina ceramic total hip arthroplasty in an Iron Man athlete

S. Nelson*[1]; K. Keggi[1]; 1. Yale New Haven Hospital, USA

In October of 1986, a 43 year old marathoner underwent a right total hip arthroplasty with a Mittelmeier alumina ceramic on ceramic (BiloxTM) articulation combined with a mechanical press fit femoral component (Richard's Biofit) via the direct anterior approach. Within weeks, the patient returned to long distance running, and before long had completed multiple standard marathons and four full Iron Man Triathlons. At the time of his eighteen year follow up visit he had logged over 25,000 miles running, 35,000 miles bicycling and 2000 miles swimming. At that visit he stated that he was slowing down, but when seen at age 72 and 29 years after his hip replacement he remained pain free and continued to jog 14 miles, bike 40 miles and swim 1/2 mile weekly. His x-rays show some horizontal settling of the monoblock, ceramic, screwed in acetabulum and valgus settling of the non-ingrowth, mechanically fixed femoral component. There is no evidence of ceramic wear, nor osteolysis. This living, running human tribology laboratory is a demonstration of the outstanding wear characteristics of even the first generation of alumina ceramics.

Anti-bacterial Strategies

Room: Lindbergh A

Session Chair: Alessandro Porporati, CeramTec GmbH

3:30 PM

(BIO-20-2016) Engineering Bacteriostatic Behavior into Implantable Medical Devices (Invited)

B. J. McEntire*[1]; E. Jones[1]; R. M. Bock[1]; G. Pezzotti[2]; B. Bal[3]; 1. Amedica Corporation, USA; 2. Kyoto Institute of Technology, Japan; 3. University of Missouri, Columbia, USA

Perioperative and latent infections are leading causes of revision surgery for orthopaedic devices resulting in significant increased patient care, comorbidities, and attendant costs. This is a growing problem due to the rising antibiotic resistance of nosocomial bacteria to germicidal therapies. Consequently, development of biomaterials which prevent nascent biofilms is seen as an important clinical remedy. Bacteriostasis is defined as the property of a biomaterial which limits attachment and growth of bacteria without necessarily killing the microorganism. Strategies for improving the bacteriostatic behavior of medical devices are focused in four broad areas: (1) Topographical changes at the micro- and nano-scales which physically impede bacterial adhesion; (2) Alterations to surface chemistry and charge which affect hydrophilicity and can electrostatically repel pathogens; (3) Enhancement of surface chemical moieties which interfere with the bacteria's metabolism and biofilm production; and (4) Surface pretreatments using specific proteins, or by grafting of synthetic and bioinspired polymers which deter surface bonding by microbes. The general aspects of these various strategies along with examples will be discussed in this review. A specific case study of a non-oxide bioceramic, silicon nitride (Si_3N_4), will be highlighted as a unique material exhibiting several bacteriostatic qualities.

4:10 PM

(BIO-21-2016) Silver Containing Multifuncional Bioactive Glass Scaffold for Bone Tissue Engineering

S. K. Arepalli*[1]; H. Tripathi[1]; R. Pyare[1]; S. Singh[2]; 1. Indian Institute of Technology(BHU), India; 2. Indian Institute of Technology (BHU), India

A significant challenge is posed for regeneration of large size bone defects. Special attention has been given to multifunctional scaffolds due to their excellent bioactivity, osteoconductivity and antibacterial properties which are of great importance for bone tissue engineering. The bioactive glasses were prepared with different concentrations of silver by sol–gel method and the scaffold fabricated foam replica technique. The morphology, porous structure and pore size of the scaffold were characterized by SEM. The compressive strength and porosity of the scaffold were measured and found a significant improvement in strength as compared to Ag-free sample. The crystalline phases present in the sample were identified using XRD. Bioactivity of the scaffold was assessed by the immersion of the sample in SBF. The formation of HCA layer was confirmed by FTIR, SEM and XRD. In-vitro cell culture studies viability and cytotoxicity and proliferation of the samples were analysed using human osteosarcoma U2-OS cell lines and found to be biocompatible. Further, cells were attached and grown on the scaffold. The human blood compatibility of the sample was assessed. The silver contained scaffold show antibacterial effect against E.coli bacteria. These qualities make the scaffolds a potential candidate in the regeneration of lost bone.

4:30 PM

(BIO-22-2016) Synthesis and Characterisation of Hydrogel/ Bioceramic composites for bone regeneration applications

T. Geever*[1]; M. Canillas Perez[3]; K. Vieira[2]; M. A. Rodríguez Barbero[3]; D. M. Devine[1]; M. J. Nugent[1]; 1. Athlone Institute of Technology, Ireland; 2. Laboratório de Avaliação e Desenvolvimento de Biomateriais, Brazil; 3. Institution Instituto de Cerámica y Vidrio, Spain

Bioceramic scaffolds exhibit exceptional compressive strength and excellent biocompatibility due to their chemical and structural similarity to the mineral phase of native bone. The main deficiency is their brittle nature, which poses a concern in high load-bearing biological applications. Polymers on the other hand have insufficient strength to meet the mechanical requirements of bone grafts in vivo, whilst suffering from the inability to induce mineralisation. However polymers can be developed by tailoring their physicochemical properties hence do not suffer from brittleness. Polyethylene glycol dimethacrylate and acrylic acid monomeric solution was added to a α-wollastonite and β-tricalcium phosphate scaffold, and polymerised using free radical photopolymerisation technique. FTIR and SEM analysis of the resultant composite illustrated polymer penetration of the bioceramic scaffold. Swelling studies showed a significant decrease in swelling ($p<0.05$) whilst compression results (>100MPa) revealed a significant increase in compressive strength of the composite when compared to the control hydrogel ($p<0.05$), which is comparable to the strength of cortical bone (100-200MPa). Additionally the polymer will be used as a carrier for antimicrobials to prevent infections which is the number one cause for revision surgery in orthopaedics.

4:50 PM

(BIO-23-2016) Surface Mediated Polymer Electrolyte and Nanostructured Ceramic Composites on degradable and non-degradable substrates for non-viral gene delivery

S. Shekhar*[1]; P. S. Murugavel[1]; A. Roy[1]; P. N. Kumta[1]; 1. University of Pittsburgh, USA

Surface mediation using multilayer layer by layer (LbL) polyelectrolyte assemblies (MPA) approach to bind the DNA is a nascent yet viable approach, still largely limited in genetic payloads. We have accordingly developed novel MPA-NanoCaPs-pDNA composites, incorporating nanostructured calcium phosphate plasmid DNA complexes (NanoCaPs-pDNA) that display excellent in-vitro cytocompatibility and gene transfection potential. In the current study, we have demonstrated gene delivery by surface mediation using a set of biodegradable synthetic polycationic and polyanionic polyelectrolytes generated on degradable and non-degradable substrate platforms. SEM, AFM, FTIR, XPS and Ellipsometry were employed to explore the layer build up process as well as the specific adsorption of NanoCaPs-pDNA complexes. Substrates coated with MPA-NanoCaPs-pDNA showed threefold increase in gene transfection of human embryonic kidney cells even up to a week compared to substrates loaded with MPA-pDNA (sans NanoCaPs). Results indicate that MPA are an encouraging platform for achieving controlled release of NanoCaPs-pDNA offering the potential to generate new gene-stimulating biomaterials that can also augment implant technology and likely heralding in a new generation of implants.

Track 2: Dental and Maxillofacial Applications

Dental and Maxillofacial Applications II

Room: Lindbergh B
Session Chair: Liisa Kuhn, Upon Health

1:30 PM

(BIO-24-2016) Multi-layer Polyelectrolyte/Calcium Phosphate Coatings on Scaffolds for Temporal Control of Multiple Growth Factor Delivery (Invited)

L. Kuhn*[1]; 1. UConn Health, USA

Combinations of growth factors synergistically enhance bone regeneration, but typically require sequential, rather than co-delivery delivery of the growth factors for maximum efficacy. Vertical alveolar bone growth around dental implants is particularly challenging as compared to regeneration of a bone defect due to the absence of adjacent bony tissue. Administration of a growth factor that can recruit and proliferate endogenous progenitor stem cells up into a scaffold surrounding an implant, followed by triggering cell differentiation into bone with a second growth factor, is a promising strategy to increase vertical bone growth. Timed sequential delivery of multiple factors from polyelectrolyte multilayer (PEM) coatings requires a barrier layer between the different growth factors to prevent co-delivery that occurs due to diffusion of the factors during layer by layer build-up. We have developed a process for the deposition of a biomimetic calcium phosphate (bCaP) barrier layer within PEM coatings. In vitro cell-based assays were used to prove bCaP successfully prevents interlayer diffusion of two different biomolecules and enables sequential delivery. This modified PEM/bCaP coating is one of the few aqueous, low temperature systems available for sequential, multifactor delivery and can be applied to a wide variety of regenerative applications.

2:10 PM

(BIO-25-2016) Marginal fit of CAD/CAM-fabricated implant-fixed titanium and zirconia complete dentures

B. Yilmaz*[2]; H. Al-meraikhi[1]; E. McGlumphy[1]; W. A. Brantley[1]; 1. Ohio State University, USA; 2. The Ohio State University College of Dentistry, USA

Background: Marginal fit of commonly used CAD/CAM fabricated titanium (Ti) and zirconia (Zr) implant-supported fixed complete prosthesis is not well-known. Purpose. Aim of this study was to compare the marginal fit of Zr and Ti implant-supported CAD/CAM-fabricated fixed complete prosthesis. Materials and methods. A master edentulous model with 4 implants was used. Implants were digitally scanned using scan bodies and a scanner (S600 ARTI, Zirkonzahn). A CAD software was used to design and mill Ti (n=5) and Zr (n=5) prostheses. Prostheses were scanned at one-screw test position using an industrial computed tomography (CT) scanner. Polygonal mesh models were generated and transported to a volume analysis software. 3D gaps between the circular mating surfaces of the prostheses and abutments were measured for 3 adjacent implants that did not have a prosthetic screw (Gap 1, Gap 2 and Gap 3). Results. Material type was not significant for 3D gaps (p=.9038). Mean 3D gaps were significantly different between Gap 3 and 4 in each group (P=.0003). Mean 3D gap for Gap 2 was 48.2 μm for Ti and non-measurably small for Zr. For Gap 3, mean gap was 74.0 μm for Ti and 84.4 μm for Zr. Mean 3D gaps for Gap 4 were 102 μm for Ti and 93.8 μm for Zr. Conclusions. CAD/CAM-fabricated Ti and Zr complete fixed prostheses had similar marginal gaps and all were clinically acceptable. Absolute passive fit was not achieved.

2:30 PM

(BIO-26-2016) Analysis of Ferritin for Inhibition of Caries Progression

S. Narayanan[1]; E. Firlar[2]; R. S. Yassar[3]; C. Sukotjo[4]; T. Shokuhfar*[1];
1. University of Illinois, USA; 2. University of Illinois at Chicago, USA;
3. University of Illinois, USA; 4. University of Illinois, USA

Ferritin, an intercellular protein complex, plays a major role in the iron metabolism and regulation of the body. It prevents toxic iron ions from forming free radicals. Despite its important role in various biological events such as body's inflammatory responses and nutritional balance, its relation on low iron levels and diseases such as early childhood caries (ECC) is very little understood. We hypothesize that ECC, a ferritin level dependent disease, can be prevented if the ferritin biomineralization is well understood and controlled. In this study, biomineralization will be explored by carrying out in-situ mineralization experiments in Graphene Liquid Cell (GLC), wherein the previously mixed ferrous sulfate medium and apoferritin colloidal solutions will be encapsulated in a graphene sandwich and then imaged in transmission electron microscope. The usage of GLC is advantageous in terms of maintaining the native state of ferritins. The crystallinity and chemical information of the iron compounds in the core will be evaluated via the selected area electron diffraction and electron energy loss spectroscopy, respectively. With these characterization and imaging techniques, the relationship between low ferritin levels and ECC disease can be explored. As a future work, biomineralization process in healthy and dysfunctional ferritins from patients with ECC will be compared to understand and prevent such diseases.

2:50 PM

(BIO-27-2016) Nanostructured commercially pure titanium with high strength for dentistry applications

C. Elias*[1]; D. J. Fernandes[1]; Y. R. Fonseca[1]; 1. Instituto Militar de Engenharia, Brazil

Titanium and its alloys are widely used in dental implants because they have high corrosion resistance and adequate biocompatibility. However, commercially pure titanium (cp Ti) and Ti-6Al-4V (Ti G5) have limitations for biomedical applications. The large difference between the modulus of elasticity of cp Ti and Ti G5 and bone leads to improper transmission of forces in the bone-implant interface, a phenomenon called "stress shielding". Another limitation of cp Ti is a low tensile strength, which reduces the possibility to manufacture small implants with thin walls. The limitation of Ti G5 is the release of aluminum and vanadium ions, which are toxic. The objective of this work is to compare the properties of modified cp Ti Grade 4 (Ti G4 Hard) with those of conventional cp Ti and Ti G5. The results of the mechanical tests showed that the Ti G4 Hard tensile strength is higher than for cp Ti 2, 4 and 5. Scanning electron microscopy analysis showed that cp Ti G4 Hard after surface treating has better morphological features than conventional cp Ti and Ti G5. Clinical test showed that Ti G4 Hard has biocompatibility and osseointegration.

Track 3: Material Needs for Medical Devices

Medical Devices I

Room: Lindbergh C
Session Chair: Markus Reiterer, Medtronic, PLC

1:30 PM

(BIO-28-2016) Functional Tuning of Medical Metals to Solve Emerging Device Demands (Invited)

J. E. Schaffer*[1]; A. J. Griebel[1]; S. Cai[1]; 1. Fort Wayne Metals Research Products Corp, USA

Minimally invasive interventions such as endoluminal grafting, aneurysm occlusion, and stenting of congenital heart defects all rely upon reinforcement by thin metallic filaments. Increasing demands around device longevity, downsizing for lessened tissue impact, and the promise of a future absorbable age have accelerated the quest for clinically-driven metals solutions. The purpose of this talk is to provide insight into ongoing research that ties materials selection and processing to functional aspects of medical metals. Three materials innovation cases are presented to highlight potential strategies to improve clinical outcomes. A beta titanium alloy is presented with observation of greater than 4% superelasticity at body temperature and Ni-allergy avoidance by virtue of a Ni-free composition. In the second case, the elastic constants of a 0.40 mm CoNiCr guidewire prematerial are modified over a range of two to one by means of annealing and cold work to reduce wire stiffness while increasing torsional rigidity, thereby enhancing torque path control. Design strategies in absorbable metals are presented with a focus on iron, magnesium and composite wires. In conclusion, evolving solutions are presented including a beta Ti alloy suitable for self expansion, stiffness tuning to enhance CoNiCr guidewires, and degradation control tactics for development of effective nutrient metal scaffolds.

2:10 PM

(BIO-29-2016) Microstructure-property-process of Metallic wire as Leads Conductor in Medical Devices (Invited)

B. Li*[1]; 1. Medtronic, USA

Metallic materials have been used as a conductor in medical devices to transport electrical signal from device to the location for medical treatment. One example is the lead used in pace maker, the pace maker generates electrical signal for the cardiac rhythm and lead transport electrical signal to heart for cardiac rhythm stimulate. The lead conductor is manufactured as a wire form and made of alloys with good corrosion resistance, good conductivity, high fatigue performance and good biocompatibility. The mostly used alloys for lead is able to meet these requirements are MP35N and Pt-Ir. The alloy was manufactured as thin wire to make coils or cables which made into lead and implanted into heart, spinal or brain for electrical stimulate. This work will present the microstructure and process effects on property of MP35N and Pt-20Ir wires. The reliability of leads made of MP35N with different processes will also be discussed.

2:50 PM

(BIO-30-2016) Evolution of mechanical behavior and microstructure of MP35N thin wire during aging

C. Xu*[1]; B. Li[1]; W. Li[1]; K. Sun[1]; Z. Song[1]; 1. Cixi Biomedical Engineering Institute, Ningbo Institute of Industrial Technology, China

MP35N alloy has been widely used in neurology clinic in a form of thin wire due to its high strength and good anti-corrosion properties. However, the production of MP35N thin wire is still difficult with the increasing deformation since the mechanism of the alloy in cold working and aging is not clear. In this paper, we investigated the evolution of mechanical behavior of the MP35N thin wire subjected to 60% cold working during aging via internal friction testing. The microstructural evolution of the alloy was also studied using HRTEM and STEM. The results show the thin wire exhibits an abrupt increase in both strength and modulus at 500°C while the thin wire shows only chemical component segregation in a scale of less than 100nm within the grain after aging at 600°C for 6 min. Severe plastic deformation and low stacking fault energy of the alloy may attribute to the above mechanical behavior and microstructural characteristics.

3:40 PM

(BIO-31-2016) Fabrication and optimization of vertically aligned platinum wire aptasensor arrays (VAPAA) for impedimetric detection of cardiac biomarkers

M. S. Patil*[1]; P. N. Kumta[1]; 1. University of Pittsburgh, USA

Cardiovascular diseases (CVD) are the leading cause of death in developed countries around the world, including the United States. Lack of standard diagnostic methods and slow turnover for processing blood samples in hospital laboratories indicate a dire need for point-of-care (POC) diagnostic biosensors for rapid and sensitive detection of cardiac markers. Therefore, this study focuses on the development and optimization of impedimetric vertically aligned platinum wire aptasensor arrays (VAPAA) for the detection of specific cardiac markers. Various parameters such as platinum surface roughness and diameter and concentrations of the components involved in the fabrication of the aptasensor were tested against clinically relevant concentrations of cardiac markers to assess optimal parameters for detection with the best precision and sensitivity. In addition, aptamer regeneration strategies were explored to create a reusable aptasensor. The fabricated platinum wire aptasensors were successfully optimized to achieve enhanced biosensor sensitivity and precision. The VAPAA generated were also able to detect various concentrations of cardiac markers prepared in phosphate-buffered saline via electrochemical impedance spectroscopy (EIS), and aptamer regeneration achieved via applied potential successfully allowed for the reuse of the biosensors.

4:00 PM

(BIO-32-2016) Accelerated Durability Testing of Next Generation Feedthroughs for Implantable Medical Devices

A. Thom*[2]; G. O. Munns[2]; B. Tischendorf[2]; M. Reiterer[1]; A. Knudsen[3]; H. Makino[4]; H. Otomaru[4]; J. Wagner[5]; S. Lundberg[5]; 1. Medtronic, PLC, USA; 2. Medtronic Energy and Component Center, USA; 3. Kyocera America, Inc, USA; 4. Kyocera Corporation, Japan; 5. Medtronic Energy and Component Center, USA

For well over 30 years a variety of technologies and materials have provided reliable electrical feedthrough function in implantable medical devices (IMDs). This presentation reviews the evolution of predictive models and testing related to biostability and longevity in next generation feedthroughs. Hermetic packaging protects the device from failures associated with corrosion in the implant environment. This packaging must be biocompatible over the service life of the device - now approaching several decades. The present study discusses the selection of representative bench test methodologies (accelerated Arrhenius) and detailed statistical analyses to predict longevity of the next-generation of glass-sealed and ceramic feedthroughs. This approach includes both the foundational materials and the modification of the implant condition associated with polymer potting of the feedthrough. Brazed feedthroughs currently serve in a majority of active IMDs. Reliability predictions for brazed feedthroughs are commonly based on attribute testing of hermeticity. This discussion contrasts the testing approach for brazed feedthroughs with that of next generation feedthroughs, specifically feedthrough structures developed using engineered glass formulations and multilayer high-temperature cofired ceramic technology.

4:20 PM

(BIO-34-2016) Annealing Effect of TiO_2 Nanostructure Synthesized by Sol-Gel for Biomedical Applications

A. H. Ramelan*[1]; S. Wahyuningsih[1]; S. Gomez-Ruiz[2]; 1. Sebelas Maret University, Indonesia; 2. Rey Juan Carlos University, Spain

TiO_2 nanosize particles have attracted significant interest of materials scientists due to their special properties and have attained a great importance in several technological applications such as photocatalysis and biomedical devices. TiO_2 nanoparticles can be produced by a variety of techniques ranging from simple chemical to mechanical to vacuum methods, including many variants of physical and chemical vapor deposition techniques. In the present research work we report the synthesis of TiO_2 nanoparticles by Sol-Gel technique. The characterization of particles was carried out by XRD, TEM and XRF techniques. The importance and applications of these nanoparticles for medical applications are also discussed in this work. The titania nanoparticles were synthesized by drop wise addition of titanium tetrachloride: $TiCl_4$ in ethanol and Pluronic P2243-250G. The reaction was performed at room temperature while stirring under a fume hood due to the large amount of Cl_2 and HCl gases evolved in this reaction. The resulting yellow solution was allowed to rest and cool back to room temperature as the gas evolution ceased. The suspensions obtained were dried in an oven for several hours at 80 ºC until amorphous and dried TiO_2 particles were obtained. The obtained powder samples were calcined for one hour in a box furnace at temperature ranging from 375 to 600 ºC in an ambient atmosphere.

4:40 PM

(BIO-35-2016) Mechanical characterization of PLDLLA/bioactive glass composite, bioactivity and in vivo characterization

E. Perrin*[1]; J. Chenal[1]; R. Seguela[1]; J. Chevalier[1]; S. Meille[1]; A. Maazouz[2]; K. Lamnawar[2]; Y. Fredholm[3]; 1. INSA de Lyon, France; 2. IMP, INSA de Lyon, France; 3. NORAKER, France

Currently, 50% of implantation procedures performed in the USA involve the use orthopedic implants with bone being the major replaced organ. Biocomposites made of the mixture of bioactive glass and medical grade resorbable polymer rise as suitable bone replacement candidates as they can be tailored to combine biocompatibility, bioactivity, resorbability and mechanical resistance. The purpose of this work is to elaborate and characterize the properties of a bioactive and resorbable composite made of PLDLLA and 45S5 bioactive glass. The biocomposite was processed following a patented protocol from Noraker (FR). The microstructural and mechanical properties have been evaluated. Moreover, the bioactivity and the biocompatibility have also been analyzed and an animal implantation was carried out. The proposed material proved to be appropriate for some bone repair applications. Indeed, it showed a outstanding osteointegration and the presence of bioactive glass accelerated significantly the bone growth at the surface of the implant 1 month after the implantation in comparison with the raw polymer. However, as the result of an interaction between the bioactive glass particles and the polymer during processing, the mechanical properties of the composite material turned out to be less than those of the raw polymer.

5:00 PM

(BIO-36-2016) In vitro biodegradation behavior, mechanical properties, and cytotoxicity of biodegradable Zn–Zr alloys

Z. Song*[1]; L. Yang[1]; P. Guo[1]; Z. Niu[1]; C. Xu[1]; 1. Cixi Biomedical Engineering Institute, Ningbo Institute of Industrial Technology, China

Zn and Zn-based alloys have drawn considerable interests for their potential as a new biodegradable implant material recently. As far as corrosion resistance is considered as biodegradable implant materials, Zn is more resistant to corrosion than Mg and easier to corrode than iron, which can avoid excessive degradation or insufficient degradation. In this study, we have developed a series of Zn-Zr alloys in order to obtain good mechanical properties and biocompatibility at the same time. The mechanical properties, corrosion behavior, in vitro cytotoxicity of the alloys have been investigated systematically to evaluate the feasibility of the alloys as bioabsorbable implants. The results show that the Zn-Zr alloys have mechanical properties similar to natural bone, and good biocompatibility in vitro. The Zn-0.8Zr alloy exhibits best corrosion resistance and good biocompatibility in vitro, suggesting the potential of these new kind of biodegradable Zn-based implants for future clinical applications.

Track 4: Advanced Manufacturing Technologies

Advanced Manufacturing II

Room: Lindbergh D
Session Chair: Roger Narayan, North Carolina State University

1:30 PM

(BIO-37-2016) Capabilities of SLA/DLP Printers for Bioprinting (Invited)

C. Venter*[1]; 1. Autodesk Research, USA

The Bio/Nano division of Autodesk has been exploring the capabilities of SLA/DLP printers for bioprinting, in particular the Ember printer. Using photocurable hydrogels and Autodesk Within software, we have been working with EpiBone, a Brooklyn-based biotech company to generate bone tissue scaffolds. These scaffolds are a randomized trabecular lattice ideal for cell growth, and are composed of bioinert polyethylene glycol. Normally these structures would be difficult to assemble at this scale, but using the DLP Ember, we are able to generate lattice structures with a 50 micron resolution. We are also developing several biomaterials ideal for a wide range of applications. Our current main focus has been on a 3D-printable photocured chitosan, which is strong, cheap, widely available, and biodegradable in water in a matter of weeks. We are studying this material not only for use in tissue engineering and bioprinting, but as a standard additive manufacturing material as well. Finally, as the Ember printer is entirely open source, from the hardware to software, we are extending this ethos to our developed materials as well. To this end, we are in the process establishing an open database for publishing and researching manufacturing materials and methods.

2:10 PM

(BIO-38-2016) A New Class of 3D Printable Particle-Laden Inks for Biomedical Application (Invited)

R. N. Shah*[1]; A. Jakus[2]; 1. Northwestern University, USA; 2. Northwestern University, USA

In order for 3D-printing to be a technically, commercially, and clinically practical fabrication method for biomedical applications, new approaches for 3D printable functional ink design need to be developed. In this talk, a new class of particle-laden 3D-printable liquid inks will be discussed. These inks are comprised of the particles of interest (60-80 vol.% solids content), an elastomeric, biocompatible and biodegradable polymer (20-40 vol.% solids content), and a series of organic solvents. These inks can be prepared under ambient conditions and rapidly 3D-printed via syringe extrusion at linear deposition rates upwards of 15 cm/s into highly bioactive and ready to use structures comprised of as many as hundreds or thousands of layers, with no drying time required prior to handling. Two promising new 3D-printable particle-based biomaterials will be highlighted: Osteogenic Hyperelastic "Bone", so named because of its highly elastic mechanical properties despite being 90wt% bioceramic, and the neurogenic 3D-Printed Graphene. The mechanisms governing the ability to directly 3D-print these new ink systems into self-supporting constructs will be presented, as well as the microstructural, physical, and biological properties of the resulting 3D-printed constructs. Expansion of this particle-laden ink system for creating highly scalable and economical 3D-printed metallic structures will also be discussed.

2:50 PM

(BIO-39-2016) Development and Characterization of graphene embedded electro conductive Bio-ink for extrusion printing of living cells

S. Shafiee*[1]; T. Shokuhfar[1]; 1. UIC, USA

Additive manufacturing in the field of Bioengineering (3D Bioprinting) provided this opportunity to precisely deposit biomaterials to form desired structures as scaffolds with precise control over pore interconnection, structure symmetry and forming composites which was not possible using other techniques. Using this methods requires using a category of biomaterials as bio-inks, which can provide biocompatibility properties as well as printability. Depending on applications, bio-inks can be tailored to provide different properties including tissue regeneration, photo responsivity, electrical conductivity or even in some cases biologically inertness. So, one of the most important parts of bioprinting process is developing a bio-ink which can provide all required properties. In this research we developed a new bio-ink with embedded modified graphed oxide nano plates to make it electrically conductive. Also this Methacrylated gelatin based bio-ink can contain and support live cells during and after printing process, which by being electrically conductive in the same time makes it suitable for neural engineering applications. In this research rheological behavior, ink consistency, mechanical properties, degradation and cell compatibility have been studied to conform biological and mechanical requirements necessary as a bio-ink for this composite.

Poster Session

Room: Coleman A/B

6:00 PM

(BIO-P01-2016) In-vitro Biological Response of The Sol-gel Derived Alumina-bovine Hydroxyapatite (BHA) Composite Powders

A. Yelten[1]; O. Karal-Yilmaz[2]; G. Cetinkaya[2]; S. Yilmaz*[1]; 1. Istanbul University, Turkey; 2. TUBITAK, Marmara Research Centre, Turkey

Development of novel bioceramic composites is often required to introduce bioactive surfaces that can promote cell adhesion, proliferation and viability. In this study, alumina-bovine hydroxyapatite (BHA) composite powders were produced through the sol-gel process. Firstly, boehmite (AlOOH) sol was synthesized by hydrolyzing the aluminum isopropoxide, starting material. Then the boehmite sol was mixed with the BHA powders derived from the bovine bones in various amounts. The mixtures were gelated and then heat treated at 1300C for 2h. Characterization tests such as XRD, SEM/EDS were carried out to analyze the mineralogical and microstructural properties of the composites. All samples presented the same results in the XRD graphs where HA, tricalcium phosphate (TCP) and α-alumina phases were detected together. SEM images demonstrated that the porous structure of the composite powders stem from the weak bonding and gaps between the calcium phosphate-based phases and alumina. The results of open porosity and bulk density tests supported these observations, as well. In-vitro bioactivity of the alumina-BHA bioceramic composite powders was ensured through in-vitro primary fetal chondrocyte culture on composite discs. The cell proliferation and viability were determined by MTT assay. Results showed different cellular responses according to the composition of the material.

(BIO-P02-2016) Novel Treatment Methods for Producing 45S5 and 45S Solgel Glasses with High Surface Areas

C. M. Goldbach*[1]; G. Pomrink[1]; L. Howell[2]; 1. NovaBone Products, USA; 2. Particle Solutions, USA

Purpose: Novel treatment methods have been investigated to produce solgel-derived 45S5 and 45S formulations with high surface areas (surface areas from 20 to >100m^2/g). Sodium containing solgel glasses have a lower melting point and experience pore structure collapse at temperatures >500C. Because of this, solgel 45S5 glasses have historically had low surface areas (0.1 to <12m2/g) while 58S solgel-derived glasses typically have surface areas >100m^2/g. Methods: Prolonged low temperature heating (<600C), stepwise heating, ultraviolet (UV) light exposure, and supercritical carbon dioxide (scCO_2) exposure were investigated. A five point BET analysis with nitrogen gas adsorption was performed for each sample to obtain the surface areas. Results: For prolonged heating, stepwise heating, UV, and $scCO_2$, the highest surface areas acheived were 128.1, 102.7, 54.8, and 54.3, respectively (correlation R^2>0.995 for all values). With the exception of prolonged heat treatments at 500C for periods of 5 and 7 days (surface areas <5m^2/g), every treatment condition exhibited a surface area increase of 4.5 to over 10 times the highest values previously reported in the literature for 45S5 bioactive glasses (<12m^2/g). Conclusion: These treatment processes produced 45S and 45S5 glasses with surface area increases from 4.5 to over 10 times the highest values seen in the literature for 45S5 bioactive glasses.

(BIO-P03-2016) Effect of Ceramic Femoral Head Material Composition on Polyethylene Structure and Oxidation in Total Hip Bearings

G. Pezzotti[2]; L. Puppulin[3]; N. Sugano[4]; B. J. McEntire[1]; W. Zhu[4]; B. Bal*[5]; 1. Amedica Corporation, USA; 2. Kyoto Institute of Technology, Japan; 3. Kyoto Prefectural University of Medicine, Japan; 4. Osaka University, Japan; 5. University of Missouri, Columbia, USA

Long-term oxidative degradation of ultra-high molecular weight polyethylene (PE) in total hip (THA) or knee (TKA) arthroplasty bearings limits prosthetic device lifetimes. Ceramics are preferred counterface materials because they are presumed to be bioinert and therefore do not contribute to polyethylene degradation. This fundamental assumption was questioned within this study. Using advanced spectroscopic techniques, the molecular-level surface chemistry of various ceramic femoral heads and conventional PE liners was examined before and after in vitro wear testing. Static hydrothermal tests were also conducted using highly cross-linked PE in contact with oxide and non-oxide femoral heads and compared to the hip simulator tests. PE crystallinity and oxidation indices were monitored by Raman spectroscopy and FTIR, respectively. Results showed significant increases in these measures for both static and dynamic tests when the PE was in contact with oxide-based femoral heads. The converse was found to be true for non-oxide heads. This study demonstrated that ceramics are not bioinert; and their non-bioinertness can either be beneficial or detrimental with respect to PE. Oxide ceramics (i.e., Al_2O_3, ZrO_2, or combinations thereof) released oxygen into the tribolayer in contrast to Si_3N_4 which scavenged oxygen.

(BIO-P04-2016) Bioactive calcium phosphate cement for bone defect repair

D. K. Mills*[1]; U. Jammalamadaka[1]; K. Tappa[1]; 1. Louisiana Tech University, USA

Bone defects and non-unions caused by trauma, tumor resection, disease, and fractures occur within young and aging populations. Current methods for bone repair and regeneration rely on the use of metal implants, bone grafts including autografts, allografts and synthetic bone graft substitutes. Bone grafting also has some limitations, including donor site restrictions, availability, cost, and unwanted transmission of disease. The next-generation of bone scaffolds for tissue regeneration should possess a combination of mechanical support, instructive guidance to promote cell proliferation, differentiation and functionality, and ability to act as a reservoir for sustained delivery of therapeutic drugs and growth factors. Drug delivery will need to be tunable and possess the capacity to alter the local microenvironment and so redirect cell function. Our preliminary results show that halloysite nnaotubes (HNTs) added to calcium phosphate produces a cement with enhanced material properties including adhesiveness, surface roughness, and increases in material strength. In vitro results show that HNTs doped with antibiotics, antifungals, and growth factors can be released in a sustained fashion. Our data further demonstrate a significant gain in material properties even after doping. In a pilot study, we have also shown that our composite can be 3D printed with retention of its antibacterial and histogenic properties.

(BIO-P05-2016) Synthesis of Hydroxyapatite by Room-temperature Reaction between Eggshell and Phosphoric Acid under Various pH and Acid Concentration

S. Lee*[1]; T. Kang[1]; 1. Mokpo National University, Republic of Korea

Synthesis of hydroxyapatite (HA) was attempted through a room-temperature reaction with calcined eggshell and phosphoric acid. Ball-milled, calcined eggshell powder, which has a specific surface area of 31.6 m^2/g, was mixed with phosphoric acid at various pH and acid concentrations in room temperature. The mixtures showed high reactivity with a vigorous exothermic reaction, and the reacted samples showed both CaOH and $CaHPO_4$ crystal phases in room temperature. After heating at temperature above 400°C, a HA crystal phase was observed in all samples. The influence of the various pH values on the change of the crystal phase and particle shape was investigated. The influence of heating temperature and the concentrations of phosphoric acid solution over the degree of formation of the HA crystal phase was also analyzed. The reaction in room temperature with 50 wt% acid concentration resulted in the formation of needle and plate shaped particles. Needle shaped particles were also observed after heat treatment at 800°C, showing a HA crystal phase of submicron size.

(BIO-P06-2016) Bactericidal visible-light responsive photocatalyst in medical environments

M. Wong*[1]; Y. Hsu[1]; J. Huang[1]; H. Chang[2]; 1. National Dong Hwa University, Taiwan; 2. Tzu-Chi University, Taiwan

To eliminate antibiotic resistant bacteria is a main motivation to develop biocides with different bactericidal mechanisms. Pure titanium dioxide, TiO_2 could eliminate bacteria upon stimulated by ultraviolet (UV) light to produce bactericidal free radicals, and likely to provide an alternative approach. UV light, however, is harmful to human and thus reduces its application in our living environments. Several ion/anion (B,C,N)-doped semiconductors are able to be stimulated by visible light. Silver (Ag) is an antibacterial material that disrupts bacterial physiology. We demonstrated that the high antibacterial property of sputtered silver nanoparticles on the surfaces of sputtered anion-doped TiO_2 films could be further enhanced by visible light illumination. We further developed TiO_2(N)/Ag/TiO_2(N) sandwich films in which the silver is embedded between two TiO_2(N) layers to enhance the antibacterial properties and the durability of the composite materials, by which various bacteria could be efficiently eliminated. The super antibacterial properties of metal impregnated anion-doped TiO_2 are likely due to the synergetic effects of metal ions, colored titania and plasmonic photocatalysis. The potential antimicrobial usages of the visible-light photocatalysts on medical environments are being explored to solve the problems on nosocomial infections and to develop useful medical products.

(BIO-P07-2016) 3D Composite Scaffolds Based on Rapid-Prototyped PCL/β-TCP Struts and Electrospun PCL Coated with Collagen and HA for Bone Regeneration

M. Yeo[1]; H. Lee[1]; M. Kim[1]; G. Yang[1]; J. Lee[1]; Y. Koo[1]; G. Kim*[1]; 1. Sungkyunkwan University, Republic of Korea

In this study, we fabricated rapid-prototyped polycaprolactone (PCL)/β-TCP composite scaffolds, and to increase the biological properties of the composite scaffold, we used a simple coating process to reinforce the scaffolds with a mixture of collagen/HA. To increase the coating efficiency of the collagen/HA, we embedded electrospun PCL nanofibers in the composite scaffold. The fabricated scaffolds were assessed for not only physical properties including surface roughness, tensile modulus, and water uptake ability, but also biological capabilities by culturing osteoblast-like cells (MG63) for various HA compositions (1, 3, 5 wt %) in a 2 wt% collagen solution. By accommodating the coating process, the composite scaffolds showed enhanced water-absorption ability (12% increase) and good mechanical properties (~35% increase of the tensile modulus), compared to the pure PCL/β-TCP composite. The results of cell viability, scanning electron microscopy, alkaline phosphatase (ALP) activity, and mineralization analyses showed that, although a small portion (0.3 vol %) of coating agent (collagen/HA mixture) was used, the cellular behavior (such as attachment spreading, proliferation, and mineralization) improved remarkably.

(BIO-P08-2016) The Gene Expression Profile of the Normal Human Osteoblasts Exposed to Bioactive Glass

M. Demir*[1]; G. Pomrink[1]; 1. NovaBone Products, USA

The interaction of bioactive glass with body fluids resulting in the release of ionic dissolution products shown to promote activation of genes that regulate osteoblast activity. This process defined as osteostimulation leads to a catalytic response that accelerates the repair and regeneration of bone tissue. There is no clear definition of the term osteostimulation and also a standardized method to demonstrate its validity. Here we propose applying RNA sequencing to quantify the complete set of RNA with all its isoforms in a given human osteoblast cell exposed to different formulations of bioactive glass test materials. Unlike the microarrays used for RNA profiling to examine the osteostimulation, RNA sequencing provides unbiased information about the transcriptome with higher accuracy and sensitivity. Here we used normal human osteoblast cells to examine the osteogenic effect of test articles with bioactive glass content including 45S5 Bioglass as positive control. After the treatment with bioactive glass dissolution products, osteoblasts were prepared for RNA isolation. Following the determination of RNA concentration, purity and quality, library construction was performed. NextSeq 500 Sequencing System was used to perform the sequencing run. The gene expression profile of the normal human osteoblasts exposed to different bioactive glass devices will be discussed.

(BIO-P09-2016) Gold-Coated Iron Nanoparticle Surface Area Optimization for Increased Implant Drug Delivery

D. J. Banner[1]; T. Shokuhfar*[1]; E. Firlar[1]; R. S. Yassar[2]; 1. University of Illinois at Chicago, USA; 2. University of Illinois at Chicago, USA

Gold-coated iron nanoparticles (AuFeNPs) below 20nm are paramagnetic, allowing the nanoparticles (NPs) to be influenced by magnetism only within a strong magnetic field. The gold coating prevents iron oxidation, and can be easily functionalized with a wide range of bioactive agents. We hypothesize that AuFeNPs may be used as drug delivery agent when integrated or embedded within an implant. This method would allow the healthcare provider to release the drug attached to the NPs with strong magnets at the healthcare provider's discretion. As the iron core provides the paramagnetic property, the gold coating thickness should be minimized in order to increase the total surface area of the NPs within a confined space such as an implant. This would increase the total volume of the drug bound within the implant. In this study, we synthesized AuFeNPs between 7nm to 20nm with a thin gold coating. Briefly, reverse emulsion was used to reduce iron sulfate in the presence of sodium borohydride to produce iron NPs, which were then coated by passivation with gold chloride. The NPs were then characterized by both Scanning/Transmission Electron Microscopy(S/TEM), Energy Dispersive X-Ray Spectroscopy(EDS), and TEM. EDS elemental mapping showed the presence of gold and iron throughout the NPs, while TEM analysis showed no clear gold and iron density boundaries, suggesting a thin gold coating layer.

(BIO-P10-2016) Properties of novel biodegradable Zn-Mg-Ca alloys: structure, mechanical properties and cytotoxicity

L. Yang*[1]; 1. Cixi Institute of Biomedical Engineering, Ningbo Institute of Industrial Technology, China

Zinc based alloys have become a new candidate for bio-degradable materials recently. In this investigation, a series of zinc-magnesium-calcium (Zn-Mg-Ca) alloys were developed and their properties including structure, mechanical properties and cytotoxicity were evaluated. It was found that the as-cast Zn-Mg-Ca alloys exhibited strong segregation, which can be eliminated by extrusion. The extruded Zn-Mg-Ca alloys showed an increasing tensile strength with the increase of magnesium content. A maximum tensile strength of 440 MPa, a highest yield strength of 170 MPa, and a largest elongation of 6.08% were recorded. For the as-cast alloys, the alloying elements showed no significant effect on their corrosion properties while the segregation played an important role. For the extruded alloys, the addition of Ca had effectively improved the corrosion resistance of the alloys while the Mg content was low. The bio-compatibility testing showed that zinc alloy had no toxicity to mouse-derived L-929 fibroblast cells. Moreover, the low concentration of alloying ions could promote the growth of mouse fibroblast cells.

(BIO-P11-2016) Composites dental modified hydroxyapatite

Z. Kula*[1]; H. Szymanowski[1]; 1. Lodz University of Technology, Poland

The task of composite dental caries lesions is the treatment of cavitary damages of tooth and the restoration of normal functions of the damaged tooth as well as the tooth correct shape recovery. Currently, two types of composite restorations are mostly used in dentistry: light-hardened materials and self-curing materials. Hydroxyapatite is an inorganic compound forming part of our teeth. It has been used in orthopedics, dentistry, surgery, laryngology and cosmetics, among others, due to its high biocompatibility with human tissue. Studies show that HAp has the following properties: restores enamel by creating a new hydroxyapatite coating on the surface of the teeth, the teeth restores shine and smoothes the surface and reduces the risk of recurrence of hyperpigmentation. Adding HAp to dental composites is supposed to alleviate hypersensitivity in the case of deep cavities, prevent caries, reduce plaque adhesion to tooth and improve aesthetics.

Saturday, July 30, 2016

Plenary Session II and Expert Panel on The Role of Materials Science for Diabetes Care

Room: Coleman A/B

8:00 AM

(BIO-PL- 03-2016) Combinatorial development of materials for islet transplantation

D. G. Anderson*[1]; 1. Massachusetts Institute of Technology, USA

The fibrotic reaction to implanted biomaterials is a fundamental challenge to the development of immuno-isolation devices. Here we describe our work developing new biomaterials and devices for the purposes of enabling islet transplantation. In particular we describe the development of a large library of synthetic hydrogel materials, and the characterization of their biocompatibility in vivo. Data will be presented on the nature of the immune response to these and conventional biomaterials. Several lead materials have been identified with significantly improved biocompatibility in rodents and primates. When formulated into microcapsules these materials enable functional, long-term islet transplantation in immune competent, diabetic rodents.

Track 1: Orthopedic Application - Where are we? Where do we need to go?

Improved Osseointegration

Room: Lindbergh A
Session Chair: Alessandro Porporati, CeramTec GmbH

10:20 AM

(BIO-40-2016) Enhanced Osteoconductivity on Surface-Modulated Silicon Nitride Bioceramics Monitored by in situ Raman Spectroscopy

G. Pezzotti[2]; B. J. McEntire[1]; R. M. Bock[1]; W. Zhu[2]; E. Marin[2]; Y. Marunaka[4]; T. Adachi[5]; T. Yamamoto[5]; N. Kanamura[5]; B. Bal*[6]; 1. Amedica Corporation, USA; 2. Kyoto Institute of Technology, Japan; 4. Kyoto Prefectural University of Medicine, Japan; 5. Kyoto Prefectural University of Medicine, Japan; 6. University of Missouri, Columbia, USA

Enhanced biomaterial osteoconductivity is important in assuring implant fixation and long-life. One promising material that exhibits improved osteoconductivity is silicon nitride (Si_3N_4). Chemical modulation of its surface was found to be beneficial in increasing its ability to interdigitate with native bone. In this study, in situ Raman spectroscopy was used to monitor the behavior of osteosarcoma (SaOS-2) cells incubated on variously-treated Si_3N_4 disc samples (i.e., oxidation, nitrogen-annealing and chemical-etching). The Raman results revealed new details concerning cell metabolism including unique differences in intracellular RNA and membrane phospholipids. Enhanced apatite formation was found to be due to the presence of a high density of positively-charged groups on an otherwise negatively-charged silanol surface. At physiological pH, these positive surface charges promoted protein binding. The proposed mechanism for this behavior results from an increased dipole-like electric charge of nitrogen vacancies (V_N^{3+}/N^{4+}) at the surface of the nitrogen-annealed samples, which attracted the COO^- and NH^{3+} terminus of SaOS-2 cells. This mechanism seems to be highly analogous to specific displacements occurring with proteins and the Ca^{2+} and PO_4^{3-} functional groups of native hydroxyapatite.

10:40 AM

(BIO-41-2016) Effect of calcium phosphate reinforcement on Gelatin-Chitosan for developing a 3D porous scaffold for bone tissue engineering: A comparative study

K. Maji*[1]; S. Dasgupta[2]; 1. National Institute of Technology (NIT), India; 2. National Institute of Technology (NIT) Rourkela, India

Calcium phosphate bioceramics such as Hydroxyapatite, b-TCP and Bioglass have received considerable attention as component of bone substitute materials. However, the osteoblast response to these materials has not yet been clearly understood. This study examined the effects of HAP, b-TCP and Bioglass on osteoblast proliferation, differentiation and mineralization in the culture system of hMSC cells. The result of the present study indicate that Bioglass and HAP promote osteogenesis by increasing collagen synthesis and calcification of extra-cellular matrix. Pure chitosan-gelatin (CG) and composites (GC scaffolds containing 10 wt%, 20wt%, 30wt%, 40 wt% bioactive ceramic) in acetic acid were freeze dried and the porous scaffolds were studied for physiochemical and in vitro biological properties. Scanning electron microscope images of the scaffold showed porous microstructure (100-300 micron) with uniform pore distribution in all compositions. All Scaffold shows acceptable mechanical properties upto 3 MPa with high interconnected porosity above 80% for cellular infiltration. MTT assay and quantitative reverse transcription (qRT)- PCR. Scaffold composition GCB (G30C40B30) showed better biomechanical and osteoinductive properties as evident by mechanical test and osteoblast specific gene expression studies.

11:00 AM

(BIO-42-2016) Structural characterisation of calcium / strontium substituted phosphate based glasses

U. Patel*[1]; E. Barney[1]; A. Hannon[2]; A. Kennedy[1]; I. Ahmed[1]; 1. University of Nottingham, United Kingdom; 2. Science and Technology Council ISIS, United Kingdom

The fully resorbable nature of phosphate based glasses and the control over their degradation, makes these glasses ideal materials for release of bio-therapeutic ions such as Strontium (Sr). Administration of Sr ions in the form of strontium ranelate has shown to have a dual effect on bone metabolism by way of activating osteoblasts and supressing osteoclasts. In this study, the structure of a range of phosphate based glasses substituted by 0-100% of SrO for CaO were investigated on an atomic level via neutron diffraction (ND) coupled with other analysis techniques such as ^{31}P NMR. Such analysis can aid understanding of the interrelationship between glass composition, durability and degradation rates. Furthermore these glasses were manufactured into microspheres (~63-125μm in diameter) providing a morphology with superior flow properties. ND results showed that CaO substitution with SrO had little effect on the short-range order of the glass, thought to be due to the similar charge and field strength of Ca^{2+} and Sr^{2+}. All P-O atoms appeared to be 4 coordinated supporting previous studies. The ^{31}P NMR data complimented such findings as the Q^i species remained consistent for each composition. Such glasses hold the potential for controlled release of therapeutic ions along with the ability for delivery via a minimally invasive route to specific sites of interest.

11:20 AM

(BIO-43-2016) Effect of titanium incorporation on the physical and biological properties of $CaSiO_3$ ceramics

C. Ning*[1]; J. Guo[1]; H. Yu[1]; 1. Shanghai Institute of Ceramics, Chinese Academy of Sciences, China

Silicon-containing biomaterials can stimulate the differentiation of bone marrow stem cells and to modify the expression of osteoblast-related genes. Calcium silicate ($CaSiO_3$) has attracted a lot of attention in being used as a bone substitute. However, its poor chemical stability results in a significant increase in pH values around the materials which consequently makes $CaSiO_3$ ceramics cytotoxic. In the present study, titania was used to improve the chemical stability of the β-$CaSiO_3$ ceramics. β-$CaSiO_3$ ceramics incorporated with different TiO_2 were fabricated. The influence of Ti incorporation on sintering behavior, mechanical properties, in vitro bioactivity and biodegradability was investigated. The results indicated that the main crystal phases of the synthetic ceramics after sintering were β-$CaSiO_3$ and $CaTiSiO_5$. The incorporation of Ti enhanced the chemical stability while it reduced the bioactivity of the ceramics to a great extent. The $CaSiO_3$ ceramic with the incorporation of only 1 mol% TiO_2 lost the ability to induce the formation of bonelike apatite after soaking in simulated body fluid (SBF) for 14 days. All these findings suggested that the introduction of Ti-$CaSiO_3$ ceramics resulted in better chemical stability and adjustable biodegradability.

11:40 AM

(BIO-44-2016) Comparative Study of Mechanical Strength and Bioactivity in Gelatin-Chitosan/Bioactive Ceramic Based Composite Scaffolds for Bone Regeneration

S. Dasgupta*[1]; 1. National Institute of Technology (NIT) Rourkela, India

The aim of the present work is to carry out comparative study on physicochemical, mechanical and biological behaviour of gelatin-chitosan based scaffold after varying the mineral phase and scaffold's composition. Bioactive ceramic nanoparticles such as hydroxyapatite (HA), β-tricalcium phosphate (β-TCP) and bioactive glass (BG) reinforced gelatin-chitosan based composite scaffolds with varying compositions were fabricated using lyophilisation of its slurry. Nanoceramic phase content upto 30 wt% found

to be beneficial for optimization of porosity, pore size, mechanical strength and biological behaviour of the prepared scaffolds. Microstructural observation using scanning electron microscopy (SEM) showed an average pore size between 100 to 150 µm with interconnected porosity of nearly 85% in all 30 wt% bioceramic reinforced scaffolds. 30 wt% nano HA reinforced (GCH-30) scaffold exhibited the highest compressive strength of 3.5 MPa, that is close to the lower limit of human spongy bone. On the other hand, 30 wt% nano bioactive glass reinforced scaffold (GCB-30) showed better adhesion, proliferation, spreading, osteogenic gene expression from mesenchymal stem cells cultured onto it. The study reveals the superior efficacy of GCB-30 scaffolds in regeneration of new bone at the musculoskeletal sites of human body.

Track 3: Material Needs for Medical Devices

Medical Devices II

Room: Lindbergh C
Session Chair: Markus Reiterer, Medtronic, PLC

10:20 AM

(BIO-45-2016) Novel Irreversible Chemistry Produces Structurally More Stable Tissue Based Biomaterials (Invited)

N. Vyavahare*[1]; 1. Clemson University, USA

Over 300,000 bioprosthetic heart valves (BHVs) are used to replace stenotic and regurgitant heart valves every year. BHVs are fabricated out of two types of xenogeneic tissues: (1) Porcine aortic valve leaflets (PAV) or (2) bovine pericardium (BP) sheet crosslinked with glutaraldehyde (GLUT). Both of these materials fail within 10-15 years due to structural degradation and/or calcification. GLUT crosslinked biomaterials have previously been demonstrated to exhibit permanent geometric deformation from cyclic mechanical deformation resulting in deviated biomechanics. The goal of this research was to find a more stable crosslinking chemistry that produces a structurally more stable biomaterial. Previously, we have demonstrated a novel crosslinking method (TRI) that utilizes carbodiimide, neomycin trisulfate, and pentagalloyl glucose to stabilize PAV biomaterials. Here, we demonstrate that TRI treated BP is structurally more durable, retains viscoelastic properties required of a compliant biomaterial, and does not exhibit permanent set effects when compared to GLUT treated BP. Further investigation will focus on accelerated wear testing of BHV biomaterials to discern the action of mechanism behind structural degradation. This will revolutionize the future of BHV design by introducing a core biomaterial that better fits patient needs and enables better quality of life.

11:00 AM

(BIO-46-2016) Evaluation of Bioactive Borate Glass Fibers in a Partial and Full Thickness Porcine Wound Model (Invited)

S. Jung*[1]; 1. Mo-Sci Corporation, USA

Bioactive borate glasses with wound healing properties were fabricated into a fiberous sheet and studied via a porcine wound healing model (partial and full thickness wounds) against two commercial wound dressings composed of collagen fibers and polymer fibers, respectively. Wound closure rate, percent of epithelialized wound surface length, and inflammation were primary study metrics. The bioactive glass wound dressing was found to have superior closure rates and percent wound surface epithelialized, and the least inflammation of the three dressings tested. Based on these findings, the bioactive borate glass fiber dressings have been demonstrated to have superior healing properties to at least two commercial fiber based wound dressings in a head to head and controlled GLP porcine wound healing study.

11:40 AM

(BIO-47-2016) Novel Highly Bioactive Glass Fibers as a Potential Biomaterial for Nerve Regeneration

M. T. Souza*[1]; O. Peitl[2]; E. D. Zanotto[2]; A. R. Boccaccini[4]; 1. Universidade Federal de São Carlos, Brazil; 2. Federal University of Sao Carlos, Brazil; 4. University of Erlangen-Nuremberg, Germany

Bioactive glasses are able to chemically bond to hard and soft tissues. However, the great majority of bioactive glass compositions do not support repeated heat-treatments, since these procedures result in uncontrolled crystallization that usually degrades their mechanical properties and may substantially diminishes their bioactivity. Consequently, the manufacture of shaped devices, fibers or scaffolds, aiming to enlarge the usage spectra of these materials, is a challenging task. To overcome this phenomenon, a new bioactive glass composition was recently developed at the Vitreous Materials Laboratory (LaMaV - UFSCar, Brazil) that shows high stability (against crystallization) coupled to high bioactivity, thus allowing one to make bioactive fibers, meshes and 3D shapes. In fiber form, this bioactive glass has an elevated bioactivity, is bioresorbable and flexible, making this material a potential alternative for soft tissue regeneration and for nerve guide applications. Therefore, this study aimed to develop a novel nerve conduit with aligned bioactive glass fibers in its interior, characterizing some key properties in vitro and initially explore the effects of these new bioactive glass fibers on a pilot in vivo study with Wistar rats.

12:00 PM

(BIO-48-2016) Ezechbone®: A resorption-adjustable calcium-based bone void-filling device developed by a NCKU/JMD joint project

J. Chern Lin*[1]; J. Lee[2]; J. Hong[3]; S. Lan[4]; C. Ju[1]; B. Yang[1]; W. Chin[5]; P. Chen[5]; C. Lin[5]; 1. National Cheng-Kung University, Taiwan; 2. National Cheng-Kung University Medical College and Hospital, Taiwan; 3. Wei-En Dental Clinic, Taiwan; 4. National Cheng-Kung University Medical Center Dou-Liou Branch, Taiwan; 5. Joy Medical Devices Corp., Taiwan

Ezechbone®, a highly resorbable and resorption rate-adjustable calcium-based bone void-filling device, has been developed by a joint research project of National Cheng Kung University and Joy Medical Devices Corp. of Taiwan. Reported in this presentation include non-clinical performance and clinical case follow-ups of the device for dental and orthopedic applications. The safety and efficacy of the device are confirmed by a series of chemical/physical characterization and biocompatibility tests such as cytotoxicity, sub-chronic toxicity, intracutaneous reactivity, skin sensitization, genotoxicity and implantation. Animal models include SD rat femur body, New Zealand white rabbit femur condyle and mandible, Lanyu pig mandible, and goat spine. The histopathologic examination indicates that the implant is intimately integrated with surrounding bone tissues throughout all implantation durations. The majority of Ezechbone® Granule, a highly porous device model of the Ezechbone® series, is readily resorbed and replaced by newly grown bone generally in a one-to-one resorption manner as early as 4W post implantation. Capsule formation, inflammation, macrophages, necrosis fibrosis or other unwanted tissue responses are substantially absent. Clinical case reports include sinus lift, ridge augmentation, frontal bone augmentation and treatment for various types of fractures.

Track 4: Advanced Manufacturing Technologies

Advanced Manufacturing III

Room: Lindbergh D
Session Chair: Roger Narayan, North Carolina State University

10:20 AM

(BIO-49-2016) How 3D Printing is Changing Patient Care (Invited)

D. Beski*[1]; 1. Materialise, USA

There is a growing trend towards personalization of medical care, as evidenced by the emphasis on outcomes based medicine, the latest developments in CT and MR imaging and personalized treatment planning in a variety of surgical disciplines. To support this trend, 3D printing is being used more readily for clinical assessment, training, and education of complex and unique cases. Here we will describe the current use and history of 3D printing within the hospital and the medical device innovation communities. Case studies performed with leading institutes will demonstrate how 3D printing is changing planning of complex interventions such as joint reconstruction and congenital heart disease.

11:00 AM

(BIO-50-2016) Spherical polymer and glass composite particles for laser sintering of 3D scaffolds

F. Schmidt*[1]; D. Karl[1]; M. Bekheet[1]; F. Zemke[1]; B. Jastram[2]; O. Goerke[1]; H. Schwandt[2]; A. Gurlo[1]; 1. Technische Universität Berlin, Germany; 2. Technische Universität Berlin, Germany

Bioactive glasses (BG) are promising materials for bone substitution, repair and reconstruction, due to their osteoconductive properties. Additive manufacturing (AM) for biomedical applications has attracted significant attention in the last years. In laser sintering (LS), a powder based AM technology, particles are joined by local laser application. Powder properties are of immense importance to achieve high powder bed density and quality of the resulting sintered parts. Spherical powder particles with a size between 10 and 100 μm are ideal. We manufactured pure PLGA microspheres with specific properties and high powder bulk densities by an emulsion method. This was further modified to produce PLGA-BG-composite microspheres with up to 50 wt% BG content. Shape, morphology and size of the microspheres can be controlled precisely by synthesis parameters, such as stirring speed and polymer concentration in the oil phase. In a second approach spherical glass particles in the SiO_2-P_2O_5-CaO system were produced by sol-gel method. The resulting powders had a high specific surface area of up to 300 m^2/g, a pore radius of 4 nm and an average particle size of 20 μm. The spherical particles are promising for an application in laser sintering, the mesoporous surface allows for the possible inclusion of active agents. The high specific surface area increases reactivity and bioactivity of this material.

11:20 AM

(BIO-51-2016) Novel Porous Resorbable Calcium Phosphate Microspheres for Biomedical Applications

I. Ahmed*[1]; U. Patel[1]; Z. Hossain[1]; V. Sottile[2]; D. Grant[1]; B. Scammell[3]; 1. University of Nottingham, United Kingdom; 2. University of Nottingham, United Kingdom; 3. University of Nottingham, United Kingdom

There has been a major shift in emphasis from tissue repair to tissue regeneration as a solution to the ever-growing need for long-term orthopaedic care. The main aim of this work was to investigate the feasibility of manufacturing porous resorbable phosphate-based glass (PBG) microspheres as stem cell carriers for applications in bone regenerative medicine. Minimally invasive procedures for bone repair and regeneration offer many benefits such as reduced trauma, especially for elderly patients. Microspheres can be administered easily and incorporated components can then be released at controlled rates for relatively long periods of time. The main advantages for this technology are; 1) the degradation profiles for amorphous PBG microspheres can easily be tailored (from day/s, weeks to several/many months), 2) these glasses can easily be doped with osteoporotic positives such as strontium to inhibit bone resorption, 3) these microspheres have the potential to be loaded with many other biological components to provide a potent combinatorial effect of bone repair and regeneration. Early trials confirmed that bulk and porous microsphere production was totally feasible and yields of approximately 95% were achieved. Preliminary studies also showed successful attachment of human mesenchymal stem cells (hMSCs) on and within the porous microspheres produced.

11:40 AM

(BIO-52-2016) Novel graphenated self-oriented nanofiber scaffolds for oriented mesenchymal cell growth

I. Hussainova*[1]; R. Ivanov[1]; J. Kazantseva[2]; G. Michael[3]; 1. Tallinn University of Technology, Estonia; 2. CellIn Technologies, Estonia; 3. AALTO University Foundation, Finland

A new generation of inorganic, bioinert yet biocompatible scaffolds with ultra-high anisotropy has been developed and tested in vitro for mesenchymal stem (MSC) and breast cancer (MDA) cell cultures. The scaffolds are made as self-aligned nanofibers with diameter of 35 -45 nm. The porosity of total 80-95% is varied from few nanometers to micrometers range. CVD technology allows deposition of graphene onto scaffold and, therefore, property variation from super-hydrophilic to super-hydrophobic. To approve the adhesion of MSCs and MDA cells on the surface of scaffolds, a fluorescent labelling was applied. For that, two different cell-specific antibodies for each cell type were used. The novel anisotropic scaffold types can be used for combining the 3D and 2D features like co-cultures, ALICE assays, bipolar assays with selective media components separation, for ex., for studying of cell-bacteria communication without direct contact, and so on. The unique features of these scaffolds present an opportunity for evaluation of primary cells fate in different conditions as they could mimic controlled conditions to assess affecting factors with greater precision and novel variations in the culture environment.

Plenary Session III and Expert Panel on The Role of Materials Science on Vascular and Cardiac Therapy

Room: Coleman A/B

1:30 PM

(BIO-PL- 04-2016) Transcatheter Heart Valve Biomaterials

M. H. Wu*[1]; 1. Edwards Lifesciences LLC, USA

Aortic stenosis is a life-threatening disease. The mortality rate for symptomatic patients with severe aortic stenosis can be as high as 50% in one year. Open-heart aortic valve replacement with extracorporeal cardiopulmonary circulation support has long been a gold standard for treating patients suffering from aortic valve stenosis and regurgitation. In the past decade, transcatheter aortic valve implantation (TAVI) has emerged as a less invasive technology for treating patients with severe aortic stenosis. Clinical evidences from the randomized controlled PARTNER trial demonstrated the benefit of TAVI as a life-saving technology for inoperable patients (cohort B). Based on the cohort A clinical outcome, TAVI is also an attractive alternative to surgery in patients with a high operative risk. With recent improved device designs towards smaller profiles, ease of use and additional features to minimize paravalvular leak, newer generation devices are now in clinical studies for considerations for treating intermediate and low surgical risk patients. Both self-expanding and balloon expandable designs are currently approved for clinical uses. Although the biomaterials used in both designs have good histories in surgical heart valves and vascular stents, we will review specific challenges unique to the transcatheter heart valve design as well as opportunities in novel biomaterial solutions and improvements for future generation device designs.

Sunday, July 31, 2016

Plenary Session IV and Expert Panel on The Role of Material Science in Orthopedics

Room: Coleman A/B

8:00 AM

(BIO-PL-05-2016) Tribocorrosion of Orthopaedic Implants: Current Concepts and Clinical Ramifications

J. J. Jacobs*[1]; 1. Rush University Medical Center, USA

Corrosion at metal/metal modular interfaces in total hip arthroplasty was first described in the early 1990's [1], and the susceptibility of modular tapers to mechanically assisted crevice corrosion (MACC), a combination of fretting and crevice corrosion, was subsequently introduced [2]. Since that time, there have been numerous reports of corrosion at this taper interface, documented primarily in retrieval studies or in rare cases of catastrophic failure. We have reported that fretting corrosion at the modular taper may produce soluble and particulate debris that can migrate locally or systemically [3], and more recently reported that this process can cause an adverse local tissue reaction [4,5]. Based on the type of tissue reaction and the presence of elevated serum metal ion levels, this process appears quite similar to adverse local tissue reactions secondary to metal on metal bearing surfaces [6]. While modularity in THR has demonstrable clinical benefits, modular junctions increase the risk of corrosion and the types of adverse soft tissue reactions seen in patients with accelerated metal release from metal-on-metal bearing THRs.

Author Index

*** Denotes Presenter**

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Dresden, Germany

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