Innovations in Biomedical Materials 2012

September 10-13, 2012

Hilton North Raleigh-Midtown, NC, USA

At the intersection of medical practitioners, materials researchers, manufacturers and marketers.

Meeting Guide

Organized by:

The American Ceramic Society
www.ceramics.org

TheraSphere®

Targeted Tough™

For HCC patients with or without partial or branch PVT.

Tough on HCC, *not on patients*

TheraSphere® is a powerful[a], well-tolerated Y-90 glass microsphere therapy for transarterial radioembolization (TARE) in HCC, providing demonstrated patient benefits[b] and rapid administration set-up, leading to a safe and quicker infusion[4].

Tough on HCC

- Two independent studies reported median survival rates of 17.2 months in Child-Pugh A hepatocellular carcinoma (HCC) cirrhotic patients with various tumor characteristics (N=291, N=108)[1,2]
- WHO and EASL response rates were 42% and 57%, respectively (N=273)[1]
- 58% of TheraSphere patients were downstaged[3]

Easy on patients

- The majority of adverse events were mild to moderate in severity[4] and were manageable or resolved over time[2]
- No ulcers or pulmonary toxicities were reported in two large independent studies (N=291, N=108)[1,2]
- Administered as an outpatient treatment

For more information, visit **www.TheraSphere.com**

TheraSphere is authorized by Federal Law for use as a humanitarian device in radiation treatment or as a neoadjuvant to surgery or transplantation in patients with unresectable HCC who can have placement of appropriately positioned hepatic arterial catheters. The device is also indicated for HCC patients with partial or branch portal vein thrombosis/occlusion, when clinical evaluation warrants the treatment. The effectiveness of this device for this use has not been demonstrated.[4]

a - Refers to high specific activity.

b - Patient benefits as indicated by Package Insert: HCC patients with PVT are eligible for treatment, majority of events graded as mild to moderate, treatment usually performed on an outpatient basis.

References: 1. Salem R, Lewandowski RJ, Mulcahy MF, et al. Radioembolization for hepatocellular carcinoma using yttrium-90 microspheres: a comprehensive report for long-term outcomes. Gastroenterology. 2010;138:52-64. 2. Hilgard P, Hamami M, Fouly AE, et al. Radioembolization with yttrium-90 glass microspheres in hepatocellular carcinoma: European experience on safety and long-term survival. Hepatology. 2010;52:1741-1749. 3. Lewandowski RJ, Kulik LM, Riaz A, et al. A comparative analysis of transarterial downstaging for hepatocellular carcinoma: chemoembolization versus radioembolization. Am J Transplant. 2009;9:1920-1928. 4. TheraSphere® [US package insert]. Ottawa, ON: Nordion (Canada) Inc.; 2011.

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Welcome

On behalf of The American Ceramic Society, welcome to the Innovations in Biomedical Materials 2012 Conference (Biomaterials 2012). This conference brings together the materials research, manufacturing and medical communities to explore technological advancements, facilitate product innovations, and identify potential new applications.

Plenary speakers for Biomaterials 2012 include Dr. Riad Salem, Northwestern University, presenting *Radioembolization with Yttrium 90 Microspheres*; Larry Hench, University of Florida, presenting *Bioactive Glasses: New Approaches for Tissue Repair, Regeneration and Prevention*; Delbert Day, Mo-Sci Corp. and Missouri University of Science and Technology, presenting *Radioactive Glass Microspheres for Medical Applications*; Hyun Bae, Cedars-Sinai Hospital, presenting *Pedicle Screw Electrical Resistance: Hydroxyapatite Coated Versus Non-Coated*; and Alan J. Russell, Carnegie Mellon University, presenting *Bio Inspired Materials for Health and Defense*.

This meeting emphasizes collaboration between R&D, medical practitioners, and biomedical materials manufacturers/marketers to better develop emerging technologies into marketable products.

- Scientists and engineers working on the research and development of new materials, products and processes for medical applications
- Manufacturers and marketers working to put these technological advancements into practice by developing effective products, devices, and treatments
- Doctors, nurses and other medical practitioners looking to help shape product and processes that will enable them to treat patients more effectively

Special thanks go to our sponsors, including Mo-Sci Corporation, Nordion, Rolla Regional Economic Commission, ASM Medical Materials, and Granta Material Intelligence. The conference is endorsed by the International Commission on Glass.

Best regards,

Roger and Steve

Steven Jung
Mo-Sci Corporation

Roger Narayan
University of North Carolina, Chapel Hill

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Radiation Synovectomy

Other
Drug Delivery
Diagnostic Imaging
Wound/Burn Healing

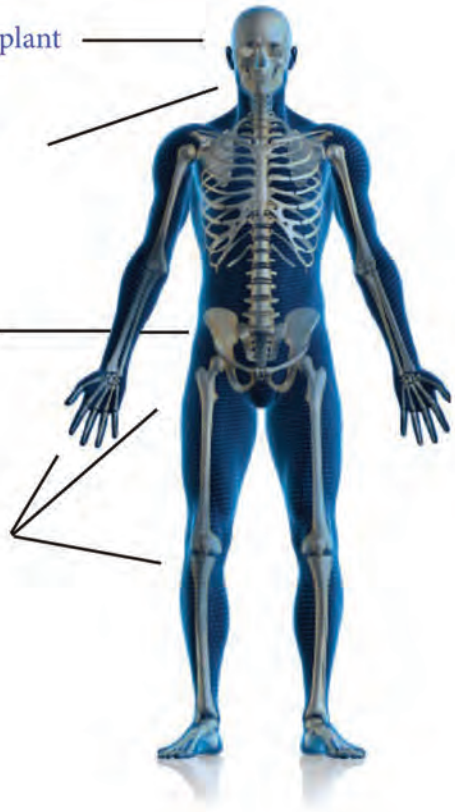

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Table of Contents

Final Program

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Schedule At A Glance

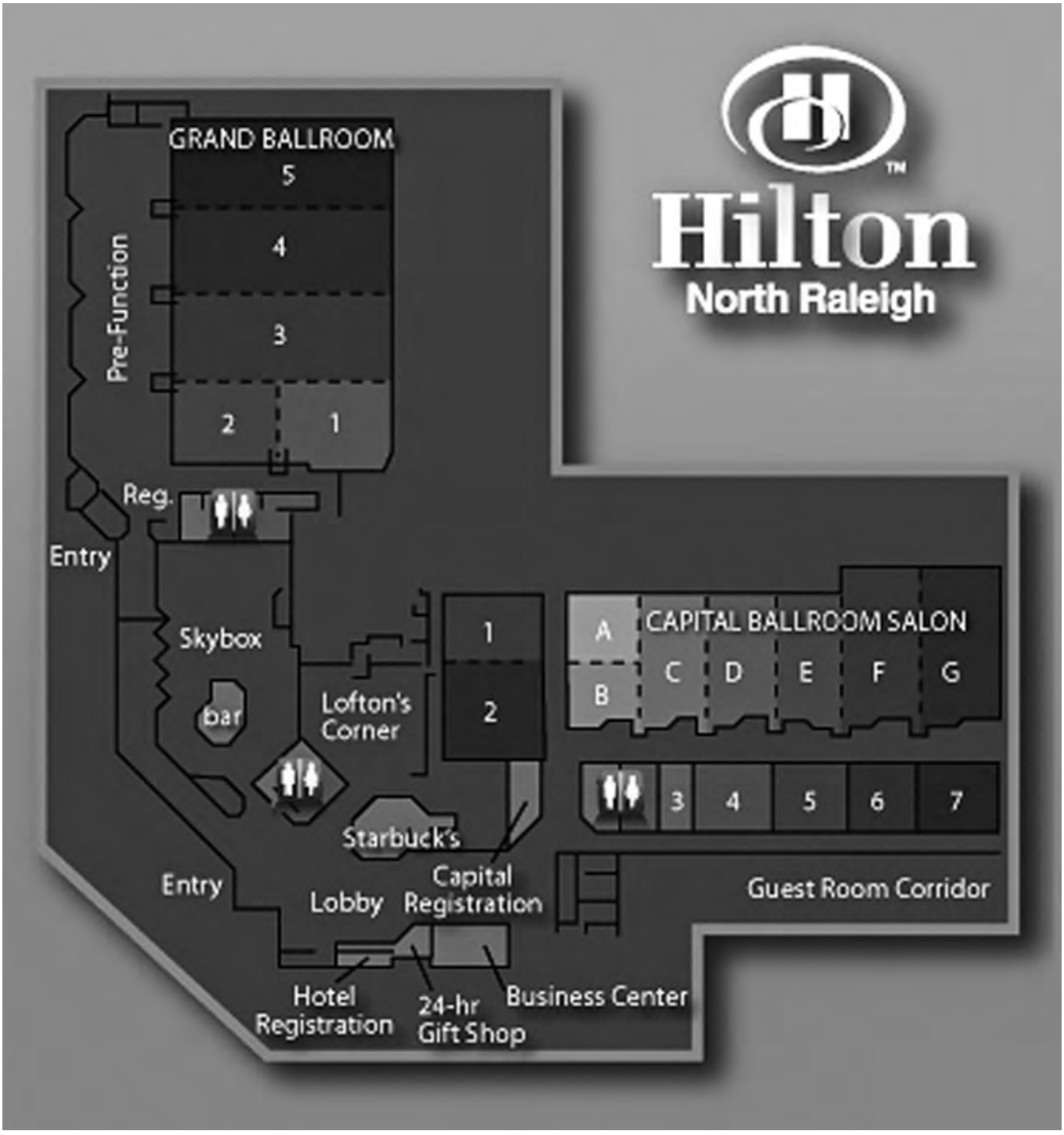
Monday – September 10, 2012		
Registration	2:30 p.m. – 7:30 p.m.	Capital Registration counter
Welcome Reception	5:30 p.m. – 7:30 p.m.	Capital Ballrooms E-G
Tuesday – September 11, 2012		
Registration	7:30 a.m. – 6:00 p.m.	Capital Registration counter
Plenary Session	8 a.m. – 9:30 a.m.	Capital Ballroom D
Break	9:30 a.m. – 9:50 a.m.	Capital Ballrooms E-G
Concurrent Technical Sessions	9:50 a.m. – 11:50 a.m.	Capital Ballrooms A/B, C, D
Lunch	11:50 a.m. – 12:40 p.m.	Capital Ballrooms E-G
Plenary Session	12:40 pm.– 1:25 p.m.	Capital Ballroom D
Concurrent Technical Sessions	1:30 p.m. – 3:20 p.m.	Capital Ballrooms A/B, C, D
Break	3:20 p.m. – 3:40 p.m.	Capital Ballrooms E-G
Concurrent Technical Sessions	3:40 p.m. – 5:50 p.m.	Capital Ballrooms A/B, C, D
Poster Session& Reception	5:45 p.m. – 7:15 p.m.	Capital Ballrooms E-G
Wednesday – September 12, 2012		
Registration	8 a.m. – 6:00 p.m.	Capital Registration counter
Plenary Session	8:30 a.m. – 9:15 a.m.	Capital Ballroom D
Break	9:15 a.m. – 9:45 a.m.	Capital Ballrooms E-G
Concurrent Technical Sessions	9:45 a.m. – 11:55 a.m.	Capital Ballrooms A/B, C, D
Lunch	Noon – 1:25 p.m.	Capital Ballrooms E-G
Concurrent Technical Sessions	1:30 p.m. – 3:20 p.m.	Capital Ballrooms A/B, C, D
Break	3:20 p.m. – 3:40 p.m.	Capital Ballrooms E-G
Concurrent Technical Sessions	3:40 p.m. – 5:50 p.m.	Capital Ballrooms A/B, C, D
Conference Dinner with speaker	6:30 p.m. – 9 p.m.	Capital Ballrooms E-G
Thursday – September 13, 2012		
Registration	8 a.m. – Noon	Capital Registration counter
Plenary IV and Innovations in Biomedical Materials Panel Discussion	8:30 a.m. – 10:15 a.m.	Capital Ballroom D
Coffee Break	10:15 a.m. – 10:30 a.m.	Capital Ballrooms E-G
Tutorial Sessions	10:30 a.m. – Noon	Capital Ballrooms A/B, C, D

Featured Conference Dinner Speaker

Christine Jackson, Director of Health Policy & Payment
Medtronic, Inc.

"Insight into the Socioeconomic Environment
of Health Care in the United States"

Hilton North Raleigh Floor Plan



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Plenary Speakers

Alan J. Russell

Carnegie Mellon University

Title: Bio Inspired Materials for Health and Defense

Biography: Russell (PhD in Biological Chemistry, 1987, Imperial College of Science and Technology, University of London) is a Distinguished University Professor of Surgery and the Founding Director of the McGowan Institute for Regenerative Medicine at the University of Pittsburgh. Further, he holds positions as Professor in the departments of Bioengineering, Chemical Engineering and Rehabilitation Science and Technology. In addition to his appointments at the University, Dr. Russell is the Executive Director of the Pittsburgh Tissue Engineering Initiative, Inc., as well as a consultant for UPMC's International and Commercial Services Division. He has founded three biotechnology companies; ICX Agentase LLC, NanoSembly LLC, and O2Cyte LLC, and was also the Founding President of the 3,000-member Tissue Engineering and Regenerative Medicine International Society.

Delbert Day

Mo-Sci Corp. and Missouri University of Science and Technology

Title: Radioactive Glass Microspheres for Medical Applications

Biography: Day has published more than 380 technical papers dealing with the structure, properties, and uses of glass, edited three books and been granted 53 US and foreign patents. His patents include glass microspheres for medi-cal (radiation therapy) and dental applications, bioactive glasses for wound and bone repair, chemically durable glasses for vitrifying nuclear waste, optically trans-parent composites, and high temperature ceramics. He conducted the first US glass melting experiments in micro-gravity on NASA's Space Shuttle and is co-inventor of special purpose glass microspheres, TheraSphereTM, which are now being used at more than 100 sites worldwide to treat patients with inoperable liver cancer. He is a co-inventor of "Glasphalt", where waste glass is recycled as part of the aggregate in asphalt paving. He is the former Chairman and President of Mo-Sci Corp, a company he co-founded to manufacture special purpose glasses for the healthcare, electron-ics, transportation, aerospace, chemical and sporting goods industries.

Riad Salem

Northwestern University

Title: Radioembolization with Yttrium 90 Microspheres

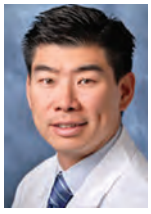
Biography: Salem is a Professor in Radiology, Medicine Hematology/Oncology and Surgery – Organ Transplantaion at the Northwestern University, Feinberg School of Medicine. He earned his MBA at George Washington University and MD at McGill University. Salem is Board certified in Diagnostic Radiology, Vascular and Interventional Radiology with interests in complex liver therapies and liver cancer. He is also affiliated with the Robert H. Lurie Comprehensive Cancer Center at Northwestern University.

Larry Hench

University of Florida

Title: Bioactive Glasses: New Approaches for Tissue Repair, Regeneration and Prevention

Biography: Hench is currently Adjunct Graduate Research Professor, Department of Materials Science and Engineering at the University of Florida, Professor and Director of Special Projects at the University of Central Florida, Visiting Professor at Kings College/ Guy's Hospital University of London, Guest Faculty at the Department of Bioengineering at Florida Gulf Coast University, and Emeritus Professor of Ceramic Materials in the Department of Materials at Imperial College London. For 10 years he served as Co-Director of the Imperial College Tissue Engineering and Regenerative Medicine Centre. He assumed the Chair of Ceramic Materials at Imperial College in 1995 following 32 years at the University of Florida where he served as Director of the Bioglass Research Centre and Co-Director of the Advanced Materials Research Center. He re-joined the faculty of the MSE Dept. at the University of Florida in 2009. Larry completed his Bachelor of Ceramic Engineering degree at The Ohio State University in 1961 and his PhD in 1964.



Hyun Bae

Cedars-Sinai Hospital

Title: Pedicle Screw Electrical Resistance: Hydroxyapatite Coated Versus Non-Coated

Biography:Hyun Bae, MD is a board-certified orthopedic surgeon at the Cedars-Sinai Spine Center, specializing in minimally invasive microsurgery and the treatment of cervical and lumbar spinal disease. He is co-director of the Spine Fellowship Program.Dr. Bae is a national leader in minimally invasive surgery, motion preservation technology, artificial disc replacement and non-fusion technologies. As a leading researcher in stem cell repair of degenerative disc disease and the use of growth factors to treat spinal cord injury, he has published extensively in top journals and presented at many national and international meetings.

Dr. Bae was among the first to use growth factor tissue engineering for intervertebral discs, multi-level artificial disc replacement for both the lumbar and cervical spine, and other novel medical devices for dynamic stabilization and minimally invasive spine surgery.Dr. Bae earned a bachelor's degree in biomechanics from the Columbia University School of Engineering and Applied Sciences. He earned his medical degree, cum laude, from the Yale University School of Medicine. He completed his surgical internship at North Shore University Hospital and his orthopedic surgical residency at the Hospital for Special Surgery in New York. He completed a spine fellowship at Case Western Reserve Hospital in Cleveland.

Presenting Author List

Name	Date	Time	Room	Page Number
Bae, H.	13-Sep	8:30AM	Capital D	13
Bagga, C.	11-Sep	3:40PM	Capital A/B	10
Bagga, C.	11-Sep	9:50AM	Capital D	9
Bahawdory, M.	11-Sep	2:20PM	Capital C	10
Baker, I.	11-Sep	1:30PM	Capital A/B	9
Benson, R.	12-Sep	2:50PM	Capital A/B	12
Chopra, N.	12-Sep	1:30PM	Capital A/B	12
Day, D.E.	11-Sep	8:45AM	Capital D	9
Day, T.	12-Sep	3:00PM	Capital D	13
Ding, S.	12-Sep	4:10PM	Capital A/B	12
DiPietro, L.A.	12-Sep	3:50PM	Capital C	13
Erbe, E.M.	12-Sep	9:45AM	Capital A/B	11
Falk, M.M.	11-Sep	4:30PM	Capital C	10
Fears, K.	11-Sep	4:10PM	Capital A/B	10
Gill, P.	11-Sep	2:40PM	Capital D	10
Gill, P.	12-Sep	2:30PM	Capital A/B	12
Gokcekaya, O.	11-Sep	5:20PM	Capital D	11
Goldstein, A.S.	12-Sep	1:30PM	Capital C	12
Goodman, S.	12-Sep	4:20PM	Capital D	13
Gouma, P.	11-Sep	9:50AM	Capital C	9
Greenspan, D.C.	11-Sep	2:00PM	Capital D	10
Harkins, A.B.	11-Sep	2:00PM	Capital C	10
Hassanzadeh, P.	11-Sep	4:50PM	Capital A/B	10
He, Y.	11-Sep	11:10AM	Capital A/B	9
Hench, L.	12-Sep	8:30AM	Capital D	11
Huard, J.	12-Sep	4:30PM	Capital C	13
Jung, S.B.	12-Sep	4:10PM	Capital C	13
Kehoe, S.	11-Sep	5:10PM	Capital A/B	10
Kennedy, A.	11-Sep	9:50AM	Capital A/B	9
Kohn, J.	11-Sep	1:30PM	Capital C	10
Kokubo, T.	12-Sep	10:15AM	Capital D	12
Lafon, J.	12-Sep	3:20PM	Capital C	13
Larson, A.C.	11-Sep	10:20AM	Capital A/B	9
Lee, S.	12-Sep	10:15AM	Capital C	12
Leonard, L.	11-Sep	10:40AM	Capital A/B	9
Li, X.	12-Sep	2:00PM	Capital A/B	12
McCarty, G.S.	11-Sep	10:20AM	Capital C	9
McEntire, B.	12-Sep	10:45AM	Capital A/B	12
McKittrick, J.	11-Sep	3:30PM	Capital C	10
Mendonca, G.	11-Sep	2:00PM	Capital A/B	9
Meyer, J.E.	12-Sep	5:20PM	Capital A/B	12
Misra, D.	12-Sep	11:05AM	Capital A/B	12
Mitchell, D.	12-Sep	2:30PM	Capital D	13
Muhaffel, F.	11-Sep	11:30AM	Capital D	9
Mushock, G.	13-Sep	10:30AM	Capital C	13
Nag, S.	11-Sep	1:30PM	Capital D	10
Nain, A.	12-Sep	10:45AM	Capital C	12
Nair, L.	12-Sep	11:15AM	Capital C	12
O'Donnell, M.D.	13-Sep	10:30AM	Capital A/B	13
Pandey, P.C.	11-Sep	10:40AM	Capital C	9
Pandey, P.C.	11-Sep	2:50PM	Capital A/B	10
Pattison, P.	12-Sep	2:00PM	Capital D	13
Pomrink, G.J.	12-Sep	3:40PM	Capital A/B	12
Pradhan, D.	11-Sep	4:40PM	Capital D	11
Primus, C.	12-Sep	4:40PM	Capital A/B	12
Ravi, V.	11-Sep	10:20AM	Capital D	9
Reiterer, M.	12-Sep	1:30PM	Capital D	13
Roenigk, K.	13-Sep	11:15AM	Capital C	13
Russell, A.J.	11-Sep	8:00AM	Capital D	9
Saini, S.	12-Sep	5:00PM	Capital A/B	12
Salamon, D.	11-Sep	5:20PM	Capital C	10
Salem, R.	11-Sep	12:40PM	Capital D	9
Sánchez Treviño, A.Y.	11-Sep	11:10AM	Capital D	9
Seyedmahmoud, S.	12-Sep	2:00PM	Capital C	12
Shi, Q.	12-Sep	10:15AM	Capital A/B	12
Singh, V.	12-Sep	9:45AM	Capital D	12
Soker, S.	12-Sep	2:50PM	Capital C	13
Stiglich, J.J.	11-Sep	10:50AM	Capital D	9
Strassner, K.D.	13-Sep	10:30AM	Capital D	13
Surmenev, R.A.	11-Sep	5:00PM	Capital D	11
Tholey, M.J.	12-Sep	3:50PM	Capital D	13
Urooj, S.	11-Sep	11:30AM	Capital A/B	9
Van Dyke, M.	12-Sep	2:20PM	Capital C	13
Velez, M.	11-Sep	5:00PM	Capital C	10
Wen, X.	11-Sep	2:40PM	Capital C	10
Wen, X.	12-Sep	9:45AM	Capital C	12
Xu, Z.	11-Sep	4:10PM	Capital D	11
Yamaguchi, S.	11-Sep	2:20PM	Capital D	10
Yang, H.	11-Sep	3:10PM	Capital C	10
Yingling, Y.G.	11-Sep	2:20PM	Capital A/B	9
Yoshimura, M.	11-Sep	3:40PM	Capital D	11
Yu, X.	11-Sep	4:00PM	Capital C	10
Zhang, J.	11-Sep	5:30PM	Capital A/B	10
Zhang, J.	12-Sep	10:35AM	Capital D	12
Zhang, X.	11-Sep	4:30PM	Capital A/B	10

Poster Presenters

Name	Date	Time	Room	Page Number
Caballero, M.	11-Sep	5:45PM	Capital E-G	11
Chinaglia, C.R.	11-Sep	5:45PM	Capital E-G	11
DiPietro, L.A.	11-Sep	5:45PM	Capital E-G	11
Eshraghi, S.	11-Sep	5:45PM	Capital E-G	11
Frank, M.J.	11-Sep	5:45PM	Capital E-G	11
Gu, J.	11-Sep	5:45PM	Capital E-G	11
Hanson, J.	11-Sep	5:45PM	Capital E-G	11
Laurindo, C.	11-Sep	5:45PM	Capital E-G	11
Meyer, J.E.	11-Sep	5:45PM	Capital E-G	11
Nikonammofrad, R.	11-Sep	5:45PM	Capital E-G	11
Nowacki, M.S.	11-Sep	5:45PM	Capital E-G	11
Soares, P.	11-Sep	5:45PM	Capital E-G	11
Souza, M.T.	11-Sep	5:45PM	Capital E-G	11
Taylor, P.	11-Sep	5:45PM	Capital E-G	11
Tiainen, H.	11-Sep	5:45PM	Capital E-G	11
Vivanco, J.	11-Sep	5:45PM	Capital E-G	11
Walter, M.S.	11-Sep	5:45PM	Capital E-G	11

Tuesday, September 11, 2012

Plenary Session I

Room: Capital D

8:00 AM

(BIO-091-2012) Bio-inspired Materials for Health and Defense (Invited)
A. J. Russell*, Carnegie Mellon University, USA

8:45 AM

(BIO-001-2012) Radioactive Glass Microspheres for Medical Applications (Invited)
D. E. Day*, T. E. Day, MO-SCI Corp, USA

9:30 AM

Break

Imaging and Treatment I

Room: Capital A/B

Session Chair: Andrew Larson, Northwestern University

9:50 AM

(BIO-007-2012) Understanding Radioactive (90Y) Ceramic Microsphere Therapy (Radioembolization) in Human Liver Cancers (Invited)
A. Kennedy*, Cancer Centers of North Carolina, USA

10:20 AM

(BIO-008-2012) MRI of SPIO-Labeled Radioembolization Microspheres
A. C. Larson*, Northwestern University, USA

10:40 AM

(BIO-009-2012) X-ray imaging enhancement with glass ceramic plates (Invited)
J. Johnson, S. Gray, University of Tennessee Space Institute, USA; C. Passlick, Fraunhofer Institute, Germany; C. Alvarez, Northwestern University, USA; S. Schweizer, South Westphalia University of Applied Sciences, Germany; A. Petford-Long, Northwestern University, USA; L. Leonard*, University of Tennessee Space Institute, USA

11:10 AM

(BIO-010-2012) Preparation of Strontium Phosphate Microspheres For On-Site Delivery of Yttrium-90
Y. He*, Mo-Sci Corporation, USA

11:30 AM

(BIO-011-2012) Examining Brain Edema Through Brain Impedance Analysis
S. Urooj*, Gautam Buddha University, India; A. Q. Ansari, Jamia Millia Islamia, India; A. K. Salhan, Delhi Research & Development Organization, India; A. Eukakille, University of Salento, Italy

Sensors I

Room: Capital C

Session Chair: Randy Avent, North Carolina State University

9:50 AM

(BIO-013-2012) Electrospun fibrous biomedical nanomaterials for nanomedicine applications (Invited)
P. Gouma*, SUNY at Stony Brook, USA

10:20 AM

(BIO-015-2012) Microfabricated Sensors for In Vivo Neurotransmitter Measurements
G. S. McCarty*, NCSU, USA

10:40 AM

(BIO-016-2012) Sysnthesis and applications of novel Nickel hexacyanoferrate-Gold Nanocomposite Biomaterial in electrochemical sensor designs
P. C. Pandey*, A. Pandey, Institute of Technology, Banaras Hindu University, India

Metallic Implants and Coatings I

Room: Capital D

Session Chair: Peter Ullrich, Titan Spine, LLC

9:50 AM

(BIO-002-2012) Selection of Biomaterials for Spinal Interbody Fusion Implants – Consideration of Design, Endplate Bonding, and Modulus vs. Engineered Modulus (Invited)
C. Bagga*, Prosidyan, Inc., USA; B. W. Cunningham, Orthopaedic Spinal Research Laboratory, USA; P. F. Ulrich, Titan Spine, LLC, USA; W. Kelly, Mechanical Solutions, Inc., USA; M. Gallagher, J. M. Schneider, Titan Spine, LLC, USA

10:20 AM

(BIO-003-2012) Titanium-boron alloys for potential orthopedic applications – microstructure, mechanical behavior and environmental stability (Invited)
V. Ravi*, S. Alas, California State Polytechnic University, Pomona, USA

10:50 AM

(BIO-004-2012) Tantalum Diffusion Coating for Increasing the Biocompatibility of Conventional Metal Implant Alloys
J. J. Stiglich*, J. W. Brockmeyer, B. E. Williams, Ultramet, USA

11:10 AM

(BIO-005-2012) Biomimetic calcium phosphate formation on titanium surfaces modified with organophoshonate molecules
A. Y. Sánchez Treviño*, M. A. Rodríguez Valverde, M. A. Cabrerizo Vílchez, University of Granada, Spain

11:30 AM

(BIO-006-2012) Single Step Synthesis and Characterization of Hydroxyapatite Deposited Microporous Titania Layer on Cp-Titanium by Micro Arc Oxidation
F. Muhaffel*, H. Cimenoglu, Istanbul Technical University, Turkey

Lunch

Room: Capital E–G

11:50 AM – 12:50 PM

Plenary Session II

Room: Capital D

12:40 PM

(BIO-017-2012) Radioembolization with Yttrium 90 Microspheres (Invited)
R. Salem*, Northwestern University, USA

Imaging and Treatment II: Advances in Nanomaterials

Room: Capital A/B

Session Chair: Andrew Larson, Northwestern University

1:30 PM

(BIO-023-2012) Dartmouth Center for Cancer Nanotechnology Excellence (Invited)
I. Baker*, Dartmouth College, USA

2:00 PM

(BIO-092-2012) From micron- to nano-topography in Dental Implant Surfaces (Invited)
G. Mendonca*, University of North Carolina at Chapel Hill, USA

Sensors II

Room: Capital A/B

Session Chair: Randy Avent, North Carolina State University

2:20 PM

(BIO-025-2012) Tuning nanoparticle-DNA recognition with ligand chemistry: molecular modeling (Invited)
A. Singh, N. Li, Y. G. Yingling*, North Carolina State University, USA

2:50 PM

(BIO-026-2012) Biomaterial derived from nanostructured Prussian blue gold and palladium and their application in L- cysteine sensing (Invited)
P. C. Pandey*, A. Pandey, Institute of Technology, Banaras Hindu University, India

3:20 PM

Break

Uses of Bioactive Glass in New Treatments

Room: Capital A/B

Session Chair: Charanpreet Bagga, Prosidyan, Inc.

3:40 PM

(BIO-036-2012) Use of Bioactive Glass in Bone Graft Substitute Materials – The New Trend in Bone Repair (Invited)
H. Bae, Cedars Sinai Hospital, USA; C. Bagga*, Prosidyan, Inc., USA

4:10 PM

(BIO-037-2012) Circular-Dichroism Spectroscopy of Albumin Adsorbed on Calcium and Strontium Phosphate Microspheres
K. Fears*, D. Burden, C. Love, U.S. Naval Research Lab, USA; D. Day, Missouri University of Science and Technology, USA; T. Clark, U.S. Naval Research Lab, USA

4:30 PM

(BIO-038-2012) Optimization of Experimental Composite Nerve Guidance Conduits: Mechanical Properties and Cytocompatibility using Cultured Schwann Cells
X. Zhang*, S. Kehoe, Dalhousie University, Canada; L. Gan, F. Wu, SiChuan University, China; D. Boyd, Dalhousie University, Canada

4:50 PM

(BIO-039-2012) Antimicrobial Properties of Silver Coated Bioactive Glass Particles for Wound Healing Applications
P. Hassanzadeh*, A. W. Wren, M. R. Towler, Alfred University, USA

5:10 PM

(BIO-040-2012) Examining the Thermal Characteristics and Cytocompatibity of La-doped Zinc-Silicate Embolic Agents
S. Kehoe*, D. Boyd, Dalhousie University, PO Box 15000, Canada

5:30 PM

(BIO-041-2012) Novel Carbon Nanotube Reinforced Bioglass Composites for Orthopedic Applications
J. Zhang*, Indiana University - Purdue University Indianapolis, USA; C. Jia, Z. Jia, University of Science and Technology Beijing, China

Blood Vessels, Nerve Guides and Hemostasis

Room: Capital C

Session Chair: Amy Harkins, Saint Louis University

1:30 PM

(BIO-093-2012) A combinatorial approach to biomaterials design (Invited)
J. Kohn*, New Jersey Center for Biomaterials, USA

2:00 PM

(BIO-028-2012) Effects of Bioactive Glass Composites on Neuronal Cell Behavior for Tissue Engineering Applications
L. M. Marquardt, Washington University in St. Louis, USA; D. Day, Missouri University of Science and Technology, USA; S. Sakiyama-Elbert, Washington University in St. Louis, USA; A. B. Harkins*, Saint Louis University, USA

2:20 PM

(BIO-029-2012) Integrin Mediated Platelet Adhesion to a Hemostatic Keratin Biomaterial
M. Bahawdory*, M. Van Dyke, Wake Forest University School of Medicine, USA

2:40 PM

(BIO-027-2012) Creating waved and aligned nanofiber composites with biomimetic microstructures and mechanical compliance to natural blood vessels (Invited)
V. Beachley, X. Wen*, Clemson University, USA

3:10 PM

(BIO-030-2012) The Relationship between Basement Membrane Development of Cardiomyocytes and Cell-to-Cell Crosstalk Reestablishment in Microwells
H. Yang*, H. Liu, Z. Wang, Clemson University, USA; T. K. Borg, Medical University of South Carolina, USA; B. Z. Gao, Clemson University, USA

Three Dimensional Scaffolds for Tissue Regeneration I

Room: Capital C

Session Chair: Edwin Fuller, NCSU

3:30 PM

(BIO-042-2012) Bioinspired ceramic scaffolds for bone replacement (Invited)
J. McKittrick*, M. M. Porter, UC San Diego, USA; P. Chen, National Tsing Hua Univerisity, Taiwan; M. A. Meyers, UC San Diego, USA

4:00 PM

(BIO-043-2012) Nanofibrous scaffolds for bone healing (Invited)
X. Yu*, Stevens Institute of Technology, USA

4:30 PM

(BIO-044-2012) Performance of silicate TAMP bioscaffolds (Invited)
T. Kowal, J. Marzillier, M. M. Falk*, Lehigh University, USA; M. Saad, M. Marei, Alexandria University, Egypt; U. Thamma, C. LaPorte, H. Jain, Lehigh University, USA

5:00 PM

(BIO-045-2012) Evaluation of bioactive glass scaffolds made by selective laser sintering
M. Velez*, Mo-Sci Corporation, USA

5:20 PM

(BIO-046-2012) Direct building of 3D hydroxyapatite microchannel structure for nutrients delivery
D. Salamon*, Brno University of Technology, Czech Republic; S. Teixeira, University of Twente, Netherlands

Metallic Implants and Coatings II

Room: Capital D

Session Chair: Peter Ullrich, Titan Spine, LLC

1:30 PM

(BIO-018-2012) Enhancing the Wear Resistance and Osseo-integration of Next Generation Beta Titanium Alloys For Orthopedic Implants (Invited)
P. Kami, S. Nag*, S. N. Dahotre, S. R. Paital, T. W. Scharf, N. D. Dahotre, R. Banerjee, University of North Texas, USA

2:00 PM

(BIO-019-2012) Effect of Surface Treatment of Titanium Alloy on Maturation of Osteoblasts In Vitro
D. C. Greenspan*, Spinode Consulting, USA; J. M. Schneider, M. E. Berg, Titan Spine, USA; B. D. Boyan, Z. Schwartz, R. Olivares-Navarrete, R. A. Gittens, Georgia Institute of Technology, USA; J. J. Stapleton, T. B. Tighe, Pennsylvania State University, USA

2:20 PM

(BIO-020-2012) Novel bioactive Ti metal and its alloy enriched with calcium ions on their surfaces by simple chemical and heat treatments
S. Yamaguchi*, T. Kizuki, S. Nath, H. Takadama, T. Matsushita, Chubu University, Japan; T. Nakamura, National Hospital Organization, Japan; T. Kokubo, Chubu University, Japan

2:40 PM

(BIO-022-2012) Biocompatibility, Corrosion and Mechanical Studies of Surface Treated Nitinol Alloys
P. Gill*, N. Munroe, Florida International University, USA; A. Datye, The University of Tennessee, USA; W. Haider, State University of New York, USA

3:20 PM

Break

Metallic Implants and Coatings III

Room: Capital D

Session Chair: Peter Ullrich, Titan Spine, LLC

3:40 PM

(BIO-031-2012) Growing Integration Layer [GIL] Method: Coating of Bioactive Ceramic Layers on Metallic Materials in Solution without Firing Processes (Invited)
M. Yoshimura*, National Cheng Kung University, Taiwan; N. Matsushita, Tokyo Institute of Technology, Japan

4:10 PM

(BIO-032-2012) Development of Magnesium Alloys as Biodegradable Orthopedic Materials (Invited)
Z. Xu*, North Carolina A&T State University, USA

4:40 PM

(BIO-033-2012) Structure and Biocompatability Analysis of Sol-Gel Prepared Niobium and Titanium Oxide with Temperature
D. Pradhan*, A. W. Wren, S. T. Misture, N. P. Mellott, Alfred University, USA

5:00 PM

(BIO-051-2012) Biocompatible RF-magnetron sputter deposited CaP-based coatings on the surface of technically pure titanium
R. A. Surmenev*, M. Surmeneva, V. Pichugin, A. Ivanova, I. Grubova, I. Khlusov, Tomsk Polytechnic University, Russian Federation; A. Kovtun, O. Prymak, M. Epple, University of Duisburg-Essen, Germany

5:20 PM

(BIO-035-2012) Yttrium doped Hydroxlapatite Coating and Antibiotic Duplex Coating on Titanium with Electrostatic Spray Deposition Method
O. Gokcekaya*, C. Ergun, Istanbul Technical University, Turkey

Poster Session

Room: Capital E-G

5:45 PM

(BIO-P001-2012) Minimal Effect on Mechanical Strength with the Addition of Cisplatin to Commercially Available Bone Cements
J. E. Meyer*, University of Wisconsin - Milwaukee, USA; K. MacDonald, Virginia Mason Medical Center, USA

(BIO-P003-2012) Effect of post heat treatment on the mechanical and tribological properties of TiO2 enriched with Ca and P obtained by micro arc oxidation
C. Laurindo*, R. D. Torres, P. Soares, Pontificia Universidade Católica do Paraná, Brazil

(BIO-P004-2012) Enhancement of Titanium Surface Bioactivity by Treatment with a Highly Bioactive Glass
C. R. Chinaglia*, O. Peitl, Federal University of Sao Carlos, Brazil; P. T. Oliveira, Ribeirao Preto College of Dentistry, Sao Paulo State University, Brazil; L. C. Sanches, E. D. Zanotto, Federal University of Sao Carlos, Brazil

(BIO-P005-2012) Titanium hydroxilation – Hydroxide formation on titanium alloy surfaces by anodic oxidation
M. S. Walter*, M. J. Frank, University of Oslo, Norway; M. Gomez-Florit, M. Monjo, University of Balearic Islands, Spain; M. F. Sunding, S. P. Lyngstadaas, H. J. Haugen, University of Oslo, Norway

(BIO-P006-2012) Hydride layer created by hot acid etching suppresses hydride formation by cathodic reduction on titanium based implant surfaces
M. J. Frank*, M. S. Walter, S. Lyngstadaas, H. J. Haugen, University of Oslo, Norway

(BIO-P007-2012) Bioactive coatings on titanium obtained by the combination of micro-arc oxidation and electrophoretic deposition
P. Soares*, C. H. Laurindo, R. D. Torres, Pontificia Universidade Catolica do Parana, Brazil

(BIO-P008-2012) Effects of Crosslink ratio on photocrosslinkable P(AM-AA) Gels for Drug Delivery
J. Gu*, Y. Lu, S. Shivkumar, Worcester Polytechnic Institute, USA

(BIO-P010-2012) Mechanochemical synthesis of copper doped nanostructured fluorapatite
R. Nikonammofrad*, S. Sadrnezhad, J. Vahdati Kahki, Sharif University of Technology, Islamic Republic of Iran

(BIO-P012-2012) The potential use of innovative hemostatic dressings as a supportive cancer care factor in parenchymatous organs surgery – preliminary report
M. S. Nowacki*, A. Jundzill, Ludwik Rydygier Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Torun., Poland; T. Kowalczyk, IPPT, Polish Academy of Sciences, Warsaw., Poland; T. Drewa, Ludwik Rydygier Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Torun., Poland

(BIO-P014-2012) Highly porous TiO_2 scaffolds for bone repair
H. Tiainen*, J. C. Wohlfahrt, A. Verket, S. P. Lyngstadaas, H. J. Haugen, University of Oslo, Norway

(BIO-P015-2012) Bioactivity of Bioceramic Bone Scaffolds Fabricated at Two Sintering Temperatures
J. Vivanco*, A. Aiyangar, C. Collins, The University of Wisconsin Madison, USA; A. Araneda, Universidad Tecnica Federico Santa Maria, Chile; H. L. Ploeg, The University of Wisconsin Madison, USA

(BIO-P016-2012) Effect Of Electrospun Scaffolds On Osteogenic Differentiation Of Palatal Periosteum And Umbilical Cord-Derived Mesenchymal Stem Cells
M. Caballero*, A. K. Pappa, M. D. Skancke, J. A. van Aalst, University of North Carolina, USA

(BIO-P017-2012) Finite element modeling and mechanical property assessment of polycaprolactone-hydroxyapatite composite scaffolds fabricated by selective laser sintering
S. Eshraghi*, S. Das, Georgia Institute of Technology, USA

(BIO-P018-2012) Large area maskless photopolymerization of hydrogels for cartilage tissue engineering
S. Eshraghi*, S. Das, Georgia Institute of Technology, USA

(BIO-P019-2012) Effect of bioactive borate glass fiber scaffolds on wound healing in diabetic mice
L. Chen, University of Illinois, USA; S. B. Jung, T. Day, MO-SCI Corporation, USA; M. Krol, L. A. DiPietro*, University of Illinois, USA

(BIO-P020-2012) New Bioactive Glass with Low Devitrifying Tendency
M. T. Souza*, O. Peitl, Federal University of São Carlos, Brazil; P. T. Oliveira, University of São Paulo, Brazil; E. D. Zanotto, Federal University of São Carlos, Brazil

(BIO-P021-2012) Treatment of Chronic Ulcers with Bioactive Borate Glass Nanofibers
S. Jung, T. Day, Mo-Sci Corporation, USA; W. Stoecker, P. Taylor*, Phelps County Regional Medical Center, USA; D. Day, Missouri University of Science and Technology, USA

(BIO-P022-2012) Unique Physical Properties of Synthetic Antimicrobial Block Copolypeptides Designed for Wound Infections
J. Hanson*, E. Tkatchouk, E. Schauer, K. R. Ogilby, J. Chow, D. Benitez, M. Bevilacqua, Amicrobe, Inc, USA

Wednesday, September 12, 2012

Plenary Session III

Room: Capital D

8:30 AM

(BIO-047-2012) Bioactive Glasses: New Approaches for Tissue Repair, Regeneration and Prevention (Invited)
L. Hench*, University of Florida, USA

9:15 AM

Break

Composites I

Room: Capital A/B

Session Chair: Erik Erbe, Nuvasive, Inc

9:45 AM

(BIO-052-2012) Biomaterial Composites: Theory and Medical Applications (Invited)
E. M. Erbe*, Nuvasive, Inc, USA

10:15 AM

(BIO-053-2012) Plasma and nanofiber-enhanced biomedical textiles for health and protection (Invited)
Q. Shi*, N. Vitchuli, J. Nowak, R. Nawalakhe, M. Sieber, M. Bourham, X. Zhang, NC State Univ, USA; M. McCord, NC State Univ and UNC, USA

10:45 AM

(BIO-055-2012) An Overview of Silicon Nitride as a Novel Biomaterial
B. McEntire*, A. Lakshminarayanan, Amedica Corporation, USA; B. Bal, University of Missouri, USA; T. J. Webster, Brown University, USA

11:05 AM

(BIO-054-2012) Hybrid Silicone for Finger Joint Reconstruction (Invited)
D. Misra*, Univ Louisiana Lafayette, USA

Three Dimensional Scaffolds for Tissue Regeneration II

Room: Capital C

Session Chair: Edwin Fuller, NCSU

9:45 AM

(BIO-057-2012) Short Laminin Peptide for Improved Neural Progenitor Cell Growth (Invited)
X. Li, N. Zhang, X. Wen*, Clemson University, USA

10:15 AM

(BIO-058-2012) Electrospun Vascular Scaffold for Engineering Fully Cellularized Small Diameter Blood Vessel (Invited)
S. Lee*, J. J. Yoo, A. Atala, Wake Forest School of Medicine, USA

10:45 AM

(BIO-061-2012) STEP based Micro/Nanofiber Aligned Networks for Tissue Engineering (Invited)
A. Nain*, Virginia Tech, USA

11:15 AM

(BIO-059-2012) Cell instructive injectable materials for bone regeneration (Invited)
L. Nair*, University of Connecticut Health Center, USA

Metallic Implants and Coatings IV

Room: Capital D

Session Chair: Peter Ullrich, Titan Spine, LLC

9:45 AM

(BIO-048-2012) BioMEMS & Biocompatible Coatings for Biomedical Applications (Invited)
V. Singh*, Q. Nguyen, Louisiana State Univ., USA; P. George, E. O. Daigle, CAP Technologies, LLC, USA

10:15 AM

(BIO-050-2012) Bioactive Ti metal and its alloys formed with positively charged TiO_2 surface layer
T. Kokubo*, S. Yamaguchi, H. Takadama, T. Matsushita, Chubu University, Japan; T. Nakamura, National Hospital Organization, Japan

10:35 AM

(BIO-034-2012) Residual Stress in Ceramic Coated Biocompatible AZ31 Magnesium Alloys
J. Zhang*, Indiana University - Purdue University Indianapolis, USA; Y. Gu, University of Alaska Fairbanks, USA; Y. Guo, C. Ning, South China University of Technology, China

Lunch

Room: Capital E–G

Noon – 1:25 PM

Composites II

Room: Capital A/B

Session Chair: Erik Erbe, Nuvasive, Inc

1:30 PM

(BIO-065-2012) Nanoscale heterostructures for selective chemical and biological sensing, bioanalysis, and delivery (Invited)
N. Chopra*, The University of Alabama, USA

2:00 PM

(BIO-067-2012) Nature-inspired Composite Design and Manufacturing (Invited)
X. Li*, University of South Carolina, USA

2:30 PM

(BIO-068-2012) Influence of Anodization on Corrosion Resistance, Ion Leaching and Wettability of Biodegradable Magnesium Metal Matrix Composites
P. Gill*, N. Munroe, Florida International University, USA; N. Hari-Babu, Brunel University, United Kingdom

2:50 PM

(BIO-066-2012) Designing Bacterial Cellulose Scaffolds for Tissue Engineering of Stem Cells (Invited)
P. Favi, M. Dhar, C. Ehinger, N. Neilsen, R. Benson*, University of Tennessee - Knoxville, USA

Bone Cements

Room: Capital A/B

Session Chair: Gregory Pomrink, NovaBone Products LLC

3:40 PM

(BIO-075-2012) Bioactive Glass Applications, Mechanism and Clinical Results (Invited)
G. J. Pomrink*, NovaBone Products LLC, USA

4:10 PM

(BIO-076-2012) Development and Applications of Sol-Gel Calcium Silicate-Based Bone Cements (Invited)
S. Ding*, Chung Shan Medical University, Taiwan

4:40 PM

(BIO-077-2012) Dental Cements- Traditional and Bioactive
C. Primus*, Primus Consulting, USA

5:00 PM

(BIO-078-2012) Performance of Bone Void Fillers Manufactured Using A 3D Rapid Prototyping Platform
S. Saini*, Integra, USA

5:20 PM

(BIO-079-2012) Characterization of Elution of Cisplatin from Commercially Available Bone Cements
J. E. Meyer*, University of Wisconsin - Milwaukee, USA; K. MacDonald, Virginia Mason Medical Center, USA

Three Dimensional Scaffolds for Tissue Regeneration III

Room: Capital C

Session Chair: Edwin Fuller, NCSU

1:30 PM

(BIO-070-2012) Engineering Complex Biomaterials Scaffolds for Connective Tissue Regeneration (Invited)
S. Samavedi, P. Thayer, A. Whittington, A. S. Goldstein*, Virginia Tech, USA

2:00 PM

(BIO-072-2012) Parametric study for fabrication of PLLA electrospun scaffolds for tissue engineering by means of response surface analysis
S. Seyedmahmoud*, University of Rome Tor Vergata, Italy; P. Mozetic, Universita campus Bio-medico di Roma, Italy; E. Traversa, S. Licoccia, University of Rome Tor Vergata, Italy

2:20 PM

(BIO-069-2012) The Use of Keratin Biomaterials to Enhance Mesenchymal Stem Cell Osteogenesis and Bone Regeneration (Invited)
R. de Guzman, J. Saul, M. Ellenburg, M. Merrill, H. Coan, T. Smith, M. Van Dyke*, Wake Forest University School of Medicine, USA

2:50 PM

(BIO-071-2012) 3-D Scaffolds for Organ Bioengineering (Invited)
S. Soker*, P. Baptista, G. Orlando, J. Yoo, A. Atala, Wake Forest University School of Medicine, USA

3:20 PM

(BIO-090-2012) Stereolityhography applied to ceramic: An innovative shaping technique to build ceramic prosthesis for the repair of large craniofacial bone defects (Invited)
J. Lafon*, Euro Industrie, USA; C. Chaput, 3DCeram, France; J. Brie, Service de Chirurgie Maxillo-Faciale,CHU de Limoges, France; T. Chartier, SPCTS, CNRS-Université de Limoges-ENSCI, France

Wound and Burn Treatment

Room: Capital C

Session Chair: Luisa DiPietro, University of Illinois at Chicago

3:50 PM

(BIO-081-2012) Wound healing research: Past, present, and future
L. A. DiPietro*, University of Illinois at Chicago, USA

4:10 PM

(BIO-082-2012) Chronic Non-Healing Wounds Treated with Bioactive Borate Glass Nanofibers
S. B. Jung*, MO-SCI Corporation, USA; W. V. Stoecker, P. Taylor, Phelps County Regional Medical Center, USA

4:30 PM

(BIO-080-2012) Exhaustion of Muscle Progenitor Cells during Aging & Disease: Implication for Stem Cell Therapy (Invited)
M. Lavasani, A. Lu, L. Niedernhofer, P. D. Robbins, J. Huard*, University of Pittsburgh, USA

Commercialization I

Room: Capital D

Session Chair: Markus Reiterer, Medtronic, Inc.

1:30 PM

(BIO-063-2012) Requirements for Bioactive Bone Implants from a Medical Device Company's Perspective (Invited)
M. Reiterer*, J. Rouleau, Medtronic, Inc., USA

2:00 PM

(BIO-089-2012) Medical Device Commercialization: Lessons Learned from a First-timer (Invited)
P. Pattison*, Nordion Inc., Canada

2:30 PM

(BIO-094-2012) Commercialization: If you build it they will come!? (Invited)
D. Mitchell*, Captiva Spine, Inc., USA

3:00 PM

(BIO-064-2012) Commercialization Paths for Disruptive Technologies - When to Start a New Company
T. Day*, Mo-Sci Corporation, USA

3:20 PM

Break

Commercialization II

Room: Capital D

Session Chair: Markus Reiterer, Medtronic, Inc.

3:50 PM

(BIO-073-2012) The system Y-TZP and its porcelain (Invited)
M. J. Tholey*, VITA Zahnfabrik, Germany

4:20 PM

(BIO-074-2012) Navigating FDA Expectations for a new PMMA Bone Cement Formulation
S. Goodman*, Aptiv Solutions, USA

Thursday, September 13, 2012

Plenary Session IV

Room: Capital D

8:30 AM

(BIO-062-2012) Pedicle Screw Electrical Resistance: Hydroxyapatite Coated Versus Non-Coated (Invited)
H. Bae*, Spine Institute, USA

Innovations in Biomedical Materials Panel Discussion

Room: Capital D

9:15 AM

Panel Discussion
The Innovations in Biomaterials Panel Discussion will explore what cells need to generate bone in the interbody space and include: (1) data on old versus new surface and the biological activity it generates; and (2) bench data and FEA analysis on engineered versus materials modulus as it relates to bone grafts stress sharing within a cage. Other issues will also be explored.

Panelists: Peter Ullrich, Titan Spine, Hyun Bae, Spine Institute, David Greenspan, Spinode Consulting

10:15 AM

Break

Tutorial Session I

Room: Capital D

10:30 AM

(BIO-085-2012) Licensing Technology from a Public University, what in the world were you thinking? (Invited)
K. D. Strassner*, Missouri University of Science and Technology, USA

Tutorial Session II

Room: Capital A/B

10:30 AM

(BIO-086-2012) CE Marking of Medical Devices (Invited)
M. D. O'Donnell*, BSi Group, United Kingdom

Tutorial Session III

Room: Capital C

10:30 AM

(BIO-087-2012) Materials Data Impact on Device Design (Invited)
G. Mushock*, ASM International, USA

11:15 AM

(BIO-088-2012) Systematic materials selection – How to optimize product performance while lowering risk (Invited)
K. Roenigk*, Granta Design, USA

Call for Papers

Abstract Due November 4, 2012

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Tuesday, September 11, 2012

Plenary Session I

Room: Capital D

8:00 AM

(BIO-091-2012) Bio-inspired Materials for Health and Defense (Invited)

A. J. Russell*, Carnegie Mellon University, USA

Living systems adapt to their environment by controlling multifunctional building blocks in cells. For example, the simple brittle star uses its skeleton to focus light on photoreceptors so as to also act as a basic eye. In our laboratory, we are using enzymes and polymers to add unique functionality to biologic catalysts. A particular focus has been to use biomimetic approaches to develop antibacterial and anti-biofilm surfaces via atom transfer radical polymerization. Multifunctional bio-inspired materials have broad utility as technologies that can mitigate the threat of weapons of mass destruction. In addition, the bio-inspired materials that will be presented could have a range of uses in hospital settings.

8:45 AM

(BIO-001-2012) Radioactive Glass Microspheres for Medical Applications (Invited)

D. E. Day*, T. E. Day, MO-SCI Corp, USA

Glass microspheres have proven to be a novel and safe means of delivering therapeutic doses of localized, beta radiation to diseased organs in the body. This paper is intended to provide physicians, engineers and others working in the medical device field with a general working knowledge of the present and possible future medical applications of bioinert and biodegradable radioactive glass microspheres. The main focus will be on microspheres made from bioinert aluminosilicate glass, that contain radioactive Y-90, and which are being successfully used world-wide to treat patients with inoperable (HCC) liver cancer. These versatile bioinert aluminosilicate glass microspheres are candidates for irradiating malignant tumors in other organs, such as the kidney, breast, or brain and can contain a blend of two or more radioisotopes of different half-life for the purpose of delivering a tailor-made radiation dose to a selected organ or site. Radioactive microspheres made from glass which biodegrades in a unique way in-vivo without releasing unwanted amounts of the radioisotope are described along with examples of their usefulness for radiation synovectomy of arthritic joints.

Imaging and Treatment I

Room: Capital A/B

Session Chair: Andrew Larson, Northwestern University

9:50 AM

(BIO-007-2012) Understanding Radioactive (90Y) Ceramic Microsphere Therapy (Radioembolization) in Human Liver Cancers (Invited)

A. Kennedy*, Cancer Centers of North Carolina, USA

Permanent implantation of radioactive ceramic microspheres into cancers in the liver involves three systems: (1) patient factors (normal and tumor), (2) microsphere properties (3) radiation effects. (1) The liver receives most of its blood supply from portal system. Hepatic arteries feed tumors preferentially instead enabling selected targeting to tumor vasculature and sparing normal liver parenchyma. (2) Early attempts to produce microspheres containing radioactive isotopes were experimental, unique devices that did prove the principle, but leached radiation. The development of ceramic microspheres in that bound the isotope within the matrix allowed commercialization of radioactive microspheres. (3) The type of radiation used to kill tumor cells via radioembolization, typically 90Y is beta decay, thus it only penetrates a few millimeters into tissue. One disadvantage to beta radiation is the difficulty in imaging it due to the minimal amount of bremsstrahlung radiation that can be captured outside the body by SPECT gamma cameras. Thus identification of the final location of implantation is problematic. Much has been learned and accomplished with first generation ceramic radioactive microspheres; additional new designs are needed to realize additional gains in helping cancer patients.

10:20 AM

(BIO-008-2012) MRI of SPIO-Labeled Radioembolization Microspheres

A. C. Larson*, Northwestern University, USA

PURPOSE: Radioembolization involves targeted transcatheter delivery of Y-90 microspheres to liver tumors; however, visualization of microsphere delivery to tumors is challenging. Labeling the spheres with superparamagnetic iron oxides (SPIOs) should permit MRI of biodistributions. The purpose of this study was to investigate MRI characteristics of yttria-alumina-silicate (YAS) microspheres labeled with varying SPIO contents. METHODS: SPIOs were added to YAS glass microspheres during manufacture (Mo-Sci Medical, Rolla, MO); the 20-40um spheres contained 2 to 20% SPIO (%-by-mass). Rats were catheterized and MRI performed before and after infusion. Microsphere distributions was characterized with T2W and T1W sequences; livers were harvested for histology. RESULTS: Heterogeneous SPIO-labeled spheres distributions were clearly visible with MRI; content did not impact distribution. Single spheres or small clusters produced characteristic dipole patterns. Signal voids were induced even for spheres with limited SPIO content. Induced signal reductions increased with increasing SPIO content. CONCLUSION: Characterization of sphere distributions should be valuable for dosimetry and prediction of response. SPIO-labeled YAS microspheres permit MRI of hepatic biodistributions. Even with relatively little SPIO content (e.g. 2%) YAS spheres remained readily visible; these spheres may be ideal for tumor-to-normal distribution measurements.

10:40 AM

(BIO-009-2012) X-ray imaging enhancement with glass ceramic plates (Invited)

J. Johnson, S. Gray, University of Tennessee Space Institute, USA; C. Passlick, Fraunhofer Institute, Germany; C. Alvarez, Northwestern University, USA; S. Schweizer, South Westphalia University of Applied Sciences, Germany; A. Petford-Long, Northwestern University, USA; L. Leonard*, University of Tennessee Space Institute, USA

ZBLAN (Zirconium, Barium, Lanthanum, Aluminum, and Sodium Fluorides) glass-ceramic materials are being developed as scintillators and storage phosphors mainly for applications in medicine. Substitution of barium fluoride for barium chloride allows the precipitation of barium chloride nanoparticles with a fluoride glass matrix, which can either store electron-hole pairs or lead to scintillation upon x-ray excitation when doped with a suitable optical activator, such as europium or co-doped with another rare-earth element. X-ray diffraction (XRD) has shown a particular phase of the barium chloride nanoparticles to be allied with either storage or scintillation. The hexagonal phase is synonymous with scintillation and the orthorhombic phase is synonymous with the storage mechanism. Extensive characterization of the materials for x-ray imaging applications had taken place to determine the exact composition and structure/property relationships x-ray diffraction, differential scanning calorimetry and many large facility techniques. In situ transmission electron microscopy is ongoing to explore the interface kinetics between the nanoparticles and glass matrix. A summary of medical applications and scientific development method will be presented on the ZBLAN glass ceramics.

11:10 AM

(BIO-010-2012) Preparation of Strontium Phosphate Microspheres For On-Site Delivery of Yttrium-90

Y. He*, Mo-Sci Corporation, USA

Porous strontium phosphate microspheres (20-38 μm) that can be labeled with Y-90 or other radioisotopes for imaging and therapeutic treatment of cancer. The labeled microspheres can be used as a vehicle

for radiation therapy by labeling Y-90 or other radioisotopes onto their surface. Preliminary testing shows that the microspheres can be labeled with a maximum of 2.9 weight percent Y-89 within 30 minutes. Mechanical testing demonstrated that the microspheres had sufficient mechanical strength to survive normal shipping/handling procedures and multiple passes through a typical IV administration set without degradation.

11:30 AM

(BIO-011-2012) Examining Brain Edema Through Brain Impedance Analysis

S. Urooj*, Gautam Buddha University, India; A. Q. Ansari, Jamia Millia Islamia, India; A. K. Salhan, Delhi Research & Development Organization, India; A. Eukakille, University of Salento, Italy

Conventional methods for detection of brain ailments are Electroencephalography, CT and MRI. Although these methods are reflects a clear picture of most of the commonly found brain related disorders, perhaps the expensiveness and delicacy cannot be over looked. It is also important to point out that these techniques are not always friendly to specific group of patient e.g. pregnant women or a patient along with some seizure foreign element especially metal within the body. Conventional method fails in such circumstances therefore in this paper electrical impedance analysis is proposed as an alternative to conventional techniques for early diagnosis. Anatomically the brain has different distributed impedance in normal conditions and as a result of any abnormality like fluid retention or tumor it will certainly change the electrical parameters hence bio-impedance. If we are considering the case of edema the variation in fluid certainly leads to change the impedance and other related parameters. These variations are recorded by conducting the experiment. A female rabbit is chosen as a subject and electrical impedance of brain is recorded in normal and abnormal conditions. A handsome variation is obtained in both the cases. The conclusion drives the proposed technique towards fruitful results and hence various irregularities and disorders can be diagnosed even in early stages.

Sensors I

Room: Capital C
Session Chair: Randy Avent, North Carolina State University

9:50 AM

(BIO-013-2012) Electrospun fibrous biomedical nanomaterials for nanomedicine applications (Invited)

P. Gouma*, SUNY at Stony Brook, USA

Electrospinning is a unique and versatile nano-manufacturing process capable of producing nanofibrous polymers and their composites. A versatile "bottom-up" technique, it has become already a high profile tool to synthesize hybrid nanocomposites, whether these are combinations of different polymers, polymer-ceramic, or polymer-metal systems in nanowire, nanobelt, or 3D nanofiber mat configurations. Furthermore, electrospun nanofibers are known to be excellent substrates for enzyme immobilization. The author's group was the first to demonstrate a bio-nano-device (a urea biosensor) by urease immobilization in a polymer mat in a single step process. It has also pioneered the synthesis of pure single crystal ceramic (metal oxide) nanowires of "extreme" aspect-ratio used as biosensing probes by means of this method alone; as well as the construction of complex, porous, 3D architectures of natural polymers mimicking the bio-scaffold-the ExtraCellular Matrix (ECM) topography. The latter is considered a breakthrough for tissue engineering nanomanufacturing. Thus, electrospun nanofibers of hybrid materials are a class of bio-nano-composites that allow for versatile design, ease of manufacturing, and diversity of biomedical applications. Nanonedicine will eventually rely on electrospun nanofiber-based synthesis and processing to build active components in sensing, actuation, nanocues in templating, drug delivery systems, etc. This paper reviews the state-of-the-art, provides highlights from the author's recent research in this field such as the "band-aid"-type skin patch and nanowire-based breathanalyzer as disease diagnostics, and provides insights for the future of electrospun biomaterials.

10:20 AM

(BIO-015-2012) Microfabricated Sensors for In Vivo Neurotransmitter Measurements

G. S. McCarty*, NCSU, USA

Recent research by our group has advanced the use of electroanalytical techniques for monitoring biochemical signaling in vivo. This presentation will discuss the measurements of neurotransmitter release and reuptake in function brain tissue using fast scan cyclic voltammetry (FSCV) at microelectrodes. The electroanalytical technique FSCV provides the necessary sensitivity and selectivity for monitoring electroactive analytes in the complex biological matrix of the brain. The microfabricated sensors improve the reproducibility in the performance of the microelectrodes. This presentation will provide an overview of these measurements and discuss recent studies monitoring dopamine release in functioning brain tissue.

10:40 AM

(BIO-016-2012) Sysnthesis and applications of novel Nickel hexacyanoferrate-Gold Nanocomposite Biomaterial in electrochemical sensor designs

P. C. Pandey*, A. Pandey, Institute of Technology, Banaras Hindu University, India

Nanocomposite of Nickel hexacyanoferrate (NiHCF) is made with gold nanoparticles (AuNPs) of two different sizes (20 and 80 nm as AuNpred and AuNpblue respectively) synthesized via 3-glycidoxypropyltrimethoxysilane mediated reduction of 3-aminopropyltrimethoxysilane treated gold chloride and characterized by scanning electron microscopy and UV-VIS spectroscopy.The size of AuNPs is found to influence greatly on the two pairs of reversible voltammetric peaks of cation rich and cation deficient forms of NiHCF Biomaterial. Such influence is identified from the cyclic voltammetry of new biomaterial modified electrodes and their applications during electrochemical sensing of two different analyte i.e. hydrazine and glutathione (GSH). The electrochemical sensing of hydrazine based on cyclic voltammetry and differential pulse voltammetry (DPV) is found as a function of sodium deficient form of NiHCF and the same is greatly amplified on increasing AuNPs nanogeometry. On the other hand NiHCF alone is not efficient electrode material for GSH analysis at required level however; the presence of AuNPs introduces size dependent sensitive and selective detection of the same. The GSH sensing based on linear sweep voltammetry (LSV) is found to be mediated by potassium rich form of NiHCF redox couple in the presence of AuNPs.

Metallic Implants and Coatings I

Room: Capital D
Session Chair: Peter Ullrich, Titan Spine, LLC

9:50 AM

(BIO-002-2012) Selection of Biomaterials for Spinal Interbody Fusion Implants – Consideration of Design, Endplate Bonding, and Modulus vs. Engineered Modulus (Invited)

C. Bagga*, Prosidyan, Inc., USA; B. W. Cunningham, Orthopaedic Spinal Research Laboratory, USA; P. F. Ulrich, Titan Spine, LLC, USA; W. Kelly, Mechanical Solutions, Inc., USA; M. Gallagher, J. M. Schneider, Titan Spine, LLC, USA

Spinal Interbody fusion implant plays a key role in the success of a spinal fusion surgery. An ideal interbody implant (cage) allows for immediate stability of the construct, has ample room for accepting bone graft material and allows appropriate load sharing between the cage and the graft material so that effective bone healing can be realized. A very important factor to be considered is also the ability of the cage to bond to the vertebral endplates. This study compares and evaluates Titanium and PEEK as materials for spinal fusion cages. Evaluations have been performed in cadavers, by simulated bench top mechanical testing, as well as through Finite Element Analysis.

10:20 AM

(BIO-003-2012) Titanium-boron alloys for potential orthopedic applications – microstructure, mechanical behavior and environmental stability (Invited)

V. Ravi*, S. Alas, California State Polytechnic University, Pomona, USA

Titanium alloys containing boron additions have been recently developed for structural applications. The microstructures of these alloys are altered significantly even with small additions of boron resulting in increases in specific strength and stiffness. The evaluation of these alloys for biomedical applications, including load-bearing orthopedic applications, must include a protocol for testing stability in physiologically relevant media. We have developed a series of in vitro test methods for determining the corrosion resistance of these alloys that offer insights into alloy behavior as a function of boron content. The biocompatibility of these alloys is also being studied in parallel. Our work has revealed several interesting insights into this class of alloys - ranging from binary systems to more complex alloys. This talk will review the unique microstructures of this class of alloys and provide insights into the effects of boron additions on their stability in physiological environments.

10:50 AM

(BIO-004-2012) Tantalum Diffusion Coating for Increasing the Biocompatibility of Conventional Metal Implant Alloys

J. J. Stiglich*, J. W. Brockmeyer, B. E. Williams, Ultramet, USA

Ultramet has been developing and commercializing refractory metal and ceramic coatings and freestanding parts for corrosive and high temperature environments for more than 42 years. Tantalum has a long history of use as an implant material, in both bone and soft tissue, and Ultramet developed and licensed a process for fabricating open-cell tantalum metal foam orthopedic bone implants that is approved by the Food and Drug Administration. Under other funding, Ultramet developed a process to diffuse highly corrosion-resistant tantalum metal into the surface of conventional stainless steels and superalloys to improve the acid corrosion resistance of propellant transfer valves. A thin, metallurgically bonded tantalum surface layer was established that graded from pure tantalum at the surface to a mixture of tantalum and the substrate elements. A significant benefit is that the tantalum surface layer precisely replicates intricate substrate features and does not require post-process machining or polishing. The potential exists to use this coating to increase biocompatibility of conventional metal implant alloys. In this briefing, Ultramet's experience with tantalum deposition will be reviewed.

11:10 AM

(BIO-005-2012) Biomimetic calcium phosphate formation on titanium surfaces modified with organophoshonate molecules

A. Y. Sánchez Treviño*, M. A. Rodríguez Valverde, M. A. Cabrerizo Vílchez, University of Granada, Spain

The aim of this work is to study the impact of the biomimetic surface properties of titanium dental implants on the biological events occurring during the early stages of osseointegration. We studied commercially pure titanium discs (ASTM grade II) finely polished and chemically functionalized with three molecules of organophosphonates: ODPA (methyl terminal group), HDPA (carboxyl terminal group) and DDPA (phosphonate terminal group). A prior nucleation of nascent calcium phosphate was carried out over the modified titanium surfaces using a rapid precipitation method. The biomimetic coatings were produced by immersion in a Simulated Body Fluid solution for 48 h. We found that the DDPA sample, after the rapid nucleation, showed the highest Ca/P coverage while the unmodified sample was barely covered. The rapidly deposited calcium phosphate layer mostly revealed a poor crystallinity. The biomimetic coatings showed a continuous layer of biomimetic apatite formed in all the cases. We validated the chemical functionalization of smooth titanium surfaces with organophosphonates in order to further the precipitation of calcium phosphate. The earlier nucleation accelerated the formation of a stable apatite layer on titanium. The biomineralization was greatly mediated by the terminal group of the chemical functionalization, following the sequence: DDPA>HDPA>ODPA.

11:30 AM

(BIO-006-2012) Single Step Synthesis and Characterization of Hydroxyapatite Deposited Microporous Titania Layer on Cp-Titanium by Micro Arc Oxidation

F. Muhaffel*, H. Cimenoglu, Istanbul Technical University, Turkey

Today the most popular issue of biomedical industry is to achieve firm binding between orthopedic-dental implants and bone-tissue shortly after the implantation. For this purpose the surfaces of these implants are covered with hydroxyapatite (HA) by various surface modification techniques, which has a chemical composition similar to that of the bone. To ensure the formation of HA layer on the surfaces of titanium, micro arc oxidation (MAO) appeared recently as an attractive method. Simply, MAO process induces microporous and rough titanium oxide layer on the surfaces, which has high potentiality to provide good bonding between the implant and the bone. In the MAO there are also some possibilities to enhance the binding between the implant and the bone by introducing HA into the titanium oxide layer. In this respect, present study aimed to deposit crystalline HA layer on titanium oxide layer of Cp-Titanium via single step MAO process. The morphology, chemical components and structures of the surface layers were investigated by x-ray diffraction analysis (XRD), scanning electron microscopy (SEM), and energy dispersive spectrometry (EDS). XRD results showed that the diffraction peaks are the characteristic peaks of HA. The hydrophilicity and roughness of the surface were examined by contact angle goniometer and surface profilometer, respectively.

Plenary Session II

Room: Capital D

12:40 PM

(BIO-017-2012) Radioembolization with Yttrium 90 Microspheres (Invited)

R. Salem*, Northwestern University, USA

Treatment options for liver tumors that cannot be resected are based on trans-arterial techniques. The majority of these techniques are based on bland or chemoembolization. 90Y microspheres represent an alternate trans-arterial option. Although 90Y microsphere therapy has only recently gained increasing awareness and clinical use, there is ample data that supports its use for both primary and metastatic liver tumors. During the past five years, numerous studies involving larger cohorts, randomized trials and 90Y microspheres in combination with other systemic and liver directed therapies have provided evidence of the safety and efficacy of 90Y therapy for the treatment of both primary and metastatic liver disease. New applications for 90Y therapy in selective lobar/segmental infusion with the intent of preserving functional liver reserve, and downstaging to resection, radiofrequency ablation, and liver transplantation are also being explored. In the USA, 90Y therapy is being utilized at several centers for all tumor types including HCC and metastatic colorectal, breast, and neuroendocrine tumors. Response rates range between 35-50% by imaging, and up to 90% by functional imaging (PET). Based on encouraging results with 90Y therapy in metastases other than colorectal, such as breast and neuroendocrine, several directions for future clinical applications are also warranted.

Imaging and Treatment II: Advances in Nanomaterials

Room: Capital A/B
Session Chair: Andrew Larson, Northwestern University

1:30 PM

(BIO-023-2012) Dartmouth Center for Cancer Nanotechnology Excellence (Invited)
I. Baker*, Dartmouth College, USA

This talk outlines the Dartmouth Center of Cancer Nanotechnology Excellence, which focuses on the use of novel antibody-targeted magnetic particles (mNPs) subjected to an alternating magnetic field (AMF) for the treatment of tumors. The nanoparticles used are either iron/iron oxide core/shell nanocomposite mNPs or commercial coated iron oxide mNPs. There are four projects. The first focuses on producing novel antibodies, determining their tumor accumulation for a range of mNP sizes in mouse models and comparing the results to untargeted mNPs. The second project focuses on developing new imaging technologies to determine the binding, location, and concentration of the mNPs based on combining optical ratiometric fluorescence spectroscopy with magnetic spectroscopy of particle Brownian motion. The other two projects are therapy-focused on breast cancer and ovarian tumors. The breast cancer work involves direct injection of mNPs into a tumor. The synergistic effects of chemotherapy and radiation therapy with magnetic hyperthermia treatments are being examined. The ovarian cancer work involves development of strategies to determine the therapeutic effectiveness of introducing antibody-conjugated mNPs into the peritoneal cavity of ovarian cancer models. In addition, an AMF is being used to damage cancer cells while also eliciting anti-tumor immunity using various chemotherapies. Supported by NIH Grant 1 U54 CA151662-01.

2:00 PM

(BIO-092-2012) From micron- to nano-topography in Dental Implant Surfaces (Invited)
G. Mendonca*, University of North Carolina at Chapel Hill, USA

Nanotechnology permits engineers and biologists to new ways of studying and interacting with biology. The aim of this presentation is to consider how nanoscale topography imposed on titanium substrates alters endosseous implant / cell interactions. The relative significance of micro and nanotopography or the combination of both at the cellular and molecular level is addressed. The potential advantages and disadvantages of nanofeatures for implant surfaces are considered. Overall, existing literature indicates that nanotopography imparted to endosseous implant surfaces can modify cellular and tissue responses and improve osseointegration. However, there is a need for more clinical studies to confirm the long-term benefits of nanotopography in implant surfaces.

Sensors II

Room: Capital A/B
Session Chair: Randy Avent, North Carolina State University

2:20 PM

(BIO-025-2012) Tuning nanoparticle-DNA recognition with ligand chemistry: molecular modeling (Invited)
A. Singh, N. Li, Y. G. Yingling*, North Carolina State University, USA

Ligand functionalized inorganic nanoparticles can be used in sensors due to their ability to bind to DNA, proteins and other biomolecules. Moreover, sensing properties of nanoparticles can be fine-tuned to recognize specific biomolecules through modification of surface ligand chemistry. For example, the interactions between DNA and nanoparticle strongly depends on the size and ligand chemistry of nanoparticles. We performed molecular dynamics simulations to investigate the effect of colloidal gold nanoparticle (GNP) as a function of ligands charge and polarity to its ability to bind and recognize DNA molecules. The surface of GNP was functionalized with thiolated alkyl ligands with different terminal groups such as hydrophobic, polar and charged groups. We observed that uncharged GNPs and GNPs with cationic ligand charge density of less than 10% can only bind to the minor groove of DNA. Whereas GNPs with ligands charge density of higher than 10% can bind to major or minor groove. Binding to major groove result in significant distortion and wrapping of DNA around the GNP corona. The distortions of the DNA helical structure strongly depends on the ligand charge density. We observed that by tuning the cationic charge density and polarity of GNP we can control the binding modes and structural mechanics of DNA.

2:50 PM

(BIO-026-2012) Biomaterial derived from nanostructured Prussian blue gold and palladium and their application in L- cysteine sensing (Invited)
P. C. Pandey*, A. Pandey, Institute of Technology, Banaras Hindu University, India

Novel biomaterial for L-cysteine (Cys) sensing is developed based on nanocomposite of Prussian blue (PB). The nanocomposite of PB was made using; (1) 3-glycidoxypropyltrimethoxysilane mediated in situ generated gold nanoparticles (AuNP) sol, and (2) nanostructured palladium powder (Pd) obtained by the calcinations of palladium-linked 3-glycidoxypropyltrimethoxysilane at 1000°C. The new biomaterial were used to fabricate; PB, PB-AuNP, and PB-AuNP-Pd; modified electrodes. These modified electrodes were characterized by cyclic voltammetry. The electrochemical sensing of Cys over these modified electrodes were examined based on amperometric measurements under optimized conditions. The results on Cys sensing revealed the following findings on the role of new biomaterials: (i) PB alone was least sensitive to Cys, (ii) PB-AuNP resulted into increased sensitivity, (iii) PB-AuNP-Pd significantly increased the sensitivity of Cys analysis as compared to that of PB-AuNP and PB, justifying synergetic effect of coupled catalytic behavior of AuNP and nanostructured Pd, (iv) PB-AuNP-Pd system showed lowest detection limit of 0.18 μM having linear range between 0.3 - 400μM, (v) Cys analysis in dietary supplement provided selective and reliable data for practical applications, (vi) the sensing data were selective to Cys and showed negligible sensitivity to interfering analytes.

Uses of Bioactive Glass in New Treatments

Room: Capital A/B
Session Chair: Charanpreet Bagga, Prosidyan, Inc.

3:40 PM

(BIO-036-2012) Use of Bioactive Glass in Bone Graft Substitute Materials – The New Trend in Bone Repair (Invited)
H. Bae, Cedars Sinai Hospital, USA; C. Bagga*, Prosidyan, Inc., USA

A significant shift has been noticed in the last decade in the choice of bone grafts in an orthopedic/spine procedure from Autograft Harvest to many new options like Synthetic Bone Graft Substitutes, Bone Morphogenic Proteins, Allograft based Bone Grafts etc.. Each one of these new bone graft options has its advantages and drawbacks. It is well accepted that there is a gap between currently available bone grafts and an ideal solution. This gap creates tremendous opportunity for innovative developments and commercialization in a global bone grafting market which is greater than 2 Billion dollars and still growing rapidly. The latest trends in development point to development of new biomaterials which offer not only the osteo-conductive ability of traditional bone grafts, but also the ability to stimulate and proliferate the cells on their surface - leading to faster and more effective bone healing and repair. Several formulations of Bioactive Glasses offer this "osteo-stimulative" ability. Additionally, there have been tremendous advancements in the processing of bioactive glasses, which make them ideal candidates for being the platform of this new generation of synthetic bone grafting to effectively satisfy the currently un-met clinical needs.

4:10 PM

(BIO-037-2012) Circular-Dichroism Spectroscopy of Albumin Adsorbed on Calcium and Strontium Phosphate Microspheres

K. Fears*, D. Burden, C. Love, U.S. Naval Research Lab, USA; D. Day, Missouri University of Science and Technology, USA; T. Clark, U.S. Naval Research Lab, USA

The adsorption behavior of bovine serum albumin (BSA) on nanocrystalline hydroxyapatite (HA) and strontium apatite (SrHA) microspheres, derived from borate glasses, was assessed using circular-dichroism spectroscopy (ECD). Numerous reports have shown that surfaces which present nano-sized features can exhibit better cellular response than surfaces with features in the micron regime. The microspheres were incubated in BSA solutions (40 mg/mL; ~64% helix; ~1% sheet) to determine if BSA adsorbed in a fundamentally different manner than on bioinert yttria-alumina-silicate (YAS) spheres that induced minimal conformational changes (~56% helix; ~4% sheet). On the apatite spheres, BSA loss a substantial amount of its helical structure and strained disulfide bonds were detected. However, the protein density on the SrHA spheres was 50% lower than on the HA spheres, indicating that BSA has a higher affinity for irreversible adsorption on HA. 5,5'-Dithio-bis-(2-nitrobenzoic acid), was used to selectively modify free thiols post-adsorption, indicating that solvent-accessible free cysteines were present on the apatite spheres, despite the absence of a reducing agent. Subsequent BSA molecules, or other proteins in vivo, could potentially form intermolecular disulfide bonds leading to increased adhesion of proteins or support the formation of macroscopic protein structures.

4:30 PM

(BIO-038-2012) Optimization of Experimental Composite Nerve Guidance Conduits: Mechanical Properties and Cytocompatibility using Cultured Schwann Cells

X. Zhang*, S. Kehoe, Dalhousie University, Canada; L. Gan, F. Wu, SiChuan University, China; D. Boyd, Dalhousie University, Canada

Zinc-silicate (Zn-Si) glasses have demonstrated potential for both soft and hard tissue engineering applications. Recently, a series of Composite Nerve Guidance Conduits (CNGCs) comprising a multicomponent Zn-Si bioglass embedded in poly-D,L-lactide-co-glycolide (PLGA) have been investigated for their potential to bridge peripheral nerve discontinuities. For these CNGCs, optimization of mechanical properties and biocompatibility can be achieved through careful control of composition based on an understanding of the composition-property relationships. However, optimization studies of such devices have been limited. In the present study, six variations of CNGC (12.5wt%-20wt% PLGA, 0-20wt% Zn-Si glass) were evaluated for their mechanical properties and cell viabilities in response to rat Schwann cells (nerve sheath) at 1, 3, and 7 days incubation periods. Interaction effects between PLGA and glass content indicate that the composition may be suitably engineered to target desirable tensile strength and cell viability. As such, response surface methodologies have been applied to obtain maximum cell viability coupled with maximum tensile strength for these CNGCs. The findings of this study suggest that a CNGC comprising 20wt% PLGA – 18.35wt% Zn-Si glass allow for maximum tensile strength (1-3MPa) and cell viability (50-89%) up to 7 days incubation.

4:50 PM

(BIO-039-2012) Antimicrobial Properties of Silver Coated Bioactive Glass Particles for Wound Healing Applications

P. Hassanzadeh*, A. W. Wren, M. R. Towler, Alfred University, USA

The aim of this work is to synthesize bioactive glass particles with antimicrobial properties to be used in injectable biomaterials for wound healing applications. A bioactive glass with composition of 0.42SiO2-0.12CaO-0.18Na2O-0.28ZnO was prepared in two particle sizes, <90μm and 425-850μm. Silver-coated glass (PAg) was synthesized by coating both particle sizes of the glass with silver ions by spinning method. Uncoated glass (PCon) was prepared in the same two particle sizes and used as the control. Scanning Electron Microscopy determined that the Ag coating mostly remained at the surface with just little diffusion through the bulk. Surface area analysis showed that coating glass particles with silver would lead to increase in the surface area for both particle sizes. Antibacterial testing against E. coli and S. epidermidis using the agar diffusion method showed that PAg had significant antibacterial properties against these strains of bacteria with the largest inhibition zone being 13mm. Antifungal testing against C. albicans indicated that smaller PAg particles produced larger inhibition zones than larger PAg particles. Also, silver is more effective in inhibiting E. coli than S. epidermidis and it seems that zinc did not have any effect on C. albicans. In conclusion, small particle size of PAg glass seems a good candidate for wound healing applications.

5:10 PM

(BIO-040-2012) Examining the Thermal Characteristics and Cytocompatibity of La-doped Zinc-Silicate Embolic Agents

S. Kehoe*, D. Boyd, Dalhousie University, PO Box 15000, Canada

Zinc-silicate (Zn-Si) glasses offer excellent biocompatibility with appropriate tailoring of composition and network structure. It has been shown that La-doped Zn-Si glasses (prepared as irregular shaped particles with a particle size distribution of 300-500μm) posses an intrinsic radiopaque nature and as such, may facilitate the reduced use of contrast media in transcatheter arterial embolization, where embolic particles are deployed to treat pathologies including hepatocellular carcinoma, and uterine leiomyomas. We hypothesize that, in addition to enhancing radiopacity, increased La content in the glasses will increase network integrity and enhance cell viability. In this work, a series of Zn-Si glasses and a series of La-doped (0 to 0.068 mol. fraction) Zn-Si glasses were synthesized and evaluated using DSC (to determine Tg) and MTT- assays (to determine cell viability). Regression models were applied to further expand upon composition-property relationships. For completeness, the effects of Ti/Si and Ti/Zn substitutions were also determined. The inclusion of La is found to significantly ($P<0.0001$) increase both Tg and cell viability. Optimization studies conclude that 0.172Zn-0.068La-0.57Si-0.05Ti is required to maximize Tg and cell viability. Conversely, 0.24Zn-0.00La-0.57Si-0.05Ti is required to minimize Tg whilst keeping cell viability maximized.

5:30 PM

(BIO-041-2012) Novel Carbon Nanotube Reinforced Bioglass Composites for Orthopedic Applications

J. Zhang*, Indiana University - Purdue University Indianapolis, USA; C. Jia, Z. Jia, University of Science and Technology Beijing, China

Novel carbon nanotube reinforced 45S5 bioglass composites have been successfully developed using mechanical mixing followed by spark plasma sintering (SPS) technique. Bioglass powder has been used previously as a bone-filling material in orthopedic and dental surgeries, but its lean mechanical strength limits its applications in load-bearing positions. In order to improve its mechanical properties, reinforced materials can be employed. In this study, the novel carbon nanotube reinforced bioglass composites show substantially improved mechanical properties. Compared with the bioglass matrix, the maximum flexural strength and fracture toughness increased 159 % and 105 %, respectively. Enhanced strength and toughness mechanisms are attributed to the interfacial bonding and bridging effects between the carbon nanotubes and the bioglass powders during crack propagations. The results suggest that the composite is a promising material for load-bearing applications in orthopedic field.

Blood Vessels, Nerve Guides and Hemostasis

Room: Capital C
Session Chair: Amy Harkins, Saint Louis University

1:30 PM

(BIO-093-2012) A combinatorial approach to biomaterials design (Invited)

J. Kohn*, New Jersey Center for Biomaterials, USA

Advances in high throughput combinatorial synthesis facilitate the application of these techniques to the discovery of biomaterials. To be of practical utility, combinatorial approaches to biomaterials design require (i) the ability to generate libraries of polymers, (ii) efficient assays for the rapid characterization of bio-relevant material properties, and (iii) computational methods to efficiently model different biological responses in the presence of polymers. Here we report on the integration of these methodologies and illustrate the potential of this approach to accelerate the development of new biomaterials. We found that it is possible to determine molecular-scale polymer properties that correlate to various biological responses and that this knowledge can be used to accelerate the development of optimized biomaterials for specific commercial products. This will be illustrated by our work relating to the development of a new polymer specifically designed for use in coronary stents.

2:00 PM

(BIO-028-2012) Effects of Bioactive Glass Composites on Neuronal Cell Behavior for Tissue Engineering Applications

L. M. Marquardt, Washington University in St. Louis, USA; D. Day, Missouri University of Science and Technology, USA; S. Sakiyama-Elbert, Washington University in St. Louis, USA; A. B. Harkins*, Saint Louis University, USA

While typically characterized as a material for hard tissue engineering, bioactive glasses have recently been shown to promote regeneration of soft tissues by positively influencing tissue remodeling during wound healing. Thus, we are studying the effect on neuronal tissue following injury. Bioactive glass is easily fabricated and manipulated to produce tailored degradation profiles by altering the chemical composition or by adding degradable polymers. In these experiments, degradable borate bioactive glass was fabricated into rods and discs, and glass/poly(ε-caprolactone) composite sheets. In order to study the compatibility of this material with neurons, rat and chick DRG and chick sympathetic ganglia neurons were cultured with different bioactive glass compositions. Cell viability and neurite length were monitored when cultured with degradable rods in static and transient conditions, on pure glass fiber discs, fibrin scaffolds with embedded glass rods, and on glass/PCL composite sheets. Results demonstrate neuronal survival in the presence of bioactive glass. Neurite extension was not significantly affected by the presence of glass in comparison with control laminin-coated surfaces. These results indicate little to no negative effect of the bioactive glass on different types of neurons in vitro suggesting it is safe to use bioactive glass for nerve regeneration.

2:20 PM

(BIO-029-2012) Integrin Mediated Platelet Adhesion to a Hemostatic Keratin Biomaterial

M. Bahawdory*, M. Van Dyke, Wake Forest University School of Medicine, USA

The goal of this study was to investigate keratin biomaterial's capacity to adhere and activate platelets, contributing to primary hemostasis. Keratin hydrogels were prepared by allowing disulfide linkages to re-form by exposure to oxygen. A colorimetric assay relating absorbance to platelet adhesion was utilized to quantify platelets bound to the surface of keratin hydrogels in the presence and absence of receptor blocking antibodies. Platelet activation was assessed through an evaluation of downstream integrin signaling events. Talin localization and phosphorylation of focal adhesion kinase (P-FAK) were measured using fluorescence and western blot analysis, respectively. Platelet adhesion to keratin hydrogels is significantly decreased when the β1 integrin subunit is blocked under static adhesion conditions. Translocation of talin is the final essential step in integrin activation; platelets bound to keratin demonstrate talin localization to the submembrane space. Activation was further confirmed by an increased expression of P-FAK in platelets adhered to keratin biomaterials relative to controls. In conclusion, keratin based hydrogels appear to be pro-adhesive with functional similarities to extracellular matrix proteins. Optimizing this novel material can only occur with an understanding of the biochemical mechanisms involved in keratin's unprecedented hemostatic abilities.

2:40 PM

(BIO-027-2012) Creating waved and aligned nanofiber composites with biomimetic microstructures and mechanical compliance to natural blood vessels (Invited)

V. Beachley, X. Wen*, Clemson University, USA

Failure of synthetic vascular grafts to structurally and functionally integrate with natural blood vessels has been largely due to the lack of mechanical compliance to natural blood vessels. A detailed dissection of the microstructural components of natural blood vessels pertaining to the mechanical properties has revealed the major contributions of the two nanofiber components, i.e., elastin, and collagen, to the 'J-shaped' stress-strain behavior of natural vessels. To achieve the overall mechanical properties similar to those of natural vessels in synthetic vascular grafts, we had created polymeric composites of two types of nanofibers with biomimetic microstructures and mechanical properties similar to those of the elastin and collagen fibers in natural blood vessels, respectively. In this work, novel fabrication technologies were developed to create aligned nanofiber composites containing straight aligned elastic nanofibers to mimic the elastin fibers, and 'wavy' aligned stiff nanofibers to mimic the collagen fibers using synthetic biopolymers. These nanofiber composites exhibited mechanical behaviors similar to those of natural blood vessels . The versatile fabrication technique that we had developed could be fine-tuned to generate nanofiber composites that precisely match the mechanical properties of vessels of different types and sizes.

3:10 PM

(BIO-030-2012) The Relationship between Basement Membrane Development of Cardiomyocytes and Cell-to-Cell Crosstalk Reestablishment in Microwells

H. Yang*, H. Liu, Z. Wang, Clemson University, USA; T. K. Borg, Medical University of South Carolina, USA; B. Z. Gao, Clemson University, USA

During the development of a cardiovascular system, basement membranes (BM) is greatly involved in vasculogenesis, angiogenesis and morphogenesis of heart (1,2). BM is a highly organized network of glycoproteins and proteoglycans closely associated with the cells, and two main proteins play the key roles in BM: laminin and collagen IV (3). In the heart, BM is not only expressed in the layer of endothelium, but also encloses each cardiomyocyte (CM) to facilitate its physiological functions. Currently, the development and function of BM in CM cultures and the relationship between BM development and CM-to-CM crosstalk establishment, such as gap-junction and adherens-junction formation, is still unclear, especially during the process of CM maturation from neonatal to adult. In this study, we examined with a confocal microscope the 3D BM network through laminin staining of adult rat CMs and investigate the BM development in neonatal rat CMs growing on aligned collagen fibers. Finally, two neonatal CMs were placed using our laser cell deposit system into a rectangular microwell to control spatiotemporally the contact mode between the two cells for the study of the relationship between BM development and gap- and adherens-junction formations.

Three Dimensional Scaffolds for Tissue Regeneration I

Room: Capital C
Session Chair: Hyun Bae, Spine Institute

3:30 PM

(BIO-042-2012) Bioinspired ceramic scaffolds for bone replacement (Invited)

J. McKittrick*, M. M. Porter, UC San Diego, USA; P. Chen, National Tsing Hua Univerisity, Taiwan; M. A. Meyers, UC San Diego, USA

To develop potential load-bearing bone replacements, inorganic-organic composites that mimic the microstructural and mechanical properties of natural trabecular or cortical bone were fabricated by different methods. The composites consist of ceramic scaffolds infiltrated with a polymeric phase. Different ceramic scaffolds were taken from nature or designed synthetically by freeze casting. Different polymer infiltration techniques include polymer melt immersion, polymer-solvent evaporation, in situ polymerization, chemical vapor deposition, and particle centrifugation. Depending on the method used to infiltrate the polymeric phase, the porous ceramics were either filled or coated with the organic material. The architectural hierarchy across multiple length scales gives these lightweight composites high strength and toughness. Good interfacial adhesion or chemical grafting of the two constituent phases results in improved mechanical properties. The inorganic-organic composites have a microstructure, porosity, strength and stiffness similar to that of natural trabecular or cortical bone. Choosing biocompatible materials, such as hydroxyapatite (HA) or titanium dioxide (TiO2), and biodegradable polymers, such as polyhydroxybutyrate (PHB)or polylactic acid (PLA), allows these composites to serve as potential bone replacements.

4:00 PM

(BIO-043-2012) Nanofibrous scaffolds for bone healing (Invited)

X. Yu*, Stevens Institute of Technology, USA

Purpose of the study: This work aims to develop a novel biodegradable ECM mimic nanofibrous scaffold with the combination of appropriate physical attributes and biological principles for bone healing. Experimental design and methods: The scaffold consisted of an inner spiral structured nanofibrous PCL scaffold and an outer tubular microsphere sintered PLGA scaffold. HAP and BMP-2 were incorporated within the nanofibrous scaffolds to improve the bioactivity. The scaffolds were characterized for mechanical properties, porosities, and morphologies. The in vitro bioactivity was characterized by evaluating the cell attachment, proliferation, and differentiation of bone cells seeded on the scaffolds. The effect of the scaffolds for in vivo bone healing was evaluated by implanting the scaffolds into a rabbit ulna defect model. Experimental results: The scaffolds had open architectures, large surface areas and an optimal porosity for enhanced bone cell attachment, proliferation, differentiation and mineralization. The outer scaffold housed the inner soft scaffold and provided sufficient mechanical strength. The nanofibrous scaffolds significantly enhanced bone healing in vivo as compared to control scaffolds. Conclusions: The nanofibrous scaffolds can simultaneously provide sufficient mechanical strength and promote bone growth, and thus have the potential for universal applicability in the treatment of bone injuries.

4:30 PM

(BIO-044-2012) Performance of silicate TAMP bioscaffolds (Invited)

T. Kowal, J. Marzillier, M. M. Falk*, Lehigh University, USA; M. Saad, M. Marei, Alexandria University, Egypt; U. Thamma, C. LaPorte, H. Jain, Lehigh University, USA

We report on the performance of tailored amorphous multi porous (TAMP) bioscaffolds based on 30CaO–xB2O3–(70-2x)SiO2 glass series designed to determine the effect of boron on the bioresponse. The fabrication methods are based on multi-scale phase separation from which one or more phases are selectively removed. The resulting structure consists of nano and macro scale porosity that can be varied independently, thus permitting the matching of degradation rate with tissue growth rate. In this paper we present our recent results on the effect of boron on the degradation rate under quasi dynamic conditions, and the in vitro bioactive response of such TAMP structures using adhesion, proliferation and upregulation of bone formation markers of MC3T3-E1 pre-osteoblast cells, both on mRNA as well as protein level. For in vivo response, the bioscaffold samples were implanted under the skin of New Zealand rabbits. Subsequent observations revealed normal cascade of wound healing and closure, hair growth, rapid degradation, minimal fibrous tissue formation and highly angiogenic and vascular development, indicating osteoinduction by the TAMP bioscaffolds. These results demonstrate distinct advantages of present bioactive scaffolds for tissue regeneration.

5:00 PM

(BIO-045-2012) Evaluation of bioactive glass scaffolds made by selective laser sintering

M. Velez*, Mo-Sci Corporation, USA

Selective Laser Sintering (SLS) was used to fabricate bone scaffolds using 13-93 bioactive glass particles. The microstructure and compression strength of the scaffolds were optimized by controlling particle size distribution of the glass particles, polymer binder content, and sintering schedule. These scaffolds can include biologically active reagents such as proteins and were specifically designed for implantation in rats and had a hollow cylindrical structure that can accommodate a metal pin through the longitudinal length of the scaffold. In-vitro, the compressive strength of the SLS scaffolds was measured as a function of time for up to three months when immersed in simulated body fluid at 38C. In-vivo, the scaffolds with and without bone morphogenic protein-2 (BMP-2), were implanted after a 5 mm segment was removed from femurs of Long-Evans rats to create critical-sized defects which were stabilized using a stainless steel K-wire. The 3-month histology results show that the scaffolds provided sufficient strength to sustain the segmental defect until bridging callus is successfully formed.

5:20 PM

(BIO-046-2012) Direct building of 3D hydroxyapatite microchannel structure for nutrients delivery

D. Salamon*, Brno University of Technology, Czech Republic; S. Teixeira, University of Twente, Netherlands

Next generation of the hard tissue scaffolds will be made to accommodate nutrient channels to support cells live inside of the 3D scaffold. Nowadays, diffusion through scaffold and a tissue usually limits transport, and forms potentially hypoxic regions. Hydroxyapatite is biocompatible material, that supports cell adhesion and proliferation, therefore ideal for the preparation of bone grafts. In this study, a 3D hydroxyapatite structure containing microchannels via microtemplating was prepared. Furthermore, the sintered structure contains asymmetric membrane walls with flux suitable for nutrition delivery, which keeps microchannels for nutrition support and waste removal separated from cell growth area. The metabolic activity of the cells was determined and the cell morphology was visualized. The ability for these structures to support cell adhesion and proliferation was shown to be favorable over a period of 7 days. The presented straightforward concept for building 3D structure containing tailored microchannels suitable especially for bioreactors applied as a bone grafts.

Metallic Implants and Coatings II

Room: Capital D
Session Chair: Peter Ullrich, Titan Spine, LLC

1:30 PM

(BIO-018-2012) Enhancing the Wear Resistance and Osseo-integration of Next Generation Beta Titanium Alloys For Orthopedic Implants (Invited)

P. Kami, S. Nag*, S. N. Dahotre, S. R. Paital, T. W. Scharf, N. D. Dahotre, R. Banerjee, University of North Texas, USA

While still the preferred material for femoral stems, the primary issue plaguing the use of titanium alloys as a femoral head material is its rather poor wear resistance. The first part of this presentation will focus enhancing the wear resistance of next generation beta-titanium alloys, such as those based on Ti-Nb-Zr-Ta alloys via surface engineering involving either introducing hard wear-resistant ceramic boride reinforcement precipitates, or introducing a hard oxygen-enriched alpha case layer on the beta matrix of the base alloy, or via laser-based local nitriding of the alloy surface. The second part of this presentation will focus on laser deposition of calcium phosphate based coatings on Ti-based alloy substrates with the objective of enhancing their osseo-integration properties. Detailed microstructural investigations (x-ray diffraction, SEM, TEM) revealed the presence of various phases as a result of the intermixing between the precursor and substrate material during laser processing and will be discussed.

2:00 PM

(BIO-019-2012) Effect of Surface Treatment of Titanium Alloy on Maturation of Osteoblasts In Vitro

D. C. Greenspan*, Spinode Consulting, USA; J. M. Schneider, M. E. Berg, Titan Spine, USA; B. D. Boyan, Z. Schwartz, R. Olivares-Navarrete, R. A. Gittens, Georgia Institute of Technology, USA; J. J. Stapleton, T. B. Tighe, Pennsylvania State University, USA

PURPOSE: The aim of this study was to determine if the addition of micron and sub-micron surface textural features enhances the maturation of osteoblasts in vitro. METHODS: Etching and sandblasting of titanium alloy (Ti alloy, Ti6Al4V) implant surfaces was used to create two different roughened surface topographies. Smooth Ti alloy was used as a control. Optical profilometry and atomic force microscopy (AFM) were used to determine the surface topography of the materials. Response of human MG-63 pre-osteoblast cells was measured by cell viability, alkaline phosphatase specific activity and osteocalcin production. RESULTS: Surface roughness values (Ra) for smooth Ti alloy were significantly lower than for the two treated Ti alloy surfaces. AFM showed that the roughened surfaces had a fine nano-scale texture uniformly over the surfaces. Smooth Ti alloy surfaces showed no such features. Although the number of viable cells on the two roughened Ti alloy surfaces was reduced compared with the smooth Ti alloy, the cells on these surfaces were more mature based on increased alkaline phosphatase and osteocalcin. CONCLUSIONS: The results of this study clearly showed a strong positive influence on osteoblast maturation on roughened Ti alloy surfaces compared with controls. This enhanced maturation may result in more rapid bone formation at the implant surface.

2:20 PM

(BIO-020-2012) Novel bioactive Ti metal and its alloy enriched with calcium ions on their surfaces by simple chemical and heat treatments

S. Yamaguchi*, T. Kizuki, S. Nath, H. Takadama, T. Matsushita, Chubu University, Japan; T. Nakamura, National Hospital Organization, Japan; T. Kokubo, Chubu University, Japan

The present authors early showed that Ti metal forms an apatite layer on its surface in body environment and bonds to living bone, when it was subjected to NaOH and heat treatments to form sodium titanate on its surface. These treatments were applied to porous Ti layer on an artificial hip joint, which has been clinically used since 2007 in Japan. However, the Ti metal tended to decrease its apatite-forming ability, when stored in humid environment. These treatments were not effective for new type of Ti-Zr-Nb-Ta alloys free from elements suspected of cytotoxicity. It was newly found that Ti metal also forms the apatite and bonds to living bone, when it was subjected to NaOH, $CaCl_2$, heat and water treatments to form calcium titanate on its surface. The treated Ti metal did not decrease its apatite-forming ability even in humid environment. These treatments were also effective for Ti-Zr-Nb-Ta alloys. Various kinds of ions such as Ag^+ ion effective for antibacterial effect, and Mg^{2+}, Sr^{2+} and Zn^{2+} ions effective for bone growth were successfully incorporated into the Ca-enriched surface layer. These novel bioactive Ti metal and its alloys might be useful for various types of dental and orthopedic implants.

2:40 PM

(BIO-022-2012) Biocompatibility, Corrosion and Mechanical Studies of Surface Treated Nitinol Alloys

P. Gill*, N. Munroe, Florida International University, USA; A. Datye, The University of Tennessee, USA; W. Haider, State University of New York, USA

The biocompatibility of an implant material is a function of its surface characteristics, such as morphology, chemistry, roughness, charge and wettability. Researches conducted by the authors have demonstrated enhanced corrosion resistance and biocompatibility of alloys subjected to magnetoelectropolishing (MEP). In this investigation, surface treated Nitinol alloys were examined by Scanning Electron Microscopy (SEM), X-ray photoelectron spectroscopy (XPS) before and after corrosion in simulated body fluids to assess the role of MEP. The proliferation of the human umbilical vein endothelium cells (HUVEC) on the surface of the alloys was studied and the cytotoxicity of leached metal ions on endothelialization was assessed. Fluorescent microscopy was used to assess the cell viability. Additionally, nano indentation was used to measure the mechanical properties. An evaluation of the effect of surface energy on endothelialization was conducted.

Metallic Implants and Coatings III

Room: Capital D
Session Chair: Peter Ullrich, Titan Spine, LLC

3:40 PM

(BIO-031-2012) Growing Integration Layer [GIL] Method: Coating of Bioactive Ceramic Layers on Metallic Materials in Solution without Firing Processes (Invited)

M. Yoshimura*, National Cheng Kung University, Taiwan; N. Matsushita, Tokyo Institute of Technology, Japan

In the ceramic coating on metallic materials, the most difficult problem is how to overcome poor adhesion of ceramic layers by their cracking and /or peeling arising from their intrinsic brittleness. On the basis of accumulated results and discussion, we propose a novel concept and technology of formation "Growing Integration Layer" [GIL] between ceramics and metallic materials to improve the adhesion performance. Those GIL(s) can be prepared from a component of the metallic materials by chemical and /or electrochemical reactions in a solution at low temperature of RT-200°C. They have particular features: 1)Widely diffused interface(s), 2)Continuously graded layers grown from the bulk(substrate), 3)Low temperature process, etc. BaTiO3 or SrTiO3/TiOx GIL films on Ti plates formed by hydrothermal-electrochemical method showed good adhesion. CaTiO3/Al2O3/Ti2Al GIL films on TiAl exhibited excellent adhesion and anti-oxidation performances: they could be sustained for 10 times cyclic oxidation test at 900°C in air for 5 hrs. The GIL strategy is effective for many metallic alloys and bulk metallic glassed because they generally contain active component(s). On a Ti-base Bulk Metallic Glass, we could succeed to prepare bioactive titanate nano-mesh layer by hydrothermal-electrochemical techniques at 90-120°C.[2]. Similarly, bioactive oxide layers could be prepared on different Bulk Metallic Glasses. The GIL methods are typical "Soft Process" and "Green Process" using aqueous solutions to prepare compositionally, structurally and/or functionally graded layers, which can be applied for variety of thermal, mechanical, chemical and biomedical areas.

4:10 PM

(BIO-032-2012) Development of Magnesium Alloys as Biodegradable Orthopedic Materials (Invited)

Z. Xu*, North Carolina A&T State University, USA

Mg and its alloys are gaining more and more attention as biodegradable orthopedic materials. Application of biodegradable implants will eliminate follow up surgery to remove the implants after bone tissue is healed. Degradation of Mg alloys in vivo even enhances the osteoblastic activity around the degrading implants finally leading to a complete replacement of the implant by bone tissue. Currently available Mg alloys for structural applications are not suitable for medical purpose because of use of Al and high concentrations of rare earth elements. Novel alloys must be developed in considerations of good mechanical properties and controlled corrosion rates. Our research is focused on Mg alloys with Zn and Ca. Ca was kept at a very level (0.3 wt.%). High purity Mg ingots, Zn and Ca granulates were used as raw materials. They were melted in resistance heating furnace and cast in steel molds under argon protection. We have investigated the effect of Zn concentration on the microstructure, mechanical properties, and corrosion properties of Mg-Zn-Ca alloys. Zn is a grain refiner. With more Zn added, the grain size became smaller. Low Zn alloys have better corrosion resistant, higher Zn alloys have better mechanical strength, but faster corrosion rates. The study also showed that solution heat treatment can improve the corrosion resistance of the alloys.

4:40 PM

(BIO-033-2012) Structure and Biocompatability Analysis of Sol-Gel Prepared Niobium and Titanium Oxide with Temperature

D. Pradhan*, A. W. Wren, S. T. Misture, N. P. Mellott, Alfred University, USA

Niobium and titanium oxides were prepared via the sol-gel technique. The structural evolution of these oxides with calcination temperature was investigated using differential thermal analysis (DTA), high temperature x-ray diffraction (HTXRD), and Raman spectroscopy. A series of selected oxide compositions and structures including; TiO2-amorphous, TiO2-tetragonal, Nb2O5-amorphous, Nb2O5-hexagonal, and Nb2O5-orthorhombic, were then selected for bioactivity testing using simulated body fluid (SBF) testing. The bioactivity of the selected oxides was evaluated using scanning electron microscopy (SEM) and energy dispersive x-ray spectroscopy (EDX) as a function of SBF reaction time. Results from this study can help determine the phases favorable for apatite formation and aid in the development of titanium and niobium oxide biomaterials.

5:00 PM

(BIO-051-2012) Biocompatible RF-magnetron sputter deposited CaP-based coatings on the surface of technically pure titanium

R. A. Surmenev*, M. Surmeneva, V. Pichugin, A. Ivanova, I. Grubova, I. Khlusov, Tomsk Polytechnic University, Russian Federation; A. Kovtun, O. Prymak, M. Epple, University of Duisburg-Essen, Germany

Pure hydroxyapatite (HA) and non-stoichiometric HA coatings doped with silica ions (Ca10(PO4)5.5(SiO4)0.5(OH)1.5), which have been prepared by RF-magnetron sputtering deposition on Ti substrates, are reported. Thin nanostructured CaP-based coatings were deposited at the power level 30-290 W, negative substrate bias up to 100 V, a pressure of 0.1 Pa for 30-180 min. Thin coatings were characterized by EDX, ESEM, XRD, IR spectroscopy, and pull off test. Biological trials on the films were done in vitro with culture of prenatal stromal cells of human lung of FL-42 line (cell suspension in the concentration of 30000 viable karyocytes in 1 ml of osteogenic culture medium was used). The CaP-based coatings were dense, pore-free. A low rf-power density (0.1-0.5 W×cm-2) resulted in low crystalline coating structure, an increase in rf-power level (>0.5 W×cm-2) induced the coating crystallization. The Ca/P ratio was varied in the range of 1.53 to 4. The adhesion strength of the coatings was 40 MPa. The prenatal stromal cells of human lung cells had diverse morphological forms after a short-term contact (4 days) with coatings tested; 85-90 % of cells had a round or ellipsoid shape. Fibroblast-like cells were observed in the areas of significant microroughness. Cells spread into the valleys of artificial surface and showed a high expression of alkaline phosphatase.

5:20 PM

(BIO-035-2012) Yttrium doped Hydroxlapatite Coating and Antibiotic Duplex Coating on Titanium with Electrostatic Spray Deposition Method

O. Gokcekaya*, C. Ergun, Istanbul Technical University, Turkey

Rehabilitation of human bodies and tissues, cannot perform normal functions, and replacing synthetic systems (implant and prothesis), gives the body normal functions that lost, these are most common uses for biomedical applications. Bioceramics stay inert in the body and called bioinert materials. To combine the strength of metal and the bioinert properties of bioceramics, we improved a coating technique to make titanium surface with a layer of hydroxlapatite. In laboratory works, we try to find the most effective technique for costs and make fabrication of porous nano-sized coatings that we want to achieve can be fabricated by using electrostatic spray method. According to studies that have been made, Yttrium doped hydroxlapatite was produced and also we tried to fabricate duplex coating with antibiotic and hydroxlapatite. We fabricated porous yttrium doped Hydroxylapatite coating with antibacterial properties on titanium by using electrostatic spray method and then sintered in air 700, 900, 1100oC and after this operation, antibiotic was coated on hydroxylapatite. The coatings were characterized by x-ray diffraction (XRD), FTIR and scanning electron microscope (SEM). A series of antibacterial tests were made to determine the properties of Hydroxylapatite coating and the differences of duplex coating.

Poster Session

Room: Capital E-G

(BIO-P001-2012) Minimal Effect on Mechanical Strength with the Addition of Cisplatin to Commercially Available Bone Cements

J. E. Meyer*, University of Wisconsin - Milwaukee, USA; K. MacDonald, Virginia Mason Medical Center, USA

The purpose of this study was to determine if the applied load at failure for four commercially available bone cements was significantly affected with the inclusion of 5% w/w cisplatin. Cement samples with and without 5% w/w cisplatin were prepared and both bending and compression testing was performed to determine the change in mechanical strength. For bending, inclusion of cisplatin significantly increased the failure load for Palacos ($p = 0.0168$). All other cements showed no significant difference in the failure load in bending between cement with cisplatin when compared to cement without cisplatin. For compression, the failure load for SmartSet MV with cisplatin was significantly less than without cisplatin ($p = 0.0069$). All other brands showed no significant difference in failure load with the inclusion of cisplatin ($p < 0.05$). In conclusion, the addition of up to 5% w/w cisplatin did not significantly affect the majority of the cements tested during both bending and compression loading. Only one cement tested, SmartSet MV, showed a negative impact on the failure load of the cement.

(BIO-P003-2012) Effect of post heat treatment on the mechanical and tribological properties of TiO2 enriched with Ca and P obtained by micro arc oxidation

C. Laurindo*, R. D. Torres, P. Soares, Pontificia Universidade Católica do Paraná, Brazil

The titanium is a widely used material for implants due to its excellent mechanical properties, corrosion resistance and biocompatibility. However, the titanium is a bioinert material. Several surface treatments are being developed to improve the bone bonding ability of titanium metal. Using the micro arc oxidation (MAO) technique, it is possible to tailor the oxide surface changing the process variables such as applied voltage, electrolyte composition, time, among others. The crystalline oxide layer could be modified by thermal or hidrothermal post-treatments. The aim of this work is study the influence of the thermal treatment on the mechanical and tribological properties of MAO titanium. The MAO treatment was performed under potentiostatic mode using voltages of

250, 300, 350 and 400V for 60s. It was used a aqueous solution of 0.02 Mol/l of Calcium glycerophosphate and 0.15 Mol/l of calcium acetate as the electrolyte. Anodized samples were submitted to a heat treatment at 600 oC for 1 hour. The surface characterization include a scanning electron microscopy (SEM), X-ray diffraction (XRD), roughness average by a profilometer, dynamic surface wettability using a goniometer. The wear rate was evaluated by a reciprocating test using a tribometer. Hardness and elastic modulus were evaluated by instrumented indentation.

(BIO-P004-2012) Enhancement of Titanium Surface Bioactivity by Treatment with a Highly Bioactive Glass

C. R. Chinaglia*, O. Peitl, Federal University of Sao Carlos, Brazil; P. T. Oliveira, Ribeirao Preto College of Dentistry, Sao Paulo State University, Brazil; L. C. Sanches, E. D. Zanotto, Federal University of Sao Carlos, Brazil

The main purpose of this study is to develop an ASTM F67-G4 titanium surface with enhanced bioactivity by treatment with a highly bioactive glass (HBG) of the SiO_2-Na_2O-K_2O-MgO-CaO-P_2O_5 system. Three sets of titanium surfaces were treated with the same mass of HBG powder, but with different particle sizes (16, 59 and 450μm) with a proprietary method, while one set remained untreated. Surface bioactivity was tested according to the ISO 23.317 (2007) - "Implants for surgery — *In vitro* evaluation for apatite-forming ability of implant materials", at times of 2, 4, 8, 24, 48, 120 and 240 hours. Scanning electron microscopy, fourier transform infrared spectroscopy; stereomicroscopy and atomic force microscopy were used to characterize the samples. Samples treated with HBG developed a thin hydroxyapatite layer already after 8 hours of test. No hydroxyapatite or phosphate layers were formed on samples without the HBG treatment. The higher the particle size the higher its apatite-forming ability. The MTT assay using UMR 106 cells at times of 1, 3 and 5 days demonstrated cell viability. We concluded that the treatment of titanium surface with the bioactive glass significantly enhances its bioactivity.

(BIO-P005-2012) Titanium hydroxilation – Hydroxide formation on titanium alloy surfaces by anodic oxidation

M. S. Walter*, M. J. Frank, University of Oslo, Norway; M. Gomez-Florit, M. Monjo, University of Balearic Islands, Spain; M. F. Sunding, S. P. Lyngstadaas, H. J. Haugen, University of Oslo, Norway

In the search for improvement of bone ingrowth of dental implants new ways for chemical surface modification have to be found. The excellent suitability of titanium (Ti) as an implant material can be further increased to obtain an active rather than a passive Ti oxide surface. This holds potential for chemically binding biomolecules to the surface. This work investigated the formation of hydroxide groups on Ti and titanium zirconium (TiZr) alloy surfaces after anodic oxidation treatment. Examinations using X-ray photoelectron spectroscopy (XPS), field emission scanning electron microscopy (FE-SEM), optical blue light profilometry and in vitro real time PCR on murine osteoblasts have been performed. Gene profile expression showed improved performance in osteocalcin (OC) for Ti and collagen I (Coll-I) levels for Ti and TiZr when compared to the sand blasted and acid etched reference groups. XPS analysis revealed OH groups, however its high potential also caused attraction of environmental carbon on Ti and TiZr surfaces after the anodic polarization treatment. The Spearmen rank correlation of the surface parameters Sa, Sku, Sdr and Ssk to the treatment parameters time and current density was found to be more significant to Ti in comparison to TiZr.

(BIO-P006-2012) Hydride layer created by hot acid etching suppresses hydride formation by cathodic reduction on titanium based implant surfaces

M. J. Frank*, M. S. Walter, S. Lyngstadaas, H. J. Haugen, University of Oslo, Norway

The majority of titanium based bone-level dental implants available on the market today feature a sand blasted and acid etched (SBAE) surface that contains comparably high hydrogen levels. Cathodic polarization of titanium based materials in acidic solutions is known to create titanium-hydride on the surface. The aim of this study was to explore the effect of cathodic reduction to titanium (Ti) and a titanium-zirconium alloy (TiZr) with a SBAE surface. Samples of both materials were cathodically polarized at different current densities and at different process times. Chemical analysis of the hydrogen concentration and layer thickness by SIMS and analysis of the surface topography by profilometry and SEM were used for characterizing the specimen. Cathodic reduction of Ti SBAE and TiZr SBAE showed to re-arrange the hydride already present on the surfaces from the etching process but could not significantly increase hydride levels. The hydrogen content development was volatile and approached a threshold level. It was concluded that the hydrogen layer created by the preceding hot acid etching inhibited further hydride creation. Hydridation did not alter the micro-topography significantly from the SBAE surface but it re-arranged the nano-topography of both materials to form hydride nano-nodules and hydride flowers.

(BIO-P007-2012) Bioactive coatings on titanium obtained by the combination of micro-arc oxidation and electrophoretic deposition

P. Soares*, C. H. Laurindo, R. D. Torres, Pontificia Universidade Catolica do Parana, Brazil

Titanium has been used successfully as biomedical implants, but has some drawbacks such as poor osteoinductive properties. Several surface modification techniques were developed to solve these problems, such as micro-arc oxidation (MAO). Many coating techniques have also been employed for the deposition of bioactive coatings, combining the mechanical benefits of metal with their biocompatibility. Among them, plasma spraying is the most popular, but it is difficult to apply uniform coatings on implants with complex geometries. In addition, it may present adhesion failures due to the mechanical properties mismatch between the coating and substrate. Electrophoretic deposition (EPD) is an alternative process. However, high temperatures during post-treatment for increasing adhesion of deposited coatings may degrade their properties. Since MAO is known to produce a well adhered TiO2 layer, our aim was to combine it with EPD in order to obtain a well adhered bioactive coating on titanium. Bioactive glass-ceramic particles were deposited by electrophoresis on a porous TiO2 layer produced by MAO. SEM and XRD were used to investigate the surface characteristic of the coatings. Adhesion strength of the coatings was assessed using scratch tester. Results showed that a combination of both techniques produced a well adhered TiO2 layer, with pores filled with bioactive particles.

(BIO-P008-2012) Effects of Crosslink ratio on photocrosslinkable P(AM-AA) Gels for Drug Delivery

J. Gu*, Y. Lu, S. Shivkumar, Worcester Polytechnic Institute, USA

Polyacrylamide gels are used extensively in cell culture, drug delivery and other novel applications. Despite its potential, the properties of gel haven't been thoroughly investigated. The purpose of this study is to analyze the swelling and deswelling kinetics and the mechanical properties of acrylamide (AM) and acrylic acid (AA) gels for various crosslinking ratios. The P(AM-AA) gels are characterized by FTIR and scanning elctron microscopy. The tensile and flexural properties were measured according to ASTM D412. The results show that 1:1 P(AM-AA) gel exhibit the most accelerated swelling and deswelling rates followed by 1:3 (AM:AA) and 3:1 (AM:AA) . A change in the ratio of the gel composition results in a significant change in swelling ratio, but all gels exhibit a super-swelling behavior. These findings can be utilized to create optimal drug delivery systems for various applications.

(BIO-P010-2012) Mechanochemical synthesis of copper doped nanostructured fluorapatite

R. Nikonammofrad*, S. Sadrnezhad, J. Vahdati Kahki, Sharif University of Technology, Islamic Republic of Iran

Flurapatite (FA) has been widely used on orthopedic and dentistry prosthesis due to its excellent bioactivity properties. Therefore, the aim of this work was to prepare and characterize copper doped nanostructured fluorapatite powder via mechanical alloying (MA) method by using a high energy planetary ball mill. FA powders with the general chemical formula Cux.Ca(10-x).(PO4)6.F2 (where x was the degree of substitution of Cu-2 by F–1) were successfully synthesized from the starting materials of calcium oxide (CaO), phosphorous pentoxide

(P2O5), calcium fluoride (CaF2), and copper (II) oxide (CuO) powders under various milling times. In order to evaluate the antibacterial effect of copper, the x values were selected equal to 0 - 4 – 9. The experimental results showed that by using calcium oxide the adsorbed water, which is detected as a by-product, will eliminate from the final powder and relatively pure FA will be obtained. The various experimental techniques like X-ray diffraction (XRD), transmission electron microscopy (TEM) and scanning electron microscopy (SEM) were utilized in order to characterize the synthesized FA powders. Moreover, in vitro tests of copper doped nanostructured fluorapatite powder were performed by immersing the prepared FA in simulated body fluid (SBF).Finally Bone-like apatite formation on the surface of the immersed samples was investigated by SEM.

(BIO-P012-2012) The potential use of innovative hemostatic dressings as a supportive cancer care factor in parenchymatous organs surgery – preliminary report

M. S. Nowacki*, A. Jundzill, Ludwik Rydygier Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Torun., Poland; T. Kowalczyk, IPPT, Polish Academy of Sciences, Warsaw., Poland; T. Drewa, Ludwik Rydygier Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Torun., Poland

Objectives:Parenchymal organs of the abdominal cavity are on the common place of the original location of a primary or metastasis cancer tumors, which unfortunately, are associated with high risk of recurrence in 5 year period of survival after surgery. The aim of our work was the use of innovative materials as a intraoperative hemostatic dressings covered with cytostatics. Methods: 10 C57B1/J mice and 10 BALB/C mice were used, as an kidney (I) and liver (II) induced cancer model. In (Group I) we have implemented 106 kidney melanoma B16 cells onto the capsula fibrosa of the left kidney. In the second group we have implemented 106 HepG2 cells subserosally into the liver. After 10 days we used innovative materials as a hemostatic dressings during surgery,to assess the clotting time. The biomaterials consisted of collagen (Type I) and polycaprolactone (Type II).Results: In both experimental study groups we have observed hemostatic effect of used dressings, during surgery (time point: Type I - 39 seconds, TYPE II - 52 s) and after 3 weeks. Conclusions: Hemostatic dressings are increasingly used in oncological surgery. Perhaps the essential element of this development, may be a potential future introduction of appropriately selected materials that can be carriers of oncostatic compounds to prevent the local cancer recurrence.

(BIO-P014-2012) Highly porous TiO_2 scaffolds for bone repair

H. Tiainen*, J. C. Wohlfahrt, A. Verket, S. P. Lyngstadaas, H. J. Haugen, University of Oslo, Norway

Synthetic bone scaffolds can be used in assisting the repair and regeneration of bone tissue in critical size bone defects. In this study, the objective was to fabricate highly biocompatible ceramic titanium dioxide (TiO_2) scaffolds with pore architectural and mechanical properties suitable for bone repair. For this purpose, porous TiO_2 foams were produced using polymer sponge replication. SEM imaging and micro-CT analysis were used to examine the pore architectural features of the scaffolds, while the mechanical properties were assessed by compression test. For an in vivo animal study, 15 scaffolds were implanted in fresh, surgically treated extraction sockets in minipig mandibles. Bone ingrowth and biocompatibility were evaluated using micro-CT and histology 6 weeks after implantation. The produced TiO_2 scaffolds were highly porous (>85 %) with well-interconnected pore network and mean pore size of ~400 μm, while the average compressive strength of the scaffolds exceeded 2.5 MPa. Combined with the excellent biocompatibility of TiO_2, the highly interconnected pore structure provided a favourable microenvironment for bone regeneration. This was manifested by good osteointegration and extensive bone ingrowth and vascularisation within the scaffold structure in vivo. Therefore, the fabricated TiO_2 scaffolds show great promise as load-bearing bone scaffolds for applications where moderate mechanical support is required.

(BIO-P015-2012) Bioactivity of Bioceramic Bone Scaffolds Fabricated at Two Sintering Temperatures

J. Vivanco*, A. Aiyangar, C. Collins, The University of Wisconsin Madison, USA; A. Araneda, Universidad Tecnica Federico Santa Maria, Chile; H. L. Ploeg, The University of Wisconsin Madison, USA

Sintered bioactive calcium phosphate (CP) scaffolds present the ability to deposit bone-like apatite in vitro when exposed to simulated body fluid (SBF), a metastable CP solution which has a similar ion concentration to human blood plasma. The current study investigated effects of sintering temperature on the formation of bone-like apatite onto a controlled macro-porous CP scaffold. Samples made of CP were manufactured through a patented injection molding process and sintered at 950°C and 1150°C. Scaffolds were soaked in SBF at 37°C for 4 weeks and subsequently characterized by: X-ray diffraction, scanning electron microscopy, energy dispersive X-ray spectroscopy, and surface roughness. Scaffolds sintered at 1150°C formed an apatite layer in half the time (2 weeks) compared to scaffolds sintered at 950°C (4 weeks). In addition, grain size (0.74, 8.07 μm) and material density (2.27, 3.22 g/cm3) of CP scaffolds increased with sintering temperature for 950°C and 1150°C, respectively. Based on these findings, we conclude that by understanding the relationship between the processing parameters and the resulting apatite layer formation on the scaffold surface, the sintering temperature can be controlled to optimize bioactivity properties.

(BIO-P016-2012) Effect Of Electrospun Scaffolds On Osteogenic Differentiation Of Palatal Periosteum And Umbilical Cord-Derived Mesenchymal Stem Cells

M. Caballero*, A. K. Pappa, M. D. Skancke, J. A. van Aalst, University of North Carolina, USA

Introduction: In this study, we compare the capacity of two polymers with Federal Drug Administration (FDA) approval for use in humans, PCL and PLGA, to support osteoinduction of mesenchymal stem cells (MSCs) harvested from palate periosteum (PP) and umbilical cord (UC). Methods: Nanofiber scaffolds were produced by electrospinning polycaprolactone (PCL) or DeltaSystem™ reabsorbable implants (PLGA). PP MSCs were isolated from infants undergoing palate repair; UC MSCs were isolated from Wharton's Jelly. The presence of MSC specific markers was determined by flow cytometry. Passage 2 cells were osteoinduced and analyzed at days 1, 3, 7, 14 and 21 for cell proliferation, viability, and differentiation. Osteoinduction was evaluated by Alizarin Red S staining and real-time fluorescent quantitative PCR. Results: Cell proliferation of both PP- and UC-derived MSCs was improved on PLGA scaffolds. Both PCL and PLGA scaffolds promoted UC MSC differentiation (indicated by earlier gene expression and higher calcium deposition), but not in PP-derived MSCs. Earlier differentiation in PP-derived MSCs was confirmed by lower CD90 expression indicating a more pre-committed bone precursor. Conclusion: UC-derived MSCs on PLGA nanofiber scaffolds have potential clinical usefulness in providing solutions for craniofacial bone defects.

(BIO-P017-2012) Finite element modeling and mechanical property assessment of polycaprolactone-hydroxyapatite composite scaffolds fabricated by selective laser sintering

S. Eshraghi*, S. Das, Georgia Institute of Technology, USA

Here we report on the finite element analysis (FEA) and the experimental mechanical property assessment of composite polycaprolactone-hydroxyapatite (PCL-HA) scaffolds fabricated by selective laser sintering (SLS) for bone tissue engineering. PCL-HA composites are desirable for bone tissue engineering because they are bioresorbable and bioactive and have mechanical properties in the lower range of trabecular bone. Solid cylinders as well as scaffolds with 1D, 2D, and 3D orthogonal porous architectures having 56.9, 67.4, and 83.3 % porosity respectively were built. PCL-HA composite material systems were made by dry blending PCL and HA powder at 0, 10, 20, and 30% volume of HA. SLS processing of the composites was optimized for each loading scenario to give part density greater than 99%. A 3-stage process based on first principles modeling was used to predict the mechanical properties of the composite scaffolds at an arbitrary filler loading. There was close agree-

ment between the modeling and experimental assessment of the scaffolds. Mechanical testing of the specimens revealed a significant increase in the compressive moduli which changed from 299.3 to 498.3 MPa for the solid cylinders and from 14.9 to 36.2 MPa for the 3D porous scaffolds when the loading of HA was increased from 0 to 30% vol.

(BIO-P018-2012) Large area maskless photopolymerization of hydrogels for cartilage tissue engineering

S. Eshraghi*, S. Das, Georgia Institute of Technology, USA

Here we report on the manufacture of polyethylene-glycol diacrylate (PEG-DA) scaffolds for articular cartilage tissue engineering using a novel additive manufacturing technique called large area maskless photopolymerization (LAMP). Engineering of large size articular cartilage constructs has been plagued with poor nutrient transport, poor tissue ingrowth, and necrosis of embedded cells due to its avascular nature and high loading forces. LAMP has the capability of manufacturing large scaffolds for critically sized (>5mm) defects with 3D microfluidic channels at extremely high resolution (17 μm). Because of the low exposure times and fast build speed of LAMP, cellular encapsulation during fabrication can also be achieved alleviating the issue of chondrocyte infiltration into the core of the construct. Computational modeling of the mechanical and transport properties enables the design of scaffolds that have sufficient nutrient transport yet can withstand high loading forces. The novelty of this work is that it couples computational modeling and computer aided design (CAD) with high resolution manufacturing yielding cartilage constructs with a priori designed mechanical and transport properties and intricate microfluidic channels on a cellular size scale.

(BIO-P019-2012) Effect of bioactive borate glass fiber scaffolds on wound healing in diabetic mice

L. Chen, University of Illinois, USA; S. B. Jung, T. Day, MO-SCI Corporation, USA; M. Krol, L. A. DiPietro*, University of Illinois, USA

Borate based bioactive glasses have been studied for several in vivo applications including bone replacement and drug delivery. To investigate borate glass as a skin wound therapeutic, 5mm full thickness wounds were made on db/db diabetic mice. Wounds were left untreated (control) or treated with 10mg of one of two different bioactive borate glass fibers (GL-1550 and GL-1605). Wound closure, bacterial load, macrophage content, myeloperoxidase (MPO/neutrophil level), and vascularity were examined. Approximately 80% of the wounds in all groups closed by day 14 after injury; by day 17 all wounds were closed. At day 1, GL-1550 and GL-1605 treated wounds had significantly less bacterial load than control. GL-1550 and GL-1605 treated wounds also had significantly more macrophages than normal skin at day 21. At day 14, neutrophil content was significantly higher than control in the GL-1605 treated group. At day 21, wounds from treated groups exhibited significantly more vascularity than normal skin. In conclusion, specific bioactive borate glass fibers seem to increase inflammatory cell infiltrate and angiogenesis as well as inhibit growth of bacteria, supporting their therapeutic potential in the treatment of chronic wounds.

(BIO-P020-2012) New Bioactive Glass with Low Devitrifying Tendency

M. T. Souza*, O. Peitl, Federal University of São Carlos, Brazil; P. T. Oliveira, University of São Paulo, Brazil; E. D. Zanotto, Federal University of São Carlos, Brazil

The shortage of skeletal allografts and other intrinsic variables in the bonegraft surgical technique has been causing an increased demand for the development of synthetic substitutes for damaged bone parts. Bioactive glasses have been clinically used over three decades demonstrating very satisfying results due to their osteoconductive and osteopromotive nature. However, the great majority of bioactive glass compositions do not support repeated heat-treatments, since this procedure results in uncontrolled crystallization that normally degrades their mechanical properties and sometimes diminishes their bioactivity. This trait causes many problems in the manufacturing of shaped devices, fibers or scaffolds. Consequently, for clinical purposes, the use of bioactive glasses has mainly been limited to particulates. This study concerns the development of a new bioactive glass composition in the SiO_2-Na_2O-K_2O-MgO-CaO-P_2O_5 system that possesses a large working range and a very low crystallization rate. The DSC technique was used to select a specific non-devitrifying glass with a 5°C/min heating rate up to 1200°C. Its bioactivity was analyzed by *in vitro* tests with SBF-K9 solution from 4 hours to 7 days, complemented by FTIR and SEM. Cell viability was demonstrated using the MTT technique with UMR 106 cells at 1, 3 and 5 days. Hence we managed to design a glass composition with a low devitrifying rate and a high bioactivity.

(BIO-P021-2012) Treatment of Chronic Ulcers with Bioactive Borate Glass Nanofibers

S. Jung, T. Day, Mo-Sci Corporation, USA; W. Stoecker, P. Taylor*, Phelps County Regional Medical Center, USA; D. Day, Missouri University of Science and Technology, USA

Bioactive borate glasses with angiogenic and wound healing properties were fabricated into nanofibers that mimic the microstructure of a fibrin clot for healing chronic wounds associated with conditions such as diabetes and venous stasis. Forty seven patients, each with a non-healing chronic ulcer, were treated with a pad composed of bioactive glass nanofibers (BGNF) one to two times per week until the wound resolved. The qualification criteria for inclusion in the study required patients are treated with conventional wound dressings with no improvement for a minimum of two weeks prior to enrolling with the BGNF. The wounds treated in this study have been diverse, and include the lower leg, bottom of foot (front pad), the heel of the foot, the neck, the lower back, the upper chest (breast), and upper thigh. Thus far twenty seven of the ulcers have been resolved with the treatment, fourteen remain in treatment and are progressing, and six patients were removed from the study for non-compliance such as moving away from the treatment facility or changing physicians. The regenerated tissues have minimal scarring and the original defect area is difficult to detect visually once treatment is complete. The composition of the glass along with the fibrous microstructure of the pad mimic the initial stage of wound healing (formation of a fibrin clot) and stimulate the growth of new blood vessels to the area treated. The introduction of this fibrous microstructure appears to transform chronic wounds to acute wounds while soluble ions released from the glass aid in the healing process.

(BIO-P022-2012) Unique Physical Properties of Synthetic Antimicrobial Block Copolypeptides Designed for Wound Infections

J. Hanson*, E. Tkatchouk, E. Schauer, K. R. Ogilby, J. Chow, D. Benitez, M. Bevilacqua, Amicrobe, Inc, USA

Local infections present unique biophysical challenges related to altered tissue architecture and function, as well as microbial growth patterns and biofilm formation. We have synthesized long chain, cationic, amphiphilic lysine/leucine block copolypeptides that are broadly antimicrobial. Here we attempt to optimize the biophysical properties of these synthetic block copolypeptides and test them for the prevention and treatment of wound infections in an in vivo porcine model. Characterization of two block copolypeptides of identical size and composition, but distinct hydrophobic domain order (based on enantiopurity) demonstrated substantial biophysical differences. Block copolypeptides with disordered hydrophobes form micelle solutions that are effective surfactants, while the copolypeptide containing an alpha-helical hydrophobe formed rigid hydrogels. In separate studies, block copolypeptides were shown to be mucoadhesive with higher values for the hydrogel forming structures. In the in vivo porcine models these biomaterials were found to be potent against common wound bacteria. These biophysical designed features should enable optimization for the prevention and treatment of wound and burn infections.

Wednesday, September 12, 2012

Plenary Session III

Room: Capital D

8:30 AM

(BIO-047-2012) Bioactive Glasses: New Approaches for Tissue Repair, Regeneration and Prevention (Invited)

L. Hench*, University of Florida, USA

Now is the time to emphasize a more biologically based method of tissue repair- regeneration of tissues. Bioactive glasses offer new approaches to make this revolution possible. 1) Gene Activation: Third generation bioactive glasses, composites and hierarchical-porous bioactive gel-glass and hybrid inorganic-organic foams activate genes that stimulate regeneration of living tissues. 2) Tissue Regeneration of Soft Tissues: Obtaining and maintaining a blood supply in implanted tissue engineered constructs is essential for long term stability. 3) Healing of Wounds: Bioactive boro-silicate glass fibre meshes, developed at Mo-Sci Corp. in Rolla, Missouri, USA show remarkable ability to enhance the rapid healing of wounds and regeneration of new skin that replicates normal skin with little scar tissues. Incorporation in wound dressings of bioactive glasses with controlled release of anti-inflammatory stimuli offers new means of treating chronic wounds. 4) Prevention of tissue degradation: Daily delivery of bioactive stimuli via the digestive pathway could potentially provide a means of slowing down the rate of deterioration of both connective tissues and cardiovascular tissues and be the basis for a fourth revolution in healthcare: remove tissues->replace tissues->regenerate tissues->prevent tissue deterioration.

Composites I

Room: Capital A/B

Session Chair: Erik Erbe, Nuvasive, Inc

9:45 AM

(BIO-052-2012) Biomaterial Composites: Theory and Medical Applications (Invited)

E. M. Erbe*, Nuvasive, Inc, USA

The theory of composites utilizes properties from various components to impart behaviors unobtainable from selected components alone. Usually synergistic properties create a higher level of performance in terms of desired strength, handling and bioactivity. Nature is full of examples, namely, in the physiologic realm of composite tissues, bone and cartilage. Bone tissue is an amazing biomaterial comprised of specific composite structures, components and viable mechanisms of action, function and repair. Specific structural and chemical elements create novel forms that interact and function within the human physiology. This dynamic and demanding environment is the focus of tissue engineering, regenerative medicine, and biomaterials. With ever improving materials synthesis, nanotechnology and smart materials, researchers aim to create materials that function and repair damaged tissues. This talk will review basic principles of composite theory and give examples of biomaterials and composite medical devices employing this relationship for the regeneration and repair of bone tissue. As research continues to uncover the fundamental aspects of bone regeneration and healing, composite materials will be required to fulfill the many aspects of structure, cell signaling and osteogenesis.

10:15 AM

(BIO-053-2012) Plasma and nanofiber-enhanced biomedical textiles for health and protection (Invited)

Q. Shi*, N. Vitchuli, J. Nowak, R. Nawalakhe, M. Sieber, M. Bourham, X. Zhang, NC State Univ, USA; M. McCord, NC State Univ and UNC, USA

We are combining atmospheric plasma treatment and electrospinning processing to create multifunctional nanofiber enhanced textiles with excellent mechanical properties for healthcare and protection. Nanofibers with controlled structures were deposited onto traditional textile materials by electrospinning. Atmospheric plasma processing was employed to manipulate the surface chemistry and improve the adhesion between nanofiber layers and substrates. Antimicrobial evaluation, peeling tests, Gelbo Flex tests, abrasion tests, and air and moisture permeability tests were performed on the composite materials. The novel nanofiber-enhanced materials feature multiple functionalities including: i) antimicrobial activity against gram (+) and gram (-) microorganisms; ii) excellent detoxifying efficiency against toxic chemicals; and iii) high barrier efficiency. The nanofibers were deposited on textile substrates to form novel layered composite systems. The adhesion between nanofiber layer and substrates can be markedly increased by both conventional and hybrid plasma treatment. The plasma-treated nanofibers displayed improved performance in a peeling test, a Gelbo Flex test and an abrasion test. The layered composite also showed excellent air and moisture permeability. The nanofiber-enhanced textiles have shown promise for use in biomedical applications such as wound dressings and protective clothing.

10:45 AM

(BIO-055-2012) An Overview of Silicon Nitride as a Novel Biomaterial

B. McEntire*, A. Lakshminarayanan, Amedica Corporation, USA; B. Bal, University of Missouri, USA; T. J. Webster, Brown University, USA

For over thirty years, silicon nitride (Si_3N_4) has been used extensively in a wide array of demanding industrial applications such as precision bearings, cutting tools, turbo-machinery, and electronics. During the past four years, it has also been used as a biomaterial in the human body. Si_3N_4 has unique properties, such as high strength and fracture toughness, inherent chemical and phase stability, low wear, biocompatibility, excellent radiographic imaging, antibacterial benefits, and superior osteointegration. This combination of properties is desirable in structural implants made for spinal fusion and disc reconstruction, hip and knee arthroplasty, and other total joints. The properties, shapes, sizes and features of Si_3N_4 can be engineered for each application – ranging from dense, finely polished articulation components, to highly porous scaffolds that promote osteointegration. Significantly, our recent work has shown that Si_3N_4 is highly resistant to bacterial biofilm formation, colonization and growth. These anti-infective characteristics are particularly valuable for in vivo implantation. We will present the unique properties and characteristics of Si_3N_4, and compare these to other ceramic and non-ceramic biomaterials. Si_3N_4 was once used only in industrial applications, but early data show that this novel biomaterial is positively impacting orthopedic care and will continue to do so into the future.

11:05 AM

(BIO-054-2012) Hybrid Silicone for Finger Joint Reconstruction (Invited)

D. Misra*, Univ Louisiana Lafayette, USA

The presentation describes an exciting evidence concerning hybrid silicone with inorganic cross-links of nanocrystalline titania that is characterized by high strength-at-break (increase of ~260% over stand alone silicone), undiminished intrinsic elongation of stand alone silicone, and high cytocompatibility. This qualifies hybrid silicone as a potential next generation biomaterial for finger joint reconstruction by eliminating the disadvantages of low tensile and fatigue strength and inferior bioactivity of stand alone silicone. The novel concept for synthesizing hybrid silicone involves covalently linking nanophase titania with a bi-functional agent, acrylic acid, which has a carboxylic group to coordinate with titania and a vinyl group to form cross-links as an integral part of the silicone network during curing reaction at elevated pressures (~25-100 MPa). Interestingly, the nanophase titania has additional benefits of scavenging of undesired biologically relevant reactive oxygen species, disinfective attributes, and enables adherence of cells on the implant device.

Three Dimensional Scaffolds for Tissue Regeneration II

Room: Capital C
Session Chair: Hyun Bae, Spine Institute

9:45 AM

(BIO-057-2012) Short Laminin Peptide for Improved Neural Progenitor Cell Growth (Invited)
X. Li, N. Zhang, X. Wen*, Clemson University, USA

Human neural stem/progenitor cells (hNPCs) are very difficult to culture and require human or animal source extracellular matrix (ECM) molecules, such as laminin or collagen type IV, to support the attachment and regulate their survival and proliferation. These ECM molecules are difficult to purify from tissues, have high batch-to-batch variability, and may cause immune response if used in clinical applications. Although several laminin and collagen IV derived peptides are commercially available, these peptides do not support long-term hNPC attachment and growth. To solve this problem, we developed a novel peptide sequence with only 12 amino acids based on IKVAV. This short peptide sequence, similar to tissue derived full laminin molecules, supported hNPCs to attach and proliferate until total confluence on the whole surface was achieved. This short peptide also directed hNPCs to differentiate into neurons. When conjugated to poly (ethylene glycol) (PEG) hydrogels, this short peptide benefited hNPC attachment and proliferation on the surface of hydrogels, also promoted cell migration from neurospheres inside hydrogels. This novel short peptide shows great promise in artificial ECM development for supporting hNPC culture in vitro, establishing hNPC niches in vitro and in vivo, and promoting hNPC transplantation in future clinical therapy.

10:15 AM

(BIO-058-2012) Electrospun Vascular Scaffold for Engineering Fully Cellularized Small Diameter Blood Vessel (Invited)
S. Lee*, J. J. Yoo, A. Atala, Wake Forest School of Medicine, USA

The demand for small diameter vascular substitutes for coronary and peripheral revascularization procedures has been increasing steadily, while key challenges associated with good functional outcome of vascular grafting remain unsolved. The principle of vascular tissue engineering, employing cells seeded on a biodegradable tubular scaffold, has been demonstrated in a variety of animal models. We have currently developed a novel bilayered poly(ε-caprolactone) (PCL)/collagen scaffolds to subject constructs comprised of scaffolds seeded with endothelial cells (ECs) and smooth muscle cells (SMCs). We investigated that the novel bilayered PCL/collagen scaffolds, after seeding with vascular cells and preconditioning in a pulsatile bioreactor system, can provide neovessels that display prolonged stability when exposed to vascular conditions in vivo. Toward clinical applications, we also investigated the possibility of using cells that are accessible by less invasive means, including endothelial progenitor cells (EPCs) from patient's own circulating peripheral blood. This study suggests that bilayered vascular scaffolds are able to facilitate endothelialization and smooth muscle maturation, which may result in improved vessel function and patency.

10:45 AM

(BIO-061-2012) STEP based Micro/Nanofiber Aligned Networks for Tissue Engineering (Invited)
A. Nain*, Virginia Tech, USA

Nanostructured topographical features of extra-cellular matrix (ECM) environment are known to directly affect dynamics of the surrounding mammalian cells including cancerous cells. ECM is typically composed of natural fibers ranging from 30-70 nm in diameter which bundle (>microns) and display different levels of fiber alignment according to tissue type and function. Using our previously reported non-electrospinning STEP (Spinneret based Tunable Engineered Parameters) technique, we are able to mimic ECM by depositing fiber arrays in highly aligned configurations (single and multiple layers) with tunable attributes. We are able to achieve tight control on fiber orientation (0-90 deg.), diameter (sub 100 nm-microns) and spacing (sub 100 nm- microns) for a variety of polymeric systems. In this talk, using STEP based fibrous scaffolds; we demonstrate the importance of fiber stiffness (N/m) and alignment in directing cellular behavior including migration and differentiation. Specifically, we will showcase our recent findings in differentiating neural stem cells to primarily neurons, long term culture of primary hepatic acrobatic monolayer, means of controlling cellular migration and its related cellular cytoskeleton dynamics (focal adhesion and stress fiber organization), blebbing dynamics of glioma cell line (DBTRG), wound healing assays and novel platform to measure forces exerted by migratory single cells.

11:15 AM

(BIO-059-2012) Cell instructive injectable materials for bone regeneration (Invited)
L. Nair*, University of Connecticut Health Center, USA

Purpose: To develop an injectable biomaterial from lactoferrin and demonstrates the cell instructive capabilities of the gel. Introduction: Injectable cell instructive biomaterials could significantly improve cell-based therapeutic strategies. Lactoferrin (LF) can modulate bone growth, implicating LF as a potential molecule to support skeletal regeneration. Methods: Injectable gels were prepared by the horse radish peroxidase (HRP) mediated enzymatic coupling of LF in the presence of hydrogen peroxide (HP). Live/Dead stain was used to follow the viability; western blot, RT-PCR and immunocytochemistry were used to follow the cell instructive ability of the encapsulated cells. The in vivo biodegradability and biocompatibility was followed by subcutaneous implantation in a rat model. Results: Encapsulation of cells in LF gel resulted in high cell viability. The gels were found to be mitogenic as evidenced from high proliferation markers (Ki67 and pErk) in encapsulated cells. The gels significantly increased the survival of serum starved cells. The osteogenic effect of the gel was demonstrated by the upregulation of β-catenin levels. Conclusions: The study demonstrated the feasibility of forming LF injectable gels using enzymatic cross-linking. The gels are biodegradable and have instructive capabilities as evidenced from the anti-apoptotic, mitogenic and osteogenic activity towards encapsulated cells.

Metallic Implants and Coatings IV

Room: Capital D
Session Chair: Peter Ullrich, Titan Spine, LLC

9:45 AM

(BIO-048-2012) BioMEMS & Biocompatible Coatings for Biomedical Applications (Invited)
V. Singh*, Q. Nguyen, Louisiana State Univ., USA; P. George, E. O. Daigle, CAP Technologies, LLC, USA

Biological micro-electro-mechanical systems (BioMEMS) along with miniaturization of the devices are rapidly becoming extremely popular, among biological/biochemical/biomedical researchers as well as industry. Microfabrication is fueling the research in the area of BioMEMS and fabrication of micro-devices with the help of enabling tools such lithography, precision micromilling machine, LASER machining, etc. These micro-devices have crucial issues of biocompatibility which can be optimally addressed by coating them with a biocompatible coating polymeric/metallic/ceramic. Parylene polymeric coating is known for its biocompatibility and additionally possesses excellent barrier, dielectric, pin hole free, conformable, and other desired properties. Therefore, it has immense potential with area of applications widely spread out to biological, corrosion, electronic, MEMS, microfluidics and BioMEMS including developing novel devices. Hydroxy-apatite (HA) a ceramic coating is widely used for making the metallic orthopedic implants more biocompatible. In this paper a novel technique Electro-Plasma Technology, which can deposit metallic coating at the rate of ~1um per second, will be discussed with respect to deposition of HA coating. In the presentation we will also discuss the deposition parameters for parylene and HA coatings and their biomedical applications as well as surface characterization from SEM and optical profiler. Further, results of characteri-

zation of HA coatings by EDAX and FTIR/XRD to study the calcium-to-phosphorous ratio and their chemical and crystalline structure will be presented.

10:15 AM

(BIO-050-2012) Bioactive Ti metal and its alloys formed with positively charged TiO_2 surface layer

T. Kokubo*, S. Yamaguchi, H. Takadama, T. Matsushita, Chubu University, Japan; T. Nakamura, National Hospital Organization, Japan

The present authors previously showed that Ti metal and its alloys form an apatite layer on their surfaces in body environment and bond to living bone, when they were subjected to NaOH and/or $CaCl_2$ and heat treatments. However, sodium or calcium titanate surface layer formed by these treatments is liable to be damaged during implantation of screw-type implants, since they take a feather-like structure. It was newly found that Ti metal also forms the apatite and bonds to living bone, when it was subjected to acid and heat treatments to form a positively charged TiO_2 on its surface. The TiO_2 surface layer was not damaged even during implantation of screw-type implants, since it took a dense structure with micrometer-scale roughness, These treatments were also effective for new types of Ti-Zr-Nb-Ta alloys, and their apatite-forming abilities were stable even in humid environment. If the acid and heat treatments were applied to a porous NaOH- treated Ti metal, osteoinductivity as well as osteoconductivity were induced for the porous Ti metal. The porous Ti metal was successfully subjected to clinical trials for application to a spinal fusion device. Bioactive Ti metal and its alloys formed with positively charged TiO_2 on their surfaces might be useful for various types of dental and orthopedic implants.

10:35 AM

(BIO-034-2012) Residual Stress in Ceramic Coated Biocompatible AZ31 Magnesium Alloys

J. Zhang*, Indiana University - Purdue University Indianapolis, USA; Y. Gu, University of Alaska Fairbanks, USA; Y. Guo, C. Ning, South China University of Technology, China

The objective of this study is to evaluate the residual stresses of the ceramic coatings on biocompatible AZ31 magnesium alloys. The coatings improve the corrosion resistance of the magnesium alloys and are produced by microarc oxidation (MAO) method. The effect of applied voltage on residual stress is studied. In this work, an integrated experimental and modeling approach has been employed. Residual stresses attributed to the MgO constituent of the coatings at oxidation voltages between 250 V to 350 V have been evaluated by X-ray diffraction (XRD) using sin2ψ method. An analytic model is also used to compute the stress distributions in the coatings. The measured stresses using sin2ψ XRD method in the MgO constituent of the MAO coatings are tensile in nature. The residual stresses decreased with the increase of the applied voltage. The predicated stresses from the model are in good agreement with the experimental measurements. At 350V, coatings have a uniform surface morphology and the lowest residual stress. This is the optimal voltage in the MAO process to produce the high-quality corrosion resistant coatings. The voltage dependence of the residual stress is attributed to the micropores and cracks during the microarc discharge process which release the residual stresses in the coatings.

Composites II

Room: Capital A/B
Session Chair: Erik Erbe, Nuvasive, Inc

1:30 PM

(BIO-065-2012) Nanoscale heterostructures for selective chemical and biological sensing, bioanalysis, and delivery (Invited)

N. Chopra*, The University of Alabama, USA

Technological demand for nanosensors relies on innovative techniques for producing multifunctional nanoscale architectures that can be produced in bulk formulation or patterned onto a large-area substrate. In this talk, I will discuss some of the recent advances we have made in the development of complex nanoscale architectures comprised of carbon nanotubes and spherical graphene shells. Introducing carbon nanostructures within a heterostructured nanosystem allows for robust surface chemistry, selectivity, and unique properties. The approach to develop such nano-architectures includes coupling high temperature chemical vapor deposition method (CVD) and wet-chemical synthesis or functional tagging of nanostructures and molecules. Morphological evolution of nanoscale heterostructures as a function of various growth parameters was studied using TEM, SEM, and XRD. New kinds of lattice relationships, interfaces, and morphologies were established. XPS and Raman spectroscopy were utilized for understanding the chemical compositions, growth kinetics, and thermal stability of the nanoscale heterostructures. Finally, the heterostructures were laid on the substrate or impregnated in composites for selective chemical and biological sensing, chemical separations, and multiplexing devices.

2:00 PM

(BIO-067-2012) Nature-inspired Composite Design and Manufacturing (Invited)

X. Li*, University of South Carolina, USA

Nacre is a natural nanocomposite with superior mechanical strength and eminent toughness. What is the secret recipe that Mother Nature uses to fabricate nacre? What roles do the nanoscale structures play in the strengthening and toughening of nacre? Can we learn from this to produce nacre-inspired nanocomposites? The recent discovery of nanoparticles in nacre is summarized, and the roles these nanoparticles play in nacre's strength and toughness are elucidated. It was found that rotation and deformation of aragonite nanoparticles are the two prominent mechanisms contributing to energy dissipation in nacre. The biopolymer spacing between nanoparticles facilitates the particle rotation process. Individual aragonite nanoparticles are deformable. Dislocation formation and deformation twinning were found to play important roles in the plastic deformation of individual nanoparticles, contributing remarkably to the strength and toughness of nacre upon dynamic loading.

2:30 PM

(BIO-068-2012) Influence of Anodization on Corrosion Resistance, Ion Leaching and Wettability of Biodegradable Magnesium Metal Matrix Composites

P. Gill*, N. Munroe, Florida International University, USA; N. Hari-Babu, Brunel University, United Kingdom

Recently, magnesium alloys have inspired a significant amount of attention from researchers all over the world for biomedical applications due to their light weight, mechanical integrity and degradation behavior. In this investigation, MgZnCa/nHA composites were studied for their corrosion resistance, ion leaching, wettability and morphology before and after surface treatment. In-vitro corrosion resistance of the composites was studied in phosphate buffered saline (PBS) and PBS with amino acids. The concentration of ions leached into the electrolyte after corrosion was measured by Inductive Coupled Plasma Mass Spectroscopy (ICP-MS). The surface morphology and crystallography of the composites were studied by scanning electron microscopy (SEM) and X-ray diffraction (XRD) respectively. The contact angle and surface energy of the composites were determined using a Kyowa contact angle meter to assess the wettability.

2:50 PM

(BIO-066-2012) Designing Bacterial Cellulose Scaffolds for Tissue Engineering of Stem Cells (Invited)

P. Favi, M. Dhar, C. Ehinger, N. Neilsen, R. Benson*, University of Tennessee - Knoxville, USA

The design of tissue specific biomimetic scaffolds using a biodegradable polymer seeded with bone and cartilage forming mesenchymal stem cells would allow for improved regeneration of these damaged and diseased native tissues. However, for bone and cartilage applications a microporous pore structure is required to facilitate osteocyte and chondrocyte ingrowth and formation of the new tissue. Therefore, in this

study microporous bacterial cellulose (BC) scaffolds were prepared using beeswax microspheres in the growing fermentation process. BC was rendered degradable using a periodate oxidation reaction. To mimic bone tissue, calcium-deficient hydroxyapatite was biomimetically deposited in the scaffolds. To mimic cartilage tissue, amination of matrices was performed on the scaffolds to simulate the Glucosaminoglycans present in the native tissue. Resulting scaffolds were seeded with equine-derived bone marrow mesenchymal stem cells (EqMSCs) and cell proliferation, viability and differentiation potentials were evaluated. An equine model was chosen due to similarities in size, load and types of joint injuries suffered by horses and humans. EqMSCs attached to, proliferated and differentiated into osteocytes and chondrocytes on and into the scaffolds. These findings demonstrate that the designed BC hydrogels and EqMSCs are promising constructs for bone and cartilage tissue engineering therapies.

Bone Cements

Room: Capital A/B
Session Chair: Gregory Pomrink, NovaBone Products LLC

3:40 PM

(BIO-075-2012) Bioactive Glass Applications, Mechanism and Clinical Results (Invited)
G. J. Pomrink*, NovaBone Products LLC, USA

Bioactive glass ceramics were originally developed by Dr. Larry Hench at the University of Florida in the late 1960's. Significant studies have been conducted on the bioactive glass materials over the past decades elucidating the mechanism of tissue regeneration. The first bioactive glass products received FDA approvals in the early 1990's and until recently these materials were limited to dental applications. Over the last 10 years various products have been approved for use in orthopedic applications to repair and regenerate bone. This presentation will provide an overview of NovaBone, commercially available products, brief history of bioactive glass and the mechanism through which bioactive glass regenerates bone along with in-vitro, per-clinical and clinical studies which demonstrate the activity and efficacy of these materials.

4:10 PM

(BIO-076-2012) Development and Applications of Sol-Gel Calcium Silicate-Based Bone Cements (Invited)
S. Ding*, Chung Shan Medical University, Taiwan

Cementitious bone repair materials are being used increasingly in minimally invasive clinical applications such as dentistry, vertebroplasty, and orthopedics. Such devices would shorten the surgical operation time, minimize the damaging effects of large muscle retraction, reduce the size of the scars and lessen post-operative pain, allowing patients to achieve rapid recovery in a cost-effective manner. This talk will introduce development and applications of novel calcium silicate-based cements (CSCs) for bone repair and regeneration. The fast-setting CSCs with high bioactivity and osteogenesis have successfully developed by using a sol-gel method, suggesting that CSCs open up new possibilities in the field of self-setting bioactive SiO2–CaO-based bone graft materials. Nevertheless, the ceramic-based cement is difficult to deliver to bone defects with complex structures and is hard to compact because of the brittle nature of the ceramic cement. The presence of natural gelatin polymer appreciably improves the anti-washout and brittle properties of the cements without adversely affecting mechanical strength. The radiopaque CSCs containing bismuth oxide have a shortened setting time in comparison with a commercial ProRoot white-colored mineral trioxide aggregate. The radiopaque CSCs may have the potential to be an endodontic material.

4:40 PM

(BIO-077-2012) Dental Cements- Traditional and Bioactive
C. Primus*, Primus Consulting, USA

Dental cements are materials that set intraorally and are commonly used to join two materials, a tooth, and a prosthesis,to fill a space vacated by decay, or to seal an orifice such as a root canal. These cements are classified according to their major chemical reacting ingredients and range from traditional zinc-oxide and eugenol, to calcium silicate hydration. A brief overview of the cements will be presented describing the ceramic and organic materials used. The bioactive properties of newer hydraulic cements based on calcium silicate and calcium aluminate will be described. These non-glass, hydraulic ceramic materials are used in dentistry for a variety of indications, but are also being researched for use as bone cement or bone scaffolds.

5:00 PM

(BIO-078-2012) Performance of Bone Void Fillers Manufactured Using A 3D Rapid Prototyping Platform
S. Saini*, Integra, USA

Bone grafts are used in numerous orthopedic procedures including spine and ankle fusion, fracture repair in long bone, cyst filling and as general extenders. Synthetic bone substitutes (also referred to as bone grafts or bone void fillers) are generally made from hydroxyapatite (HA), beta-tricalcium phosphate (β-TCP) or calcium sulfate and due to limitations in current manufacturing techniques, many synthetic substitutes lack a defined internal architecture, potentially limiting patient healing outcomes and surgeon utility. In this study, a 3D rapid prototyping manufacturing platform was used to fabricate synthetic bone void fillers with defined shapes and internal architectures to ensure proper graft placement and retention. Each configuration was able to direct new bone formation through the engineered architecture, resulting in tissue with mechanical properties comparable to native tissue. Furthermore, the controlled architectures allowed for more gradual material resorption, ensuring a substrate for long term remodeling.

5:20 PM

(BIO-079-2012) Characterization of Elution of Cisplatin from Commercially Available Bone Cements
J. E. Meyer*, University of Wisconsin - Milwaukee, USA; K. MacDonald, Virginia Mason Medical Center, USA

The purpose of this study was to characterize the four-day elution profile of cisplatin-loaded commercially available bone cements. Standard cement pellets were prepared for four commercially available bone cements (Cemex, Palacos, Simplex P, SmartSet MV) with the inclusion of 5% w/w cisplatin. The pellets were placed in saline solution and incubated at body temperature on a rotary platform for a total of 96 hours, saline solution was changed every 24 hours. The concentration of eluded drug was determined using standardized high-performance liquid chromatography (HPLC) analysis. In general, all cements eluted cisplatin over the four days of the study and demonstrated a gradual decrease in the amount of elution each day. Cemex produced the greatest elution on each day, along with the greatest overall elution during the 4-day study. For each day, Cemex had a significantly greater elution compared to Palacos and SmartSet MV while all other brands were not statistically different ($p<0.01$). In conclusion, most brands of cement produced a similar elution profile for the 4-day study although there was significantly more elution from Cemex when compared to some brands.

Three Dimensional Scaffolds for Tissue Regeneration III

Room: Capital C
Session Chair: Hyun Bae, Spine Institute

1:30 PM

(BIO-070-2012) Engineering Complex Biomaterials Scaffolds for Connective Tissue Regeneration (Invited)
S. Samavedi, P. Thayer, A. Whittington, A. S. Goldstein*, Virginia Tech, USA

One of the more interesting problems plaguing current efforts to repair ruptured ligaments is strain concentration in the bone tunnel, where the graft anchors to the patient's bone. Indeed, the primary cause of laxity failure within 12 months of anterior cruciate ligament repair is poor in-

tegration between soft and hard tissues. In our effort to solve this problem and move closer to a functional engineered connective tissue, we have developed a family of approaches to fabricate complex scaffolds with spatial gradients. In this presentation we show ongoing efforts to fabricate porous biomaterial scaffolds by the process of electrospinning with the express purpose of creating engineered tendons and ligaments that anchor to bone. First, we show that the use of two off-set spinnerets dispensing different materials can achieve spatial gradients in chemistry that affect osteoblastic differentiation of bone marrow stromal cells. Next, we demonstrate approaches to incorporate live cells into these electrospun scaffolds, and to process them into thicker structures while maintaining cell viability. Finally, we show preliminary findings in which the fibers transitions spatially, from highly aligned (for ligament regeneration) to random (which may be more supportive of bone regeneration). Importantly, these complementary tools can be integrated and applied to regeneration of a variety of tissues.

2:00 PM

(BIO-072-2012) Parametric study for fabrication of PLLA electrospun scaffolds for tissue engineering by means of response surface analysis

S. Seyedmahmoud*, University of Rome Tor Vergata, Italy; P. Mozetic, Universita campus Bio-medico di Roma, Italy; E. Traversa, S. Licoccia, University of Rome Tor Vergata, Italy

One of the main challenges in tissue engineering is generating functional three dimensional (3D) scaffolds mimicking the extracellular matrix (ECM) properties to provide mechanical support until the newly formed tissues are structurally stabilized. Efficiency and simplicity of electrospinning provides a versatile approach for fibrous scaffold design which can produce fibers that are exceptionally long, uniform in diameter, and diversified in composition. Despite eletrospinning is a popular technique, results strongly depend on the specific set-up and on the material, hence It is necessary to understand the role of each process parameter via appropriate statistical methods. The aims of this talk is twofold: (i) creating a Process map for robust design and analysis of technological patterns to control the geometry via Design of experiment (ii) developing a predictive experimental framework for successful electrospinning of uniform fibers in the desired range of diameter in a consistent manner. High porous PLLA scaffolds (average 90%) were successfully fabricated via electrospinning. Surface response analysis determined the processing parameters combination for fabrication of beads free and uniform PLLA fibers in range of 700nm-3.3µm. To obtain a biological assay scaffolds were seeded with the human mesenchymal stem cells (hMSCs).

2:20 PM

(BIO-069-2012) The Use of Keratin Biomaterials to Enhance Mesenchymal Stem Cell Osteogenesis and Bone Regeneration (Invited)

R. de Guzman, J. Saul, M. Ellenburg, M. Merrill, H. Coan, T. Smith, M. Van Dyke*, Wake Forest University School of Medicine, USA

It has been well established that several techniques can be used to enhance the osteoconductivity and osteoinductivity of biomaterial matrices. Among these are architecture, material stiffness, topography, adhesive surface chemistry, and inclusion of trophic factors using drug delivery strategies. However, no biomaterial system has been shown to completely replicate the outcomes of the clinical gold standard, bone autograft. Even the most commercially successful bone graft substitute product, Infuse(TM), has its limitations. Taking cues from the cells most responsible for functional tissue repair in vivo, it is possible to discern promising biomaterial candidates for bone regeneration scaffolds. One such approach using keratin biomaterials has been investigated for its ability to enhance the differentiation of adult mesenchymal stem cells and regenerate bone in rats. Keratin biomaterials provide important gene regulation and were shown to bias cell differentiation away from adipogenesis and toward osteogenesis. Scaffolds developed using this material demonstrated a unique release kinetic profile of BMP2 delivery and were shown to regenerate bone in a critical size rat femur defect model. Keratins are the first biomaterial to demonstrate inherent osteogenic gene regulation and in combination with trophic factors, may provide a novel bone graft substitute.

2:50 PM

(BIO-071-2012) 3-D Scaffolds for Organ Bioengineering (Invited)

S. Soker*, P. Baptista, G. Orlando, J. Yoo, A. Atala, Wake Forest University School of Medicine, USA

There is a severe shortage of donor organs which is worsening yearly due to the aging population. Regenerative medicine and tissue engineering apply the principles of cell transplantation, material sciences, and bioengineering to construct biological substitutes that could restore and maintain normal function in diseased, injured and missing tissues and organs. However, progression of these technologies to therapy is hindered by multiple factors such as the supply of sufficient cell numbers and cell types, authentic tissue architecture and vascularization. A new technology, intact organ decellularization that produces "natural tissue" scaffolds (made of tissue extracellular matrix-ECM), was recently applied to engineer hearts, livers lungs, kidneys, pancreata and small intestine. The bio-scaffolds can be reseeded with endothelial and parenchymal cells by using the intact vascular channels as a conduit. The bio-scaffold provides spatial information for cell localization and engraftment, and supports cellular proliferation and phenotype maintenance. This technology has the potential for accurate reconstruction of organs, by allowing authentic cell-cell and cell-matrix interactions, which are essential for cell differentiation and maintenance of specialized functions. It offers a potential approach for fabrication of human organs that can be readily transplanted into patients.

3:20 PM

(BIO-090-2012) Stereolityhography applied to ceramic: An innovative shaping technique to build ceramic prosthesis for the repair of large craniofacial bone defects (Invited)

J. Lafon*, Euro Industrie, USA; C. Chaput, 3DCeram, France; J. Brie, Service de Chirurgie Maxillo-Faciale,CHU de Limoges, France; T. Chartier, SPCTS, CNRS-Université de Limoges-ENSCI, France

Stereolithography process applied to ceramic makes it possible to directly fabricate useful 3D complex ceramic structures, without tooling or machining, on the basis of a CAD file of the part. This layered manufacturing process is based on the space-resolved polymerisation of a UV photocurable formulation consisting in a dispersion of ceramic particles in a reactive resin. This method was applied to the fabrication of a new type of craniofacial hydroxyapatite prosthesis and bone graft substitutes with 3d porous structure that constitutes a breakthrough in the reconstruction of large craniofacial bone defects (more than 25 cm2). The prosthesis is built directly from the patient's skull CT-scan data without using moulding or tooling phase. The surgical process is simple and rapid. In the frame of one clinical study, 8 prostheses were implanted on 8 patients between 2005 and 2009. Post-operative scans and standard radiographs demonstrate a perfect integrity of the implants and their bio-integration into the surrounding skeleton. No complication was observed. The aesthetic result was considered to be excellent by both the patients and the surgeons.

Wound and Burn Treatment

Room: Capital C

Session Chair: Luisa DiPietro, University of Illinois at Chicago

3:50 PM

(BIO-081-2012) Wound healing research: Past, present, and future

L. A. DiPietro*, University of Illinois at Chicago, USA

The field of wound healing has attracted enormous research interest, with more than 20,000 papers published on the topic in the last five years alone. Interest in the field derives from its relevance to many biologic and pathologic processes, including acute inflammation, fibrosis, cancer, angiogenesis, and developmental biology. In addition, the problem of non-healing wounds represents a significant burden in terms of

health care costs and patient morbidity. There is a critical need to fully understand both normal healing and associated pathologies. This lecture will include an overview of the normal healing process. A review of the current state of wound healing research, including a discussion of essential needs in the field, will be provided. The important issues involved in effectively translating findings from model systems to patient care will also be examined. New strategies for understanding the complexity of wound healing will be discussed.

4:10 PM

(BIO-082-2012) Chronic Non-Healing Wounds Treated with Bioactive Borate Glass Nanofibers

S. B. Jung*, MO-SCI Corporation, USA; W. V. Stoecker, P. Taylor, Phelps County Regional Medical Center, USA

Traditionally, bioactive glass has been used primarily for hard tissue regeneration in orthopedics, spine, the jaw, and in the bones of the middle ear. In the last decade, the use of bioactive glasses to stimulate soft tissue regeneration has become a larger area of study as certain bioactive glasses, especially bioactive borate glasses, have shown promising results for promoting angiogenesis (blood vessel formation). In this preliminary human clinical trial, angiogenic bioactive glass nanofibers that mimic the microstructure of a fibrin clot were used for treating chronic non-healing wounds. Over fifty patients, each with a non-healing ulcer, were treated with a pad composed of bioactive glass nanofibers (BGNF) two times per week until the wound resolved. Thus far twenty seven of the ulcers have been resolved with the treatment of the BGNF, seven patients have dropped from the study for personal reasons, and the other sixteen patients are in different stages of healing. As the ulcers resolve, it has been noted that the regenerated tissue has minimal scarring and the original wounded area is difficult to detect visually.

4:30 PM

(BIO-080-2012) Exhaustion of Muscle Progenitor Cells during Aging & Disease: Implication for Stem Cell Therapy (Invited)

M. Lavasani, A. Lu, L. Niedernhofer, P. D. Robbins, J. Huard*, University of Pittsburgh, USA

Aging is characterized by the progressive erosion of tissue homeostasis and functional reserve in all organ systems. Although controversy remains as to the molecular mechanism(s) underlying the process of aging, accumulated cellular damage, including DNA damage, appears to be a major determinant of lifespan as well as age-related pathologies. Moreover, there is evidence that the accumulation of damage in stem cells renders them defective for self-renewing and regenerating damaged tissues. We have recently demonstrated that a population of muscle progenitor cells(MPCs) isolated from the ERCC1-deficient mouse model of accelerated aging, are defective in their proliferation abilities, differentiation capacity and resistance to oxidative stress. We have observed that intraperitoneal (IP) injections of wild-type (WT)-MPCs into Ercc1 knockout (Ercc1-/-) mice resulted in an improvement in age related pathologies. Although the mechanisms by which the transplantation of WT-MPCs extend the lifespan of these progeria mice is still under investigation, we have obtained evidence that the beneficial effect imparted by the injected cells occur through a paracrine effect that involve angiogenesis.

Commercialization I

Room: Capital D
Session Chair: Markus Reiterer, Medtronic, Inc.

1:30 PM

(BIO-063-2012) Requirements for Bioactive Bone Implants from a Medical Device Company's Perspective (Invited)

M. Reiterer*, J. Rouleau, Medtronic, Inc., USA

The transition from restorative to regenerative therapies is perhaps the biggest trend in the medical device industry for 21 century. In the past, medical devices mostly relied on mechanical and electrical engineering to improve patient health, and less on fundamentally curing deceases. The current economic environment, increasing life expectancy, and patient expectations call for regenerative therapies. An area of long research interest is bone replacements, as non-bioactive solid materials lead to complication such as limited bone attachment, bone remodeling, or require revision surgeries due to patient growth. In the first part of the talk mechanics of ossification are reviewed, next clinical requirements for bioactive bone replacements are discussed. Finally, the clinical prerequisites are used to derive a set of desired design guidelines, biochemical and mechanical properties that are considered to be important for successful introduction to the medical device market.

2:00 PM

(BIO-089-2012) Medical Device Commercialization: Lessons Learned from a First-timer (Invited)

P. Pattison*, Nordion Inc., Canada

Medical device commercialization strategies can vary significantly depending on the technology, the market, government regulations and several other factors leaving those new to the field uncertain and confused on how to proceed. There are however some universal truths that can be elucidated. In this presentation, we'll be looking for some of those universal truths by examining how one company made their way through the medical device haze - what things they did well and what things could have done better on the road to commercialization.

2:30 PM

(BIO-094-2012) Commercialization: If you build it they will come!? (Invited)

D. Mitchell*, Captiva Spine, Inc., USA

Despite the vast research and technological advancements related to medical device improvements, why is it so difficult to successfully commercialize improved technology for the betterment of patient care? This presentation provides a perspective from a self-described risk adverse entrepreneur. Determining whether your technology can contribute to the medical community, while supporting a fiscally responsible business is not a game of chance. An organized business plan is required. Most importantly, it is never too early to define the path to commercialization. This presentation will provide an outline of the key steps and business analyses required to responsibly establish a medical device company on behalf of the key stakeholders. Topics covered include: defining the market segments and size, understanding the competitive landscape, determining the regulatory path and IP landscape, defining the clinical and economical benefits for all key stakeholders, cost analysis for development and commercialization, sales model determination, and determining the "why do this?", and "is it worth doing?"

3:00 PM

(BIO-064-2012) Commercialization Paths for Disruptive Technologies - When to Start a New Company

T. Day*, Mo-Sci Corporation, USA

Disruptive technologies are defined as a new way of doing things that disrupt or overturn the traditional method or practice of how businesses conduct themselves. It can bring tremendous opportunity when embraced or terrible obsolescence if ignored. In the world of medical device companies, many hang on to existing products trying to get every last drop of revenue off of their current "golden goose" before making the move to the "next generation" or version of virtually the same technology. True disruptive technologies leap frog and leave behind current technologies and all next-gen versions of the same. This presentation describes the path chosen when new biomedical technologies are developed that "change the game" but no existing commercial company will embrace the technology for fear of putting existing products back on their shelf.

Commercialization II

Room: Capital D
Session Chair: Markus Reiterer, Medtronic, Inc.

3:50 PM

(BIO-073-2012) The system Y-TZP and its porcelain (Invited)
M. J. Tholey*, VITA Zahnfabrik, Germany

All-ceramic dental materials are in high demand for their aesthetic and biocompatible properties. The clinical problem of "chipping" of porcelain zirconia frameworks is investigated by considering the metastability of the tetragonal phase of Y-TZP ceramics. One specific problematic area is the interface between the porcelain and the Y-TZP framework and whether the associated veneering procedures result in a phase transformation of the zirconia.The role of temperature gradients for zirconia framework are compared as well as their influence on residual stress. SEM observations of the zirconia at the porcelain zirconia interface were made to identify the zirconia microstructure. XRD2 micro-diffraction measurements were carried out on the interface area to generate locally phase information. The temperature gradients between the inner and outer surfaces of crowns were measured with thermocouples. Direct observation of the residual stresses was made with an optical polarimeter. Under firing conditions the phase composition of zirconia grains at the interface revealed both monoclinic and tetragonal structure. These observations indicate that destabilisation of the tetragonal phase of zirconia can occur at the interface. Slow cooling decreases the temperature differences between the inner and outer surfaces. Optical polarimeter observations indicated much lower stresses within the porcelain layer upon slow cooling.

4:20 PM

(BIO-074-2012) Navigating FDA Expectations for a new PMMA Bone Cement Formulation
S. Goodman*, Aptiv Solutions, USA

FDA premarket requirements for PMMA bone cements have evolved over time. The cements were originally classified as Class III and reached the market via the premarket approval (PMA) route. The cements evolved to include radio-opaque agents and single antibiotics. In 1999, PMMA bone cements were reclassified to Class II requiring submission of a 510(k) pre-market notification and Class II Special Controls guidances were released. In recent years, there has been increased scrutiny by the Agency for combination products, including medical devices containing drug components and antimicrobials. New formulations currently being considered for commercialization involve multiple antibiotics with greater total antibiotic concentrations and with somewhat different indications for use. Commercialization of new formulations requires careful navigation of FDA's ever changing expectations relating to performance testing, clinical testing and pharmaceutical information to be provided to the Agency. A case study will be presented of the pathway to market for a new dual- antibiotic formulation.

Thursday, September 13, 2012

Plenary Session IV

Room: Capital D

8:30 AM

(BIO-062-2012) Pedicle Screw Electrical Resistance: Hydroxyapatite Coated Versus Non-Coated (Invited)
H. Bae*, Spine Institute, USA

Objectives. To assess if HA coated titanium pedicle screws exhibit the same electroconductive characteristics as non-coated screws. Summary of Background Data. Stimulus evoked electromyographic testing has become a common tool for assisting in the confirmation of proper placement of pedicle screws during spine surgery. HA coated screws have recently come to market as a means of increasing "pullout" strength. The manufacturer has recommended that HA coated screws not be stimulated due to inconsistent responses. There is no published data to confirm this recommendation. The non-Hydroxyapatite coated screws tested showed low resistive properties and proved to be an ideal conductor of electrical current. The resistive properties associated with the HA coated pedicle screws were found to be similar to those of commonly used insulators such as rubber and plastic, removing the effectiveness of evoked electromyographic testing. Conclusion. This data suggests that the increased resistance value of the HA coated screw is large enough that any electromyographic response produced would be due to shunting of electric current from the non-coated head of the screw into adjacent tissue and not through the shank of the screw and should not be stimulated to assist in determining the accuracy of pedicle screw placement.

Tutorial Session I

Room: Capital D

10:30 AM

(BIO-085-2012) Licensing Technology from a Public University, what in the world were you thinking? (Invited)
K. D. Strassner*, Missouri University of Science and Technology, USA

University Technology Transfer Office (TTO) are often seen as barriers to the moving technologies into the marketplace, of course University TTOs wonder why companies don't just sign their standard, one size fits all, license agreement, write the check and get on with moving their multi-million dollar technology straight to market. How can these two divergent positions come together? This session will explore the topic from a partnership perspective rather than the legal context of the legalese of licensee agreement. The discussion will highlight steps to building an effective partnership that will maximize the benefits to both parties. Insight will be offered to get the deal done and avoiding "perfect" rather than focusing on "good enough". In the end both parties are seeking what is best for their stakeholders and this is achievable but understanding what those stakeholder wins are is important part of forming a lasting vibrant partnership.

Tutorial Session II

Room: Capital A/B

10:30 AM

(BIO-086-2012) CE Marking of Medical Devices (Invited)
M. D. O'Donnell*, BSi Group, United Kingdom

This tutorial will give an outline of EU medical device regulations and the involvement and interaction of member states, competent authorities, notified bodies and manufacturers. The CE marking process will also be outlined which can be used to place medical devices on the European market in all 29 member states. This will focus on medical devices directive (MDD – 93/42/EEC revision 2007/47/EC). A summary of device classification will be given and examples of Class I, IIa, IIb and III devices shown. Conformity routes and the essential requirements will be discussed. The importance of harmonised standards and guidance documents including quality management systems, risk management, clinical evaluation, biocompatibility, sterilisation validation, packaging validation and product specific standards will be examined. The concept of post-market surveillance (PMS) will be summarised, focussing on active and passive PMS. Finally, the links between the EU regulatory framework and other global markets will be discussed in particular the United States, Canada, Japan and Australia. The tutorial will include a number of interactive group learning sessions.

Tutorial Session III

Room: Capital C

10:30 AM

(BIO-087-2012) Materials Data Impact on Device Design (Invited)

G. Mushock*, ASM International, USA

For nearly 100 years, ASM International has been committed to providing high-quality materials information, education and training, networking opportunities and professional development resources in cost-effective and user-friendly formats to engineering and science professionals worldwide. Understanding the needs within the Medical Device industry for relevant and reliable materials data, we have developed the ASM Medical Materials portfolio of products. My presentation will focus on the impact of materials information in the design and production of implantable medical devices. As we have seen in the news lately, materials are a key component of device safety and efficacy. Having access to relevant and reliable materials data early in the design process saves time, money and mitigates risk. I will discuss why materials are important, what type of information is needed, and where to find that information.

11:15 AM

(BIO-088-2012) Systematic materials selection – How to optimize product performance while lowering risk (Invited)

K. Roenigk*, Granta Design, USA

Materials are of vital importance to new product development in the medical device industry. Making the right materials choice can be critical to device performance. But designers also need to consider the impact of this choice on factors such as bio-compatibility, qualification, regulation, and cost. The risks of an incorrect selection are high, including unnecessary redesigns and excess costs. This can mean that designers prefer a relatively conservative approach, re-using materials with which they are familiar because finding information on new materials may be difficult and too time consuming. But how can they be sure that these materials are the optimal choice for their application? This talk will introduce the latest materials information technology, developed in collaboration with industry to meet these challenges. This includes: specialist systems to capture, manage, and share corporate materials data; access to comprehensive reference data on medical materials; and software tools to support materials selection and substitution. Case studies will show how this technology can be applied to materials choices, with a particular focus on ceramics.

Author Index

*** Denotes Presenter**

Author Index

If you
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or produce it,

it makes sense to
be in the place
that can do
all 3…

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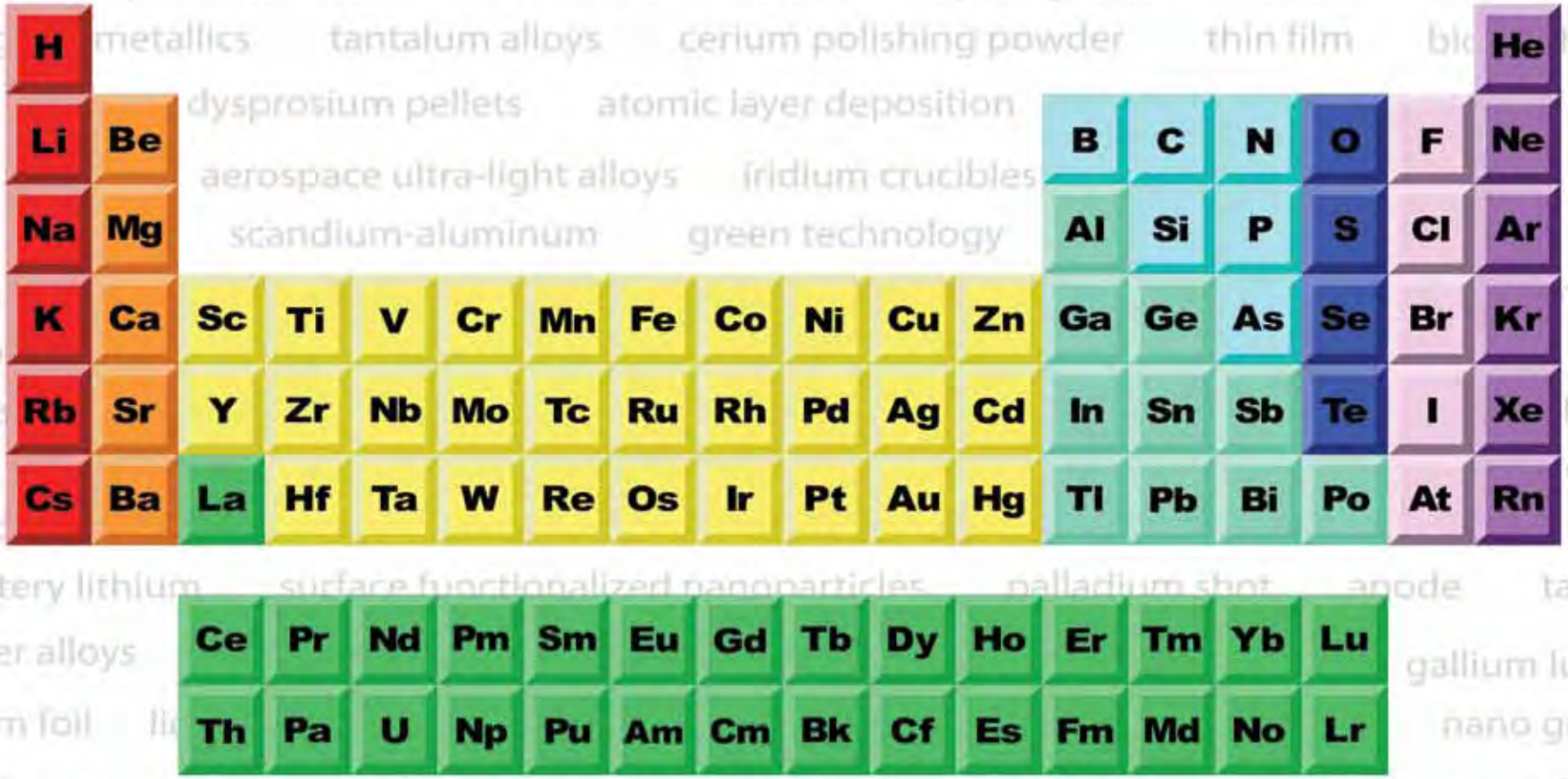

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