conference program

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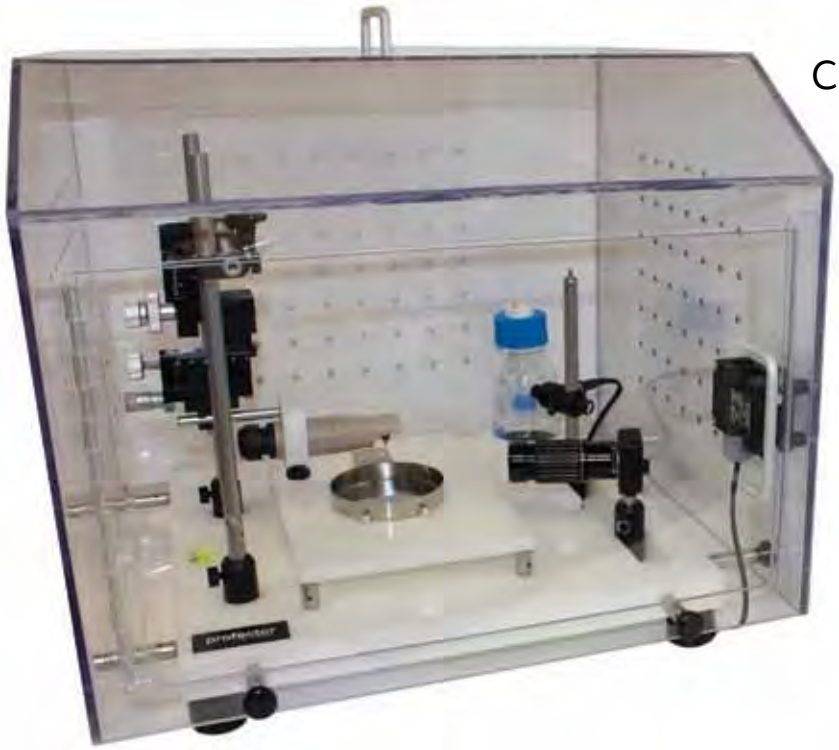

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Welcome Letter

Welcome to ESPIN 2014—the third biannual international meeting dedicated to electrospinning science. This conference addresses many topics: theory; polymer, metal, and ceramic materials; energy storage and harvesting; filtration; materials for sustainability and biomedical applications; and especially the fast-growing ceramic nanomaterials field. Distinguished scientists **Prof. Alexander Yarin,** University of Illinois at Chicago, USA; **Dr. Luana Persano,** National Research Council-CNR, Italy; and **Prof. Il-Doo Kim,** Korea Advanced Institute of Science and Technology, Republic of Korea are the plenary lecturers.

The technical program features invited lectures, contributed papers, and poster presentations. Participants represent an international mix of industrial, academic, and government laboratory researchers, engineers, technologists, leaders, and students. So be sure to take advantage of the ample opportunities to exchange information and ideas on the latest developments in electrospinning theories, experimental investigations, and applications.

We are pleased to build on previous successes of this conference series and to provide a distinctive forum to address emerging needs, key challenges, and opportunities in electrospinning. This year's gathering continues to highlight the most recent scientific advances and technological innovations in the field, and it facilitates the interactions and collaborations that will shape electrospinning's future.

The American Ceramic Society's staff and ESPIN 2014 conference chairs thank you for participating. We hope you have an intellectually stimulating time and a rewarding experience here in San Francisco, and we very much look forward to your continued participation in future electrospinning meetings!

2014 Conference Chairs:

Wolfgang Sigmund,
University of Florida

Younan Xia,
Georgia Tech

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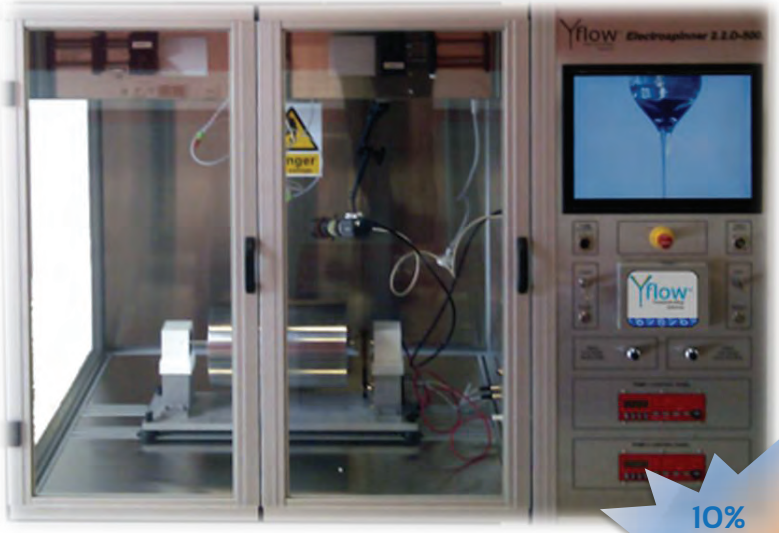

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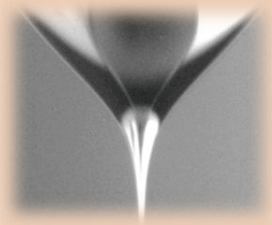

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Schedule At A Glance

Monday August 4, 2014

3 – 7 p.m.	Conference Registration	Metropolitan Foyer
5 – 7:30 p.m.	Welcome Reception	Metropolitan Foyer

Tuesday August 5, 2014

7 a.m. – 6:30 p.m.	Conference Registration	Metropolitan Foyer
8:45 a.m. – 9:45 a.m.	Opening Remarks and Plenary Speaker 1	Metropolitan III
9:45 – 10 a.m.	Break	Metropolitan Foyer
10 a.m. – 12 p.m.	Concurrent Sessions	Metropolitan I, II, III
12 – 1:30 p.m.	Lunch on Own	
1:30 – 3:30 p.m.	Concurrent Sessions	Metropolitan I, II, III
3:30 – 3:50 p.m.	Break	Metropolitan Foyer
3:50 – 5:50 p.m.	Concurrent Sessions	Metropolitan I, II, III
6 – 8 p.m.	Poster Session, Table top Exhibits	Metropolitan Foyer, Olympic, Concordia

Wednesday August 6, 2014

7:30 a.m – 6 p.m.	Conference Registration	Metropolitan Foyer
9 – 9:45 a.m.	Plenary Speaker 2	Metropolitan III
9:45 a.m. – 10 a.m.	Break	Metropolitan Foyer
10 a.m. – 12 p.m.	Concurrent Sessions	Metropolitan I, II, III
12 – 1:30 p.m.	Lunch on Own	
1:30 – 3:30 p.m	Concurrent Sessions	Metropolitan I, II, III
3:30 – 3:50 p.m.	Break	Metropolitan Foyer
3:50 – 5:50 p.m.	Concurrent Sessions	Metropolitan I, II, III
7 – 9:30 p.m.	Conference Dinner	Metropolitan Ballrooms

Thursday August 7, 2014

7:30 a.m. – 12:30 p.m.	Conference Registration	Metropolitan Foyer
9 – 9:45 a.m.	Plenary Speaker 3	Metropolitan III
9:45 – 10 a.m.	Break	Metropolitan Foyer
10 a.m. – 12:10 p.m.	Concurrent Sessions	Metropolitan I, II, III

2014 ICE Plenary Speakers

Tuesday, August 5, 9:00 a.m. – Room: Metropolitan III
Alexander Yarin, University of Illinois at Chicago,
Department of Mechanical and Industrial Engineering, USA
Title: *Electrically-Assisted Subsonic and Supersonic Solution Blowing of Monolithic and Core-Shell Petroleum-Derived and Bio-Polymer Nanofibers: Experiments and Modeling*

PhD-1980, DSc (Habilitation)-1989. Affiliations: Senior Research Associate at The Academy of Sciences of the USSR, Moscow (1977-1990); Professor at the Technion-Israel Institute of Technology (1990-2006), and at the University of Illinois at Chicago, USA (2006-present); Concurrently, Professor at Korea University, Seoul, S. Korea (2013-present). Fellow of the Center for Smart Interfaces at the Technical University of Darmstadt, Germany (2008-2012). Prof. Yarin is the author of 3 books, 10 book chapters, about 250 research papers, and 6 patents. He is and Associate Editor of the journal "Experiments in Fluids" and one of the three co-Editors of "Springer Handbook of Experimental Fluid Mechanics", 2007.

Wednesday, August 6, 9:00 a.m. – Room: Metropolitan III
Luana Persano, Nanoscience Institute, National Research Council-CNR, Italy
Title: *Functional Polymer Nanofibers: Opportunities and Challenges*

Persano, PhD in innovative materials and technologies (2006), is currently staff researcher at the National Research Council-Nanoscience Institute. She has been Marie-Curie fellow at FORTH, Greece, and visiting scientist at Harvard University and University of Illinois. Her research interests include nanomanufacturing, conventional and soft lithography on organics and nanocomposites semiconductors, photonic and piezoelectric devices, and electrospinning technology transfer. Since 2003, she has authored or co-authored 70 papers in refereed journals, book chapters and one international patent. She has several oral and invited contributions to international conferences. Among other prizes, she received the "CNR-Start-Cup" award in 2010 and the "Bellisario" award as Young Talent in Industrial Engineering in 2011.

Thursday, August 7, 9:00 a.m. – Room: Metropolitan III
Il-Doo Kim, KAIST, Department of Materials Science and Engineering, Korea
Title: *Advances in Functional Metal Oxide Nanofibers*

Kim received his PhD degree (2002) from KAIST. From 2003 to 2005, he was a postdoctoral fellow with Prof. Harry L. Tuller at MIT. He returned to Korea Institute of Science and Technology as a senior research scientist. In Feb. 2011, he joined at KAIST as a faculty member in Department of Materials Science and Engineering. Dr. Kim's current research emphasizes controlled processing and characterization of functional nanofibers via electrospinning for practical applications in exhaled breath sensors and energy storage devices such as Li-ion, Li-S, and Li-Air batteries. Dr. Kim had served as a conference chair in International Conference on Electrospinning 2012, which was held in Jeju, South Korea, 2012. He has published over 113 articles and holds 122 patents. Dr. Kim is a Deputy Editor of the Journal of Electroceramics (Springer).

2014–2015

Meetings & Expositions of THE AMERICAN CERAMIC SOCIETY

AUGUST 17 – 21, 2014
5th International Congress on Ceramics
Beijing International Conference Center
Beijing, China

OCTOBER 12 – 16, 2014
MS&T14 – Materials Science & Technology Conference and Exhibition, combined with ACerS 116th Annual Meeting
David L. Lawrence Convention Center
Pittsburgh, Pennsylvania USA

NOVEMBER 3 – 6, 2014
75th Conference on Glass Problems – 75th GPC
Greater Columbus Convention Center
Columbus, Ohio USA

JANUARY 21 – 23, 2015
Electronic Materials and Applications – EMA 2015
DoubleTree by Hilton Orlando at Sea World®
Orlando, Florida USA

JANUARY 25 – 30, 2015
39th International Conference and Expo on Advanced Ceramics and Composites – ICACC'15
Daytona Beach, Florida USA

MARCH 25 – 26, 2015
ACerS St. Louis Section and Refractory Ceramics Division Joint Meeting
St. Louis, Missouri USA

APRIL 28 – 30, 2015
Ceramics Expo
International Exposition Center
Cleveland, Ohio USA

MAY 17 – 21, 2015
Glass & Optical Materials Division Annual Meeting and Deutsche Glastechnische Gesellschaft – ACerS GOMD-DGG Joint Annual Meeting
Miami, Florida USA

JUNE 14 – 19, 2015
International Symposium on Ceramic Materials and Components for Energy and Environmental Applications – 11th CMCEE
Hyatt Regency Vancouver
Vancouver, British Columbia Canada

AUGUST 30 – SEPTEMBER 4, 2015
PACRIM 11 – 11th Pacific Rim Conference on Ceramic and Glass Technology
JeJu Island Korea

SEPTEMBER 15 – 18, 2015
UNITECR 2015 – Unified International Technical Conference on Refractories
Vienna, Austria

OCTOBER 4 – 8, 2015
MS&T15 – Materials Science & Technology Conference and Exhibition, combined with ACerS 117th Annual Meeting
Greater Columbus Convention Center
Columbus, Ohio USA

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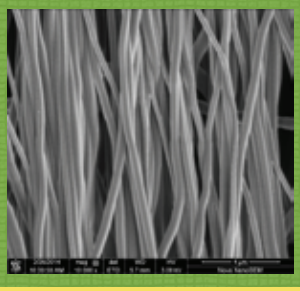

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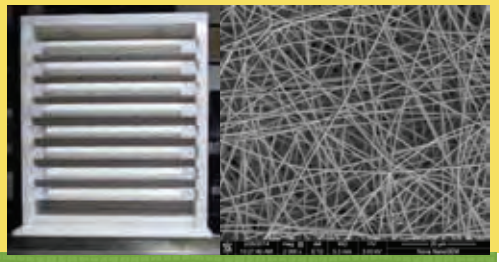

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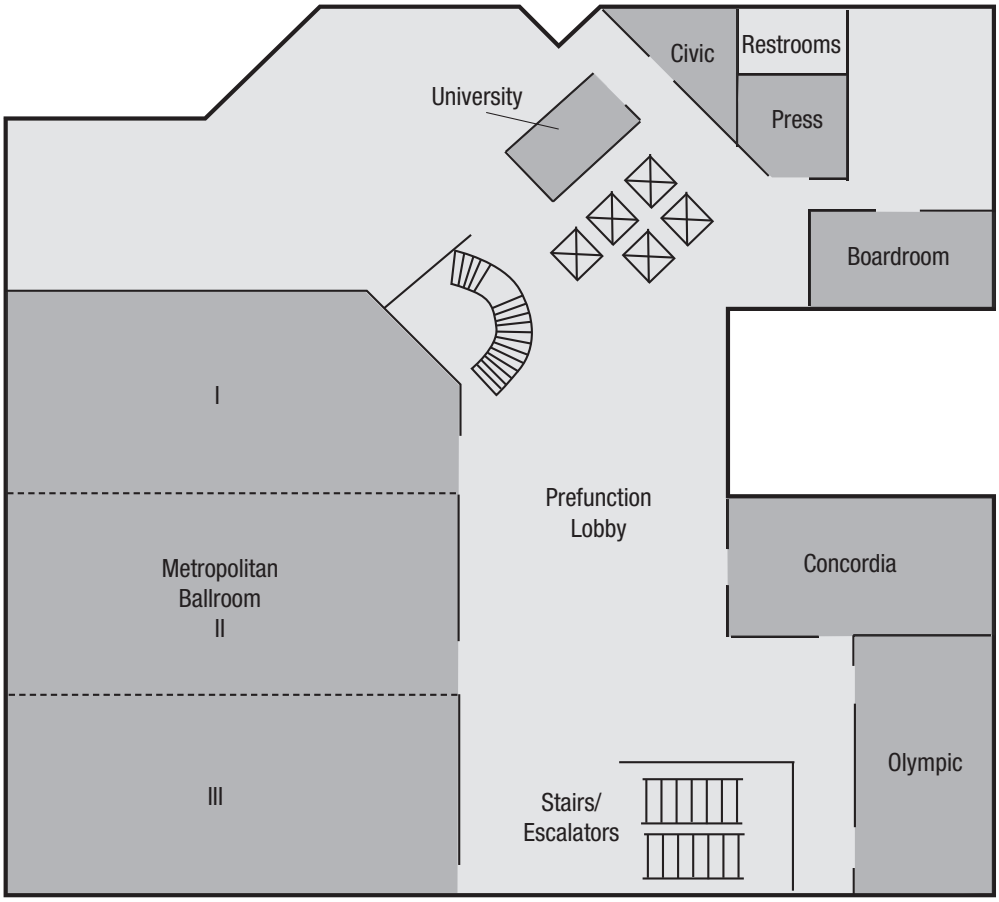

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Jin, M.	5-Aug	6:00PM	Metropolitan Foyer	15
Kim, B.	5-Aug	6:00PM	Metropolitan Foyer	14
Kim, J.	5-Aug	6:00PM	Metropolitan Foyer	13, 14
Kim, K.	5-Aug	6:00PM	Metropolitan Foyer	15
Kim, S.	5-Aug	6:00PM	Metropolitan Foyer	14
Kim, T.	5-Aug	6:00PM	Metropolitan Foyer	14
Laurita, R.	5-Aug	6:00PM	Metropolitan Foyer	13, 15
Lee, S.	5-Aug	6:00PM	Metropolitan Foyer	13
Li, C.	5-Aug	6:00PM	Metropolitan Foyer	14
Lim, B.	5-Aug	6:00PM	Metropolitan Foyer	14
Modesti, M.	5-Aug	6:00PM	Metropolitan Foyer	14
Nielsen, D.J.	5-Aug	6:00PM	Metropolitan Foyer	13
Picciani, P.	5-Aug	6:00PM	Metropolitan Foyer	13
Raheja, A.	5-Aug	6:00PM	Metropolitan Foyer	15
Rajkumar, N.	5-Aug	6:00PM	Metropolitan Foyer	14
Rodriguez, I.A.	5-Aug	6:00PM	Metropolitan Foyer	13
Roso, M.	5-Aug	6:00PM	Metropolitan Foyer	13, 14
Sharma, R.	5-Aug	6:00PM	Metropolitan Foyer	15
Solouk, A.	5-Aug	6:00PM	Metropolitan Foyer	14
Soukup, K.	5-Aug	6:00PM	Metropolitan Foyer	15
Stanishevsky, A.	5-Aug	6:00PM	Metropolitan Foyer	14
Stephansen, K.	5-Aug	6:00PM	Metropolitan Foyer	13
Topcu, S.	5-Aug	6:00PM	Metropolitan Foyer	15
Wakode, R.N.	5-Aug	6:00PM	Metropolitan Foyer	14
Wong, D.	5-Aug	6:00PM	Metropolitan Foyer	14
Wu, Q.	5-Aug	6:00PM	Metropolitan Foyer	13
Xia, Z.	5-Aug	6:00PM	Metropolitan Foyer	14
Yoon, J.	5-Aug	6:00PM	Metropolitan Foyer	14
Youm, J.	5-Aug	6:00PM	Metropolitan Foyer	15
Yu, Q.	5-Aug	6:00PM	Metropolitan Foyer	13
Zaccaria, M.	5-Aug	6:00PM	Metropolitan Foyer	14, 15
Zhao, Q.	5-Aug	6:00PM	Metropolitan Foyer	15

Tuesday, August 5, 2014

Opening Remarks and Plenary Session I

Room: Metropolitan III

8:45 AM

Opening Remarks: Wolfgang Sigmund, Univ of Florida

9:00 AM

(ICE-001-2014) Electrically-Assisted Subsonic and Supersonic Solution Blowing of Monolithic and Core-Shell Petroleum-Derived and Bio-Polymer Nanofibers: Experiments and Modeling
A. L. Yarin*, University of Illinois at Chicago, USA

9:45 AM

Break

Novel Developments in Electrospinning and Other Nanofiber Fabrication Technologies I

Room: Metropolitan III

Session Chairs: Wolfgang Sigmund, University of Florida; Il-Doo Kim, Korea Advanced Institute of Science and Technology

10:00 AM

(ICE-002-2014) Multifunctional polymer particles and fibers by electrohydrodynamic co-jetting (Invited)
J. Lahann*, University of Michigan, USA

10:30 AM

(ICE-003-2014) Scaling up nanofiber production (Invited)
E. Smit*, The Stellenbosch Nanofiber Company, South Africa

11:00 AM

(ICE-004-2014) Feasibility of using deflector plates for achieving fiber alignment
J. Walser*, S. J. Ferguson, ETH Zurich, Switzerland; M. D. Caversaccio, University of Bern, Inselspital, Switzerland

11:20 AM

(ICE-005-2014) Free Surface Electrospun Polyvinylidene Fluoride Membranes for Direct Contact Membrane Distillation
K. M. Forward*, E. Estrada, R. Oh, S. West, B. Hensley, California State Polytechnic University, Pomona, USA

11:40 AM

(ICE-006-2014) Nanospider™ – A unique way to produce nanofibers
C. Tekemen*, Elmarco s.r.o., Czech Republic

Polymer Nanofibers I

Room: Metropolitan II

Session Chairs: Dario Pisignano, Università del Salento; Kyung Paik, KAIST

10:00 AM

(ICE-007-2014) Cross-linked electrospun polyvinyl alcohol membranes and their potential applications (Invited)
Y. B. Truong*, S. Maisch, Y. Gao, C. P. Huynh, J. Mardel, M. Musameh, M. Hickey, I. L. Kyratzis, CSIRO, Australia

10:30 AM

(ICE-008-2014) Internal nanostructure of electrospun polymer nanofibers (Invited)
A. Camposeo*, National Nanotechnology Laboratory of CNR-NANO, Italy; I. Greenfeld, Technion - Israel Institute of Technology, Israel; F. Tantussi, Università di Pisa and INO-CNR Sezione di Pisa, Italy; M. Moffa, National Nanotechnology Laboratory of CNR-NANO, Italy; F. Fuso, M. Allegrini, Università di Pisa and INO-CNR Sezione di Pisa, Italy; E. Zussman, Technion - Israel Institute of Technology, Israel; D. Pisignano, Università del Salento, Italy

11:00 AM

(ICE-009-2014) Spontaneous Formation of Metal-Polymer Hybrid Nanostructures Using Functionalized Electrospun Polymer Nanofibers
H. Son, J. Ryu, H. Lee, Y. Nam*, KAIST, Republic of Korea

11:20 AM

(ICE-011-2014) Controlling the Crystallinity and Morphology of Electrospun PCL Fibres
T. Cirstea*, P. Dobson, A. Watt, University of Oxford, United Kingdom

Ceramic and Composite Nanofibers I

Room: Metropolitan I

Session Chairs: Joseph Tracy, North Carolina State University; Younan Xia, Georgia Institute of Technology

10:00 AM

(ICE-012-2014) Electrospinning Activities at the Australian National University (Invited)
A. Lowe*, Australian National University, Australia

10:30 AM

(ICE-013-2014) Electrospinning: A route to synthesize ceramic nanocomposites on a single fiber or particle (Invited)
J. S. Andrew*, J. D. Starr, M. A. Budi, University of Florida, USA

11:00 AM

(ICE-014-2014) Electrospun PZT Nanofibers: Morphology Control and Rapid Thermal Processing (RTP)
A. Gevorkyan, G. E. Shter, G. S. Grader*, Technion, Israel

11:20 AM

(ICE-015-2014) Elaboration of AlN nanofilaments by electrospinning
T. Gerges*, V. Salles, Laboratoire des multimateriaux et interfaces (UMR 5615 Université Lyon 1-CNRS), France; S. Bernard, Institut Européen des Membranes (UMR 5635-CNRS/ENSCM-UM2), France; A. Brioude, G. Ferro, Laboratoire des multimateriaux et interfaces (UMR 5615 Université Lyon 1-CNRS), France

11:40 AM

(ICE-016-2014) Fabrication of ceramic porous LiCoOx nanofibrous mesh
Y. Aykut*, Uludag University, Turkey; S. Khan, B. Pourdeyhimi, North Carolina State University, USA

Novel Developments in Electrospinning and Other Nanofiber Fabrication Technologies II

Room: Metropolitan III

Session Chairs: Joerg Lahann, University of Michigan; Eugene Smit, The Stellenbosch Nanofiber Company

1:30 PM

(ICE-017-2014) Dramatic difference in morphology and core content of electrospun core-sheath fibers deposited on hydrophobic and hydrophilic substrates
D. Kim, Seoul National University, Republic of Korea; J. P. Lagerwall*, University of Luxembourg, Luxembourg

1:50 PM

(ICE-018-2014) A process monitoring system for a multi-jet electrospinning head
L. Bonura*, A. Cacace, G. Bianchi, A. Varesano, National Research Council of Italy, Italy

2:10 PM

(ICE-019-2014) Electrostatic template effect during alternative electrospinning and electrospraying on micropatterned collectors: Towards nanofibrous and microstructured 2D and 3D composites
G. Schlatter*, S. Nedjari, C. Wittmer, B. El Maghnouji, A. Hébraud, University of Strasbourg / CNRS, France

2:30 PM

(ICE-022-2014) Plasma-assisted electrospinning: the many facets of a process

L. Calzà, Alma Mater Studiorum- Università di Bologna, Italy, Alma Mater Studiorum- Università di Bologna, ItalyInterdepartmental Center for Industrial Research, Italy; V. Colombo, Alma Mater Studiorum- Università di Bologna, Italy; L. Dolci, Interdepartmental Center for Industrial Research, Italy; A. Fiorani, D. Fabiani, M. Focarete, Alma Mater Studiorum - Università di Bologna, Italy; M. Gherardi, C. Gualandi, R. Laurita*, A. Liguori, Alma Mater Studiorum- Università di Bologna, Italy; S. Quiroga, Alma Mater Studiorum - Università di Bologna, Italy; P. Sanibondi, Alma Mater Studiorum- Università di Bologna, Italy; M. Zaccaria, Alma Mater Studiorum - Università di Bologna, Italy

2:50 PM

(ICE-025-2014) Electrospinning as a Polymer Blending Technique to Fabricate Adhesives

S. Wong*, X. Ma, G. Ji, T. A. Blackledge, University of Akron, USA

3:10 PM

(ICE-026-2014) Lysozyme encapsulation in porous fibers of poly (-lactic acid)-alginate through coaxial electrospinning

A. Raheja*, Indian Institute of Technology Madras, India; A. Smith, University of Guelph, Canada; C. T. Sainathan, N. T. Srinivasan, Indian Institute of Technology Madras, India; L. Lim, University of Guelph, Canada

3:30 PM

Break

3:50 PM

(ICE-027-2014) Multi-Structured Nanofibers and Their Wetting Property

Y. Zhao*, Beihang University, China

4:10 PM

(ICE-020-2014) Effect of Relative Humidity on the Flatness of Electrospun Microtube Array Membranes (MTAMs)

T. Chu*, S. Rwei, National Taipei University of Technology, Taiwan; Y. Shu, Lee-Ming Institute of Technology, Taiwan; C. Chen, C. Chen, Taipei Medical University, Taiwan; W. Tseng, Lee-Ming Institute of Technology, Taiwan

4:30 PM

(ICE-021-2014) Structural tuning of electrospun nano-porous poly-l-lactic acid (PLLA) microtube array membranes (MTAMs)

C. Chiu*, J. Yang, Taipei Medical University, Taiwan; C. Lin, National Taiwan Normal University, Taiwan; C. Chen, Taipei Medical University, Taiwan

4:50 PM

(ICE-023-2014) Potential of Electrospun Polymeric Microtube Array Membranes (MTAMs)

C. Chen*, J. Yang, Taipei Medical University, Taiwan; C. Lin, National Taiwan Normal University, Taiwan; H. V. Lin, National Taiwan Ocean University, Taiwan

Polymer Nanofibers II

Room: Metropolitan II

Session Chairs: Yen Truong, CSIRO; Andrea Camposeo, National Nanotechnology Laboratory of CNR-NANO

1:30 PM

(ICE-029-2014) Photon waveguiding and optical resonances management by electrospun nanofibers (Invited)

A. Camposeo, M. Moffa, R. Manco, Istituto Nanoscienze-CNR, Italy; V. Fasano, Istituto Italiano di Tecnologia, Italy; G. Morello, L. Persano, Istituto Nanoscienze-CNR, Italy; D. Pisignano*, Università del Salento, Italy

2:00 PM

(ICE-030-2014) Novel nanofiber Anisotropic Conductive Films (ACFs) for ultra-fine pitch assembly (Invited)

K. W. Paik*, T. Kim, S. Lee, KAIST, Republic of Korea

2:30 PM

(ICE-031-2014) Preparation of extracting polymer wool from polystyrene and Aliquat 336 via electrospinning and its application for online preconcentration of thiocyanate in flow injection analysis

Y. O'Bryan*, The University of Melbourne, Australia; Y. B. Truong, CSIRO Materials Science and Engineering, Australia; R. W. Cattrall, The University of Melbourne, Australia; I. L. Kyratzis, CSIRO Materials Science and Engineering, Australia; S. D. Kolev, The University of Melbourne, Australia

2:50 PM

(ICE-033-2014) Bio-Based Biocomposite Electrospun Scaffolds: From design to In-Vitro Investigation of Cell Differentiation

D. Grande*, J. Ramier, V. Langlois, E. Renard, Institut de Chimie et des Matériaux Paris-Est, France; O. Stoilova, N. Manolova, I. Rashkov, Institute of Polymers, Bulgaria; P. Albanese, Laboratoire "Croissance, Réparation et Régénération Tissulaires", France

3:10 PM

(ICE-034-2014) Pulsatile drug release from electrospun poly(ethylene oxide)–sodium alginate blend nanofibres

Y. Kaassis*, UCL, United Kingdom; N. Young, University of Oxford, United Kingdom; N. Sano, Newcastle University, United Kingdom; H. Merchant, University of Huddersfield, United Kingdom; D. Yu, University of Shanghai, China; N. Chatterton, London Metropolitan University, United Kingdom; G. Williams, UCL, United Kingdom

3:30 PM

Break

3:50 PM

(ICE-035-2014) Polymer Nanofiber Interleaved Carbon/Epoxy Composites and Its Performance

K. N. Shivakumar*, R. Panduranga, North Carolina A&T State University, USA; E. J. Adams, The Boeing Company, USA

4:10 PM

(ICE-036-2014) Thermal analysis of nanofibres: The importance of heating rate

I. Steyaert*, Ghent University, Belgium; G. Van Assche, H. Rahier, Vrije Universiteit Brussel, Belgium; K. De Clerck, Ghent University, Belgium

4:30 PM

(ICE-032-2014) Unbreakable Codes in Electrospun Fibers to Stop Medicine Counterfeiting

C. Huang*, Nanjing Forestry University, China

4:50 PM

(ICE-039-2014) COOH-Functionalized Poly (3,4-ethylenedixoythiophene) Electrospun Nanofibers for Sensor Electrodes

M. Dai*, University of Massachusetts, USA; Z. Jiang, University of Massachusetts, USA; V. Rotello, University of Massachusetts, USA; S. R. Nugen, University of Massachusetts, USA

5:10 PM

(ICE-037-2014) Special wettability materials prepared by electrospinning

N. Wang*, J. Wu, Y. Zhao, School of Chemistry and Environment, Beihang University, China

Ceramic and Composite Nanofibers II

Room: Metropolitan I

Session Chairs: Adrian Lowe, Australian National University; Jennifer Andrew, University of Florida

1:30 PM

(ICE-040-2014) Large Area Electrospinning of Carbon Nanotubes and Their Undamaged Recovery for Use in Advanced Conductive Composite Materials

S. G. King*, S. P. Silva, V. Stolojan, University of Surrey, United Kingdom; A. J. Goodwin, Thomas Swan & Co. Ltd., United Kingdom

1:50 PM

(ICE-041-2014) The influence of viscosity on the stable electrospinning of silica nanofibers

J. Geltmeyer*, K. De Buysser, K. De Clerck, Ghent University, Belgium

2:10 PM

(ICE-042-2014) Iron-based electrospun nanostructures - Innovative magnetic and actuating nanocomposites
T. Fiorido, Université Lyon 1, France; J. Galineau, INSA Lyon, France; V. Salles*, Université Lyon 1, France; L. Seveyrat, F. Belhora, P. Cottinet, INSA Lyon, France; L. Hu, Université Lyon 1, France; Y. Liu, INSA Lyon, France; B. Guiffard, Université de Nantes, France; A. Bogner-Van De Moortele, T. Epicier, D. Guyomar, INSA Lyon, France; A. Brioude, Université Lyon 1, France

2:30 PM

(ICE-043-2014) Flexible and freestanding mats consisting of electrospun ceramic nanofibers for photo-detector application
M. Xi, Y. Zhao, X. Ma, H. Fong*, South Dakota School of Mines and Technology, USA

2:50 PM

(ICE-045-2014) One-pot route to Carbon Electrospun Fibers decorated with Metal-based Nanomaterials
A. Cherifi*, A. Both Engel, M. Bechelany, S. Tingry, D. Cornu, ENSCM, France

3:10 PM

(ICE-046-2014) Flexible PAN/ZnO photocatalyst nanofibers prepared by coaxial electrospinning
K. Chutchakul, V. Pavarajarn*, Chulalongkorn University, Thailand

3:30 PM

Break

3:50 PM

(ICE-048-2014) Nanofibre electrospinning of composite PVA-Silica
Y. Singh*, D. Ramjugernath, I. Davidson, UKZN, South Africa; L. Chetty, Ethekwini municipality, South Africa

4:10 PM

(ICE-049-2014) Fabrication and Characterization of a Microreactor of Au/TiO2 in Microtube Array Membrane (MTAM) for Oxidative Conversion of Carbon Monoxide
H. Chiu*, T. Yang, Z. Chu, National Taipei University of Technology, Taiwan; C. Chen, Taipei Medical University, Taiwan; S. Wang, National Taipei University of Technology, Taiwan

4:30 PM

(ICE-050-2014) Switchable Self-cleaning surfaces from electrospun TiO2 nano-rice structures
A. Venkatesan*, Singapore University of Technology and Design (SUTD), Singapore; S. Dinachali, Institute of Materials Research and Engineering, Singapore; A. Nair, Amrita Centre for Nanosciences & Molecular Medicine, AIMS Ponnekkara., India; A. Baji, Singapore University of Technology and Design (SUTD), Singapore; S. Ramakrishna, National University of Singapore, Singapore

4:50 PM

(ICE-051-2014) Controlling the morphology and microstructure of electrospun nickel oxide nanofibers
A. Khalil*, R. Hashaikeh, Masdar Institute of Science & Technology, United Arab Emirates

Poster Session

Room: Metropolitan Foyer

6:00 PM

(ICE-P001-2014) Simulation of core-shell flow in the Taylor-cone by finite element method
L. Christiansen*, P. Fojan, Aalborg University, Denmark

(ICE-P003-2014) Numerical Simulation of Multiphase Flows in Electrospinning
P. Hwang*, Y. Wu, Feng Chia University, Taiwan; C. Chen, Taipei Medical University, Taiwan

(ICE-P004-2014) Modeling the Formation of Electrospun Fibre Materials
M. Mijajlovic, V. Zivkovic, The University of Adelaide, Australia; D. J. Nielsen*, E. I. Micich, Defence Science and Technology Organisation, Australia; I. L. Kyratzis, CSIRO, Australia; M. J. Biggs, The University of Adelaide, Australia

(ICE-P005-2014) Coaxial electrospun nanofibers for protein formulation in the solid state
U. Angkawinitwong*, S. Brocchini, G. R. Williams, UCL School of Pharmacy, United Kingdom

(ICE-P006-2014) Ultra-violet light modified electrospun polymeric mesh: Spatial control of wettability, protein adsorption, and cell adhesion
J. S. Hersey*, J. D. Freedman, M. W. Grinstaff, Boston University, USA

(ICE-P007-2014) Wound dressing based on Chitosan/Polyvinyl Alcohol Nanofibers Mesh
P. Picciani*, P. F. Lanzillotti, C. T. Andrade, Federal University of Rio de Janeiro, Brazil

(ICE-P008-2014) PVA-PLA Core-Shell Fibers by Coaxial Electrospnning
P. Picciani*, R. P. Gonçalves, M. L. Dias, Federal University of Rio de Janeiro, Brazil

(ICE-P009-2014) Nerve cuff electrode deposited with drug loaded biodegradable nanofibers for suppression of early stage inflammatory response
D. Heo*, School of Dentistry, Kyung Hee University, Republic of Korea; S. Park, S. Lee, J. Kang, Korea Institute of Science and Technology, Republic of Korea; J. Kim, S. Song, E. Heo, I. Kwon, School of Dentistry, Kyung Hee University, Republic of Korea

(ICE-P010-2014) Electrospun Meshes as Simple Surface Tension Sensors for Point of Care Diagnosis
E. J. Falde*, Boston University, USA; S. T. Yohe, Genentech, Inc., USA; M. W. Grinstaff, Boston University, USA

(ICE-P011-2014) Electrospun maleic anhydride grafted poly(lactic acid) bio-nanocomposites reinforced with cellulose nanocrystals
Q. Wu*, C. Zhou, Louisiana State University, USA

(ICE-P012-2014) Electrospun chitosan nanofibers with controlled levels of silver nanoparticles. Preparation,Characterization and Antibacterial Activity
S. Lee*, D. Heo, W. Ko, J. Kim, D. Lee, S. Song, E. Heo, School of Dentistry, Kyung Hee University, Republic of Korea

(ICE-P013-2014) The preparation and characterization of lysine doped polypyrrole @spider silk protein core-shell structure fibrous scaffold containing nerve growth factor
Q. Yu*, Jiaxing University, China

(ICE-P014-2014) Oral delivery of biopharmaceuticals by encapsulation into electrospun fish sarcoplasmic proteins
K. Stephansen*, Technical University of Denmark, Denmark; M. Garcia Diaz, University of Copenhagen, Denmark; F. Jessen, I. S. Chronakis, Technical University of Denmark, Denmark; H. M. Nielsen, University of Copenhagen, Denmark

(ICE-P015-2014) Advantages of Surface-Initiated ATRP (SI-ATRP) for the Functionalization of Electrospun Materials
C. Gualandi*, University of Bologna, Italy; C. Vo, University of Manchester, United Kingdom; M. Focarete, M. Scandola, University of Bologna, Italy; A. Pollicino, University of Catania, Italy; G. Di Silvestro, University of Milano, Italy; N. Tirelli, University of Manchester, United Kingdom

(ICE-P016-2014) Comparative performance of collagen nanofibers electrospun from different solvents and stabilized by different crosslinkers
C. Gualandi*, A. Fiorani, University of Bologna, Italy; S. Panseri, Rizzoli Orthopaedic Institute, Italy; M. Montesi, National Research Council of Italy, CNR, Italy; M. Marcacci, Rizzoli Orthopaedic Institute, Italy; M. Focarete, A. Bigi, University of Bologna, Italy

(ICE-P017-2014) Electrospun-hybrid scaffolds for bone tissue engineering
M. Roso*, M. Dettin, A. Lorenzetti, C. Boaretti, M. Modesti, University of Padova, Italy

(ICE-P018-2014) Atmospheric plasma surface modification of electrospun poly(L-lactic acid): effect on mat properties and cell culturing
L. Calzà, Interdepartmental Center for Industrial Research, Italy; V. Colombo, Alma Mater Studiorum- Università di Bologna, Italy; L. Dolci, Interdepartmental Center for Industrial Research, Italy; A. Fiorani, M. Focarete, Alma Mater Studiorum - Università di Bologna, Italy; M. Gherardi, R. Laurita*, A. Liguori, Alma Mater Studiorum- Università di Bologna, Italy; S. Quiroga, Alma Mater Studiorum - Università di Bologna, Italy; P. Sanibondi, Alma Mater Studiorum- Università di Bologna, Italy

(ICE-P019-2014) A facile method for electrospinning of poly (vinyl alcohol)/ chitosan/graphene oxide biocomposite nanofibers
J. Kim*, Y. Liu, M. Park, H. Kim, Chonbuk National University, Republic of Korea

(ICE-P020-2014) Compressed Electrospun Gelatin-Honey Membranes for Dental Applications
I. A. Rodriguez*, The University of Memphis, USA; B. W. Burger, Dulles Institute for Oral/Maxillofacial Surgery, USA; G. L. Bowlin, The University of Memphis, USA

(ICE-P021-2014) Controlled release of dexamethasone loaded in core-shell SF/PEO nanofibers to modulate inflammatory response
S. S. Al-Deyab*, King Saud University, Saudi Arabia; W. Chen, Donghua University, China; M. H. El-Newehy, King Saud University, Saudi Arabia; X. Mo, Donghua University, China

(ICE-P067-2014) The Effects of Electrospinning Parameters on Nanofiber Diameter of a Polymeric Biocomposite for Biomedical Application
S. Khorshidi, Amirkabir University of Technology (Tehran, Islamic Republic of Iran; A. Solouk*, Amirkabir University of Technology (Tehran, Islamic Republic of Iran; H. Mirzadeh, S. Mazinani, Amirkabir University of Technology (Tehran Polytechnic), Islamic Republic of Iran

(ICE-P022-2014) Tungsten Oxide Nanofibers From Electrospun PVP-Based Aqueous Precursors
A. Stanishevsky*, J. Wetuski, University of Alabama at Birmingham, USA; E. Košťáková, D. Lukaš, Technical University of Liberec, Czech Republic

(ICE-P024-2014) Microstructural and piezoelectric characterization of BST fibers
F. A. Berutti, B. Faraco, A. K. Alves*, C. P. Bergmann, UFRGS, Brazil

(ICE-P025-2014) Influence of electrospinning and heat treatment conditions on TiO2 fibers properties
A. K. Alves*, L. Soares, F. A. Berutti, C. P. Bergmann, UFRGS, Brazil

(ICE-P026-2014) Characterization of hollow BaTiO3 nanofibers and intense visible photoluminescence
K. Lee, J. Yoon*, Dankook University, Republic of Korea

(ICE-P027-2014) Process optimization of electrospun Ceramic Nanofibers from Preceramic Polymers and their use for Hierarchically structured fibers production
M. Roso*, A. Guo, C. Boaretti, P. Colombo, M. Modesti, University of Padova, Italy

(ICE-P028-2014) Effect of grain size distribution on the magnetic behavior of CoFe2O4 nanofibers
D. M. Carrillo Flores*, Advanced Materials Research Center, Mexico; J. T. Elizalde Galindo, Universidad Autonoma de Ciudad Juarez, Mexico; V. Corral Flores, Centro de investigacion en Quimica Aplicada, Mexico; J. R. Farias Mancilla, Universidad Autonoma de Ciudad Juarez, Mexico; C. Ornelas Gutierrez, F. Espinosa Magaña, Advanced Materials Research Center, Mexico

(ICE-P029-2014) Preparation of flexible YSZ ceramic nanofibers by sol-gel assisted electrospinning
W. Li, C. Li*, D. Chen, X. Jiao, Shandong University, China

(ICE-P030-2014) Synthesis and properties of hollow structure Li2-xMnSixP1-xO4 nanofibers by electrospinning method
B. Kim*, C. Kim, B. Jang, S. Yang, J. Son, Korea National University of Transportation, Republic of Korea

(ICE-P031-2014) Preparation and characterization of conductive polyurethane composite nano fibers via electrospinning
N. Rajkumar*, N. Rangasamy, Chonbuk national university, Republic of Korea; S. Park, Inha University, Republic of Korea; H. Kim, Chonbuk National University, Republic of Korea

(ICE-P032-2014) Environmental Pollutants Degradation using Photocatalyst-Carbon Nanofiber composites
S. Kim*, M. Kim, S. Lim, S. Hwang, Daegu Gyeongbuk Institute of Science and Technology (DGIST), Republic of Korea

(ICE-P033-2014) Effective nickel oxide nanofibers toward methanol oxidation: advantage of the nanofibrous morphology
B. Lim*, H. Kim, M. Park, N. Barakat, Chonbuk National University, Republic of Korea

(ICE-P034-2014) Electrospun CdS-TiO2 doped carbon nanofibers for visible- light-induced photocatalytic hydrolysis of ammonia borane
B. Lim*, B. Pant, M. Park, H. Kim, Chonbuk National University, Republic of Korea

(ICE-P065-2014) Fabrication and characterization of polyvinylpyrrolidone /Cu^{2+} nanofibers
Z. Xia*, S. Topcu, P. Gouma, Stony Brook University, USA

(ICE-P035-2014) Biocatalytic polymer nanofibers for stabilization and delivery of enzymes
D. Wong*, M. Dai, J. Talbert, S. Nugen, J. Goddard, University of Massachusetts, Amherst, USA

(ICE-P036-2014) Effect of heat treatment and composition in the photoactivity of Sn-Si-TiO_2 fibers
A. K. Alves*, M. Manique, F. A. Berutti, C. P. Bergmann, UFRGS, Brazil

(ICE-P037-2014) NOx reduction during methane combustion using electrospun fibers
F. A. Berutti, A. Tabarelli, A. K. Alves*, C. P. Bergmann, UFRGS, Brazil

(ICE-P038-2014) A novel functional biodegradable electrospun membrane for nutrient recovery
C. Gualandi*, L. Paltrinieri, A. Zucchelli, University of Bologna, Italy; C. Cellamare, R. Farina, Italian National Agency for New Technologies, Energy and Sustainable Economic Development, ENEA, Italy; M. Focarete, University of Bologna, Italy

(ICE-P039-2014) Integrated Coal Gasification and Electrochemical Fuel Cell Combined Cycle
R. N. Wakode*, Indian Institute of Technology, Bombay, India

(ICE-P066-2014) Polymers in conventional electrospinning and coaxial electrospinning
R. Cui*, Applied Science and Engineering, USA

(ICE-P040-2014) Preparation of Carbon Nanofiber Contenting Plasma-Modified CNT via Electrospinning Process for Supercapacitor Applications
C. Chen, W. Chang*, C. Hung, W. Meng-Yueh, National Cheng Kung University, Taiwan; C. Wang, Southern Taiwan University of Science and Technology, Taiwan

(ICE-P041-2014) NixCo1-x Alloy nanoparticles-doped Carbon nanofibers as Effective Non Precious Catalyst for Ethanol Oxidation
N. Barakat*, Chonbuk National University, Republic of Korea

(ICE-P042-2014) Improved Reproducibility of the Morphologies and Photovoltaic Performances of P3HT Electrospun Nanofibers through Control Over the Evaporation Rate
T. Kim*, S. Yang, S. Sung, Y. Kim, C. Park, Seolu National University, Republic of Korea

(ICE-P043-2014) Cd-doped Co nanoparticles as effective and stable electrode for capacitive deionization technology
J. Kim*, H. Kim, N. Barakat, M. Park, Chonbuk National University, Republic of Korea

(ICE-P044-2014) Study of the effect of silica and tin oxide nanoparticles on electrospun separator properties
M. Zaccaria*, G. Cannucciari, D. Fabiani, C. Gualandi, M. Focarete, University of Bologna, Italy

(ICE-P045-2014) Construction of an electrospinning device for fast nano-material synthesis
K. Freitag*, T. Nilges, TUM, Germany

(ICE-P046-2014) Influence of nitrogen doping on the catalytic activity of Ni-incorporated carbon nanofibers for alkaline direct methanol fuel cells
M. H. El-Newehy*, B. M. Thamer, King Saud University, Saudi Arabia; N. A. Barakat, Chonbuk National University, Republic of Korea; M. A. Abdelkareem, Minia University, Egypt; S. S. Al-Deyab, King Saud University, Saudi Arabia; H. Y. Kim, Chonbuk National University, Republic of Korea

(ICE-P048-2014) Electrically conductive nanostructured membranes for filtering application
M. Modesti*, M. Pasetto, A. Lorenzetti, C. Boaretti, M. Roso, D. Hrelja, University of Padova, Dept of Industrial Engineering, Italy

(ICE-P049-2014) Novel biobased polymeric electrospun nanofibers with high antibacterial efficacy
C. Gualandi*, L. Paltrinieri, M. Focarete, M. Vannini, G. Totaro, L. Sisti, A. Celli, G. Mazzola, D. Di Gioia, University of Bologna, Italy

(ICE-P068-2014) Use of nanofibre membranes for the treatment of wastewater effluent
N. Daels*, K. De Clerck, S. Van Hulle, Ghent University, Belgium

(ICE-P069-2014) Development of silver-containing nanocellulosics for effective water disinfection
M. Gouda, King Faisal University, Saudi Arabia; A. A. Hebeish, National Research Center, Egypt; M. A. Al-Omair*, King Faisal University, Saudi Arabia

(ICE-P047-2014) Waterproof-breathable PVDF membranes prepared in one-step by Electrospinning
D. Esperón*, Yflow S.L., Spain; E. Dueñas Ladrón de Guevara, Universidad de Málaga, Spain; A. Dominguez Huertas, I. González Loscertales, Yflow S.L., Spain

(ICE-P050-2014) Wet-electrospinning for producing multi-core fibers, with diameters ranging from submicron up to the tens of microns
D. Esperón*, Yflow S.L., Spain; I. González Loscertales, Universidad de Málaga, Spain

(ICE-P051-2014) Use of a modified McIntyre cannula needle as a low cost spinneret assembly for coaxial electrospinning
A. Raheja*, C. T. Sainathan, N. T. Srinivasan, Indian Institute of Technology Madras, India

(ICE-P052-2014) Nanoparticle dispersion in PEO polymeric solutions via plasma treatment for the production of electrospun lithium batteries separator
V. Colombo, Alma Mater Studiorum- Università di Bologna, Italy; D. Fabiani, M. Focarete, C. Gualandi, Alma Mater Studiorum - Università di Bologna, Italy; M. Gherardi, R. Laurita, Alma Mater Studiorum- Università di Bologna, Italy; M. Zaccaria*, Alma Mater Studiorum - Università di Bologna, Italy

(ICE-P053-2014) Atmospheric pressure plasma enhanced electrospinnability of poly (L-lactic acid) solutions
V. Colombo, Alma Mater Studiorum- Università di Bologna, Italy; D. Fabiani, M. Focarete, Alma Mater Studiorum - Università di Bologna, Italy; M. Gherardi, Alma Mater Studiorum- Università di Bologna, Italy; C. Gualandi, Alma Mater Studiorum - Università di Bologna, Italy; R. Laurita*, Alma Mater Studiorum- Università di Bologna, Italy; M. Zaccaria, Alma Mater Studiorum - Università di Bologna, Italy

(ICE-P054-2014) Enlarging Pore Size for Improving Cell Infiltration in Electrospun Scaffolds by Positive Voltage and Negative Voltage Electrospinning
Q. Zhao*, O. So, M. Wang, The University of Hong Kong, Hong Kong

(ICE-P056-2014) Development of pulse electrospinning installation and getting micron length of polymer fibers
Y. Aliyev*, B. Dabynov, G. Ustayeva, D. Igimbayeva, M. Nazhipkyzy, Z. Mansurov, Institut of combustion problems, Kazakhstan

(ICE-P057-2014) Surface modification of electrospun poly (Acrylonitrile-co- Styrene) copolymer nanofibers towards developing a dye removal
M. El-Aassar*, City of Scientific Research and Technology Applications, Egypt; M. El-Kady, Engineering Faculty, Egypt-Japan University of Science and Technology, Egypt; H. Shokry, City of Scientific Research and Technology Applications, Egypt

(ICE-P058-2014) Multiwall carbon nanotubes (MWCNT) embedded in oriented Poly(vinylidene fluoride) (PVDF) nanofibers by electrospinning
J. P. Santos, A. B. Silva, R. E. Bretas*, Universidade Federal de São Carlos, Brazil

(ICE-P059-2014) Electrospun core-sheath PEO/Eudragit S100 nanofibers for enhanced magnetic resonance imaging
M. Jin*, G. Williams, University College London School of Pharmacy, United Kingdom; A. Bligh, University of Westminster, United Kingdom; D. Yu, University of Shanghai for Science and Technology, China

(ICE-P060-2014) Piezoelectric Properties of Polylactic Acid based Electrospun Nanofiber Webs
K. Kim*, S. Lee, Y. Ahn, A. Prabu, Kyung Hee University, Republic of Korea

(ICE-P061-2014) Electrospun Poly(vinylidene fluoride) Nanowebs Coated with Silicone Rubber as Piezoelectric Sensors for Healthcare Monitoring
Y. Ahn*, A. Prabu, K. Kim, Kyung Hee University, Republic of Korea

(ICE-P062-2014) Catalytic Oxidation of Low Concentration Gaseous Organic Pollutants over Electrospun Nanofibrous Catalysts
K. Soukup*, P. Topka, V. Hejtmanek, O. Solcova, Institute of Chemical Process Fundamentals of the ASCR, Czech Republic

(ICE-P063-2014) The post-spinning stretching effect on the uniaxial orientation of PAN electrospun precursor web for carbon nanofiber
J. Youm*, K. Yang, Chonnam National University, Republic of Korea

(ICE-P064-2014) Characteristics of PVDF-HFP based nanocomposite gel polymer electrolytes dispersed with MWCNTs for li-ion batteries
R. Sharma*, A. Sil, S. Ray, Indian Institute of Technology, India

(ICE-024-2014) 3D Self-supported Electrospun Nanomats of Cerium doped Titania Photocatalysts
S. Topcu*, P. Gouma, Stony Brook University, USA

Wednesday, August 6, 2014

Plenary Session II

Room: Metropolitan III

9:00 AM

Introduction: Wolfgang Sigmund

9:05 AM

(ICE-052-2014) Functional polymer nanofibers: opportunities and challenges
L. Persano*, A. Camposeo, National Research Council-CNR, Italy; D. Pisignano, Università del Salento, Italy

9:45 AM

Break

Biomedical Applications of Electrospun Materials I

Room: Metropolitan III

Session Chairs: Xiumei Mo, Donghua University; Jingwei Xie, University of Nebraska Medical Center

10:00 AM

(ICE-053-2014) Applications of Electrospun Membranes (Invited)
I. Kyratzis*, Y. B. Kyratzis, CSIRO, Australia

10:30 AM

(ICE-054-2014) Electrospun Nanofibers at Work in Biomedical Research (Invited)
Y. Xia*, Georgia Institute of Technology, USA

11:00 AM

(ICE-055-2014) Cell-laden Nanofibrous Scaffolds Made by Concurrent Electrospinning and Cell Electrospraying
Q. Zhao*, M. Wang, The University of Hong Kong, Hong Kong

11:20 AM

(ICE-056-2014) Electrospun Polymer Nanofiber Scaffolds for Tissue Engineering
R. Vera-Graziano*, Universidad Nacional Autónoma de México (National Autonomous University of México), Mexico; F. Sabina-Ciscar, Universidad Nacional Autónoma de México, Mexico; A. Maciel-Cerda, F. Sánchez-Arévalo, Universidad Nacional Autónoma de México (National Autonomous University of México), Mexico; R. Montiel-Campos, N. Batina, Universidad Autonoma Metropolitana (Metropolitan Autonomous University), Mexico; J. Cornejo-Bravo, Universidad Autónoma de Baja California (Autonomous University of Baja California), Mexico; A. Raya-Rivera, Hospital Infantil de México Federico Gómez (Infant Hospital of Mexico Federico Gomez), Mexico; F. Rivera-Torres, Universidad Pedagógica y Tecnológica de Colombia (Pedagogic and Technologic University of Colombia), Colombia; A. Ospina-Orejarena, Universidad Nacional Autónoma de México (National Autonomous University of México), Mexico; L. Villareal-Gómez, Universidad Autónoma de Baja California (Autonomous University of Baja California), Mexico; S. Alcántara-Barrera, Centro de Investigación Aplicada en Tecnologías Competitivas (Applied Research Center on Competitive Technologies), Mexico; L. Ávila-Gutíerrez, A. Navarro-Cerón, R. Romero Aragón, A. Monrroy-Brera, Universidad Nacional Autónoma de México (National Autonomous University of México), Mexico

11:40 AM

(ICE-057-2014) A bioinspired nanofiber-hydrogel mimic of the cartilage extracellular matrix
F. A. Formica*, ETH Zürich, Switzerland; K. Maniura-Weber, A. M. Bühlmann, EMPA, Switzerland; M. Zenobi-Wong, ETH Zürich, Switzerland

Energy Storage and Harvesting with Electrospun or Sprayed Materials I

Room: Metropolitan II

Session Chairs: Avinash Baji, Singapore University of Technology and Design; You-Lo Hsieh, University of California, Davis

10:00 AM

(ICE-058-2014) Molecular Orientation, Degradation and Gelation in Environmentally Sustainable Polymers: Electrospun Nanofibers of Poly(hydroxybutyrates) and Their Copolymers (Invited)

J. F. Rabolt*, L. Gong, B. Chase, University of Delaware, USA; I. Noda, Meredian Bioplastics, USA

10:30 AM

(ICE-059-2014) Electrospinning of Multifunctional Hybrid Fibers (Invited)

W. Sigmund*, University of Florida, USA

11:00 AM

(ICE-060-2014) Mesoporous Metal-Doped Carbon Nanofibers as Cathode for Lithium-Air Batteries

S. Martinez Crespiera, D. Amantia*, C. Pelegrín, E. Knipping, C. Aucher, M. Faccini, L. Aubouy, LEITAT, Spain

11:20 AM

(ICE-062-2014) Design of 3D Nanofiber Electrodes for Future Energy Devices

W. A. Zhang*, V. Esposito, S. Søren Simonsen, W. Zhang, S. Ramousse, J. Oluf Jensen, Technical University of Denmark, Denmark; P. N. Pintauro, Vanderbilt University, USA

Filtration, Textiles and Other Topics I

Room: Metropolitan I

Session Chairs: Gregory Rutledge, MIT; Jennifer Andrew, University of Florida

10:00 AM

(ICE-063-2014) Advanced Electrospinning of Nanofiber Nonwovens and Nanofiber Yarns (Invited)

T. Lin*, Deakin University, Australia

10:30 AM

(ICE-064-2014) Imaging of Particulates within a Nanofibre Network

D. J. Nielsen*, E. I. Micich, M. Jamriska, D. Chong, R. Hebden, Defence Science and Technology Organisation, Australia

10:50 AM

(ICE-065-2014) Polymeric Electrospun Nanofibrous Mats to Enhance the Mechanical Behavior of Composite Laminates

J. Belcari, O. Bocchi, T. Brugo, A. Celli, M. Focarete, C. Gualandi, A. Mazzotta, G. Minak, University of Bologna, Italy; F. Moroni, R. Palazzetti, Strathclyde University, United Kingdom; L. Pesola, University of Bologna, Italy; A. Pirondi, Strathclyde University, United Kingdom; H. Saghafi, L. Sisti, A. Zucchelli*, University of Bologna, Italy

11:10 AM

(ICE-066-2014) Nanostructured membranes as advanced solutions for VOCs control: the synergy of graphene and TiO2 nanoparticles

M. Roso*, A. Lorenzetti, C. Boaretti, D. Hrelja, M. Modesti, University of Padova, Italy

11:30 AM

(ICE-067-2014) Polyethersulfone Electrospun Nanofibrous Membranes for water purification

J. Bae*, H. Kim, H. Choi, Gwangju Institute of Science and Technology, Republic of Korea

Biomedical Applications of Electrospun Materials II

Room: Metropolitan III

Session Chairs: Luana Persano, Nanoscience Institute of CNR; Ilias Louis Kyratzis, CSIRO

1:30 PM

(ICE-068-2014) Electrospining Nanoyarn Scaffold for Tissue Engineering (Invited)

X. Mo*, Donghua University, China

2:00 PM

(ICE-069-2014) Microskin-seeded Electrospun Nanofiber Scaffolds for Skin Regeneration (Invited)

J. Xie*, J. Jiang, M. A. Carlson, University of Nebraska Medical Center, USA

2:30 PM

(ICE-071-2014) PCLCol/PVAHA coaxial nanofiber coating on titanium implant osseointegration

W. Ren*, Wayne State University, USA; D. Markel, Providence Hospital, USA

2:50 PM

(ICE-072-2014) Co-culture of neuron stem cells (NSCs) and astrocyte on poly-l-lactic acid microtube array membranes (MTAMs)

C. Tseng*, J. Ciou, Biomedical Materials and Tissue Engineering, Taiwan; K. Chen, Tatung University, Taiwan; Y. Wang, Taipei Medical University, Taiwan; S. Chou, C. Chen, Biomedical Materials and Tissue Engineering, Taiwan

3:10 PM

(ICE-073-2014) Blending Highly-ionized Synthetic Polypeptides with Elastin-like Polypeptides leads to Novel Fiber Formation by Electrospinning

D. T. Haynie, D. Khadka*, USF, USA

3:30 PM

Break

3:50 PM

(ICE-074-2014) Electrospinning of silk fibroin/poly(N-vinylcaprolactam) to form hybrid nanofibres

N. Roy Choudhury*, J. Whittaker, N. Dutta, Ian Wark Research Institute, Australia

4:10 PM

(ICE-076-2014) Electrospun 5-fluorouracil loaded bovine serum albumin-polyvinylpyrrolidone nanofibers for anti- cancer therapeutics

U. E. Illangakoon*, UCL, United Kingdom; A. Haidery, J. Inal, N. Chatterton, London Metropolitan University, United Kingdom; G. Williams, UCL, United Kingdom

4:30 PM

(ICE-078-2014) Role of Gellan-Based Electrospun Nanofibers in Wound Healing

P. Vashisth*, H. Singh, P. A. Pruthi, R. P. Singh, V. Pruthi, IIT Roorkee, India

4:50 PM

(ICE-079-2014) Hybrid electrospun scaffold for muscle bioengineering

O. Evrova*, ETH Zurich, Switzerland; R. Tauscher, University Hospital Zürich, Switzerland; G. Palazzolo, ETH Zurich, Switzerland; V. Milleret, University Hospital Zürich, Switzerland; M. Zenobi-Wong, ETH Zurich, Switzerland; T. Sulser, J. Buschmann, D. Eberli, University Hospital Zürich, Switzerland

Energy Storage and Harvesting with Electrospun or Sprayed Materials II

Room: Metropolitan II

Session Chairs: John Rabolt, University of Delaware; Alexander Yarin, University of Illinois at Chicago

1:30 PM

(ICE-080-2014) Electrospun Fibers for Functional and Electroactive Applications (Invited)

A. Baji*, Singapore University of Technology and Design, Singapore; Y. Mai, University of Sydney, Australia; S. Ramakrishna, National University of Singapore, Singapore; V. Ganesh, Singapore University of Technology and Design, Singapore

2:00 PM

(ICE-081-2014) Hierarchical Biopolymer Functional Hybrids (Invited)

Y. Hsieh*, University of California, Davis, USA

2:30 PM

(ICE-082-2014) High pressure sensitivity in piezoelectric devices based on nanofibers

L. Persano*, National Research Council-CNR, Italy; C. Dagdeviren, Frederick Seitz Materials Research Laboratory, and Beckman Institute for Advanced Science, University of Illinois, USA; Y. Su, Y. Zhang, Northwestern University, USA; S. Girardo, National Research Council-CNR, Italy; D. Pisignano, Università del Salento, Italy; Y. Huang, Northwestern University, USA; J. Rogers, Frederick Seitz Materials Research Laboratory, and Beckman Institute for Advanced Science, University of Illinois, USA

2:50 PM

(ICE-084-2014) The electrochemical performance of supercapacitor with the parameters of pore structure and electrical conductivity

C. Kim, Chonnam National University, Republic of Korea; B. Kim, Deagu University, Republic of Korea; K. Yang*, Chonnam National University, Republic of Korea

3:10 PM

(ICE-085-2014) Electrospun carbon fibers as promising electrodes for enzymatic biofuel cells

A. Both Engel, A. Cherifi, M. Bechelany, S. Tingry, D. Cornu*, ENSCM, France

3:30 PM

Break

3:50 PM

(ICE-086-2014) Electrospinning of Non-Polymeric Systems: Green and Polymer-free Electrospun Nanofibers from Cyclodextrins and Cyclodextrin Inclusion Complexes

T. Uyar*, A. Celebioglu, F. Kayaci, Bilkent University, Turkey

4:10 PM

(ICE-087-2014) Electrospun Carbon Nanofibers from Kraft Lignin for EMI shielding Application

Y. Li*, F. Ko, University of British Columbia, Canada

4:30 PM

(ICE-088-2014) Direct deposit of polyvinyl alcohol/silicon/ graphene nanoribbon nanofiber for a facile production of high capacity lithium-ion battery anodes

Y. Kim, G. Shoorideh, Cornell Univ, USA; Z. Li, B. Patel, S. Chakrapani, S. Lee, AZ Electronic Materials Corp, USA; Y. L. Joo*, Cornell Univ, USA

4:50 PM

(ICE-090-2014) Free-standing film electrode composed of nanostructured TiO2/C nanofibers for lithium ion batteries

Y. Sha*, B. Zhao, Z. Shao, Nanjing Tech University, China

5:10 PM

(ICE-083-2014) Fabrication and energy harvesting property of 1-D lead-free KNN nano materials

Y. Zhuang*, F. Li, Xi'an Jiaotong University, China; S. Zhang, Materials Research Institute, Pennsylvania State University, USA; X. Zhuo, Xi'an Jiaotong University, China

Filtration, Textiles and Other Topics II

Room: Metropolitan I

Session Chairs: Tong Lin, Deakin University; David Nielsen, Defence Science and Technology Organisation

1:30 PM

(ICE-091-2014) Separation of Oil-in-Water Emulsion Using Electrospun Mats

L. Choong*, Y. Lin, G. Rutledge, MIT, USA

1:50 PM

(ICE-094-2014) Efficient Nanofibrous Adsorbents for Removal of Toxic and Heavy Metal Ions from Water

M. Faccini*, D. Amantia, D. Morillo, M. Sánchez, L. Aubouy, Leitat Technological Center, Spain

2:10 PM

(ICE-095-2014) Turning Nanofibre into Products

I. Hosie*, S. Feasey, Revolution Fibres Ltd, New Zealand

2:30 PM

(ICE-097-2014) Piezoelectric behaviour of Poly(vinylidene fluoride) electrospun mat

J. Belcari, A. Celli, D. Fabiani, M. Focarete, University of Bologna, Italy; M. Gazzano, ISOF - CNR, Italy; C. Gualandi, G. Pasini, L. Sisti, M. Zaccaria, A. Zucchelli*, University of Bologna, Italy

2:50 PM

(ICE-098-2014) Spraybase®: Customizing electrospinning technology

G. Hendy*, S. Finnegan, M. Maguire, Profector Life Sciences, Ireland

3:10 PM

(ICE-099-2014) Nanovascularization of polymer matrix: generation of nanochannels and nanotubes by sacrificial electrospun fibres

C. Gualandi*, J. Belcari, M. Focarete, A. Zucchelli, University of Bologna, Italy

3:30 PM

Break

3:50 PM

(ICE-101-2014) Electrospun Chitosan Nanomembrane as a Novel Sorbent for Sequestration of Toxic Metal Ions

N. Horzum*, Izmir Katip Celebi University, Turkey; A. Eroglu, Izmir Institute of Technology, Turkey; T. Shahwan, Birzeit University, Palestine, State of; M. Demir, Izmir Institute of Technology, Turkey

4:10 PM

(ICE-102-2014) Fabrication of porous carbon nanofibers by carbonization of electrospun poly(vinyl alcohol) nanofibers

S. Nagamine*, T. Matsumoto, M. Ohshima, Kyoto University, Japan

4:30 PM

(ICE-092-2014) Superhydrophobic Nonwovens for Medical Textile Applications

M. Dasdemir*, H. Ibili, University of Gaziantep, Turkey

4:50 PM

(ICE-093-2014) Electrospun Polysulfone (PS) Microtube Array Membranes (MTAMs) as Advanced Blood Filtration Substrates

C. Chen*, Taipei Medical University, Taiwan; Z. Chu, National Taipei University of Technology, Taiwan; C. Tseng, Taipei Medical University, Taiwan; M. Wu, Taipei Medical University Hospital, Taiwan; C. Chen, Taipei Medical University, Taiwan

Thursday, August 7, 2014

Plenary Session III

Room: Metropolitan III

9:00 AM

Introduction: Wolfgang Sigmund

9:05 AM

(ICE-103-2014) Advances in Functional Metal Oxide Nanofibers

I. Kim*, Korea Advanced Institute of Science and Technology, Republic of Korea

9:45 AM

Break

Biomedical Applications of Electrospun Materials III

Room: Metropolitan III

Session Chairs: Florian Formica, ETH Zürich; Ricardo Vera-Graziano, Universidad Nacional Autonoma de Mexico (National University of Mexico)

10:00 AM

(ICE-105-2014) Electrospun Polycaprolactone-nano hydroxyapatite composite fibers for Bone defect applications

P. Harikrishnan*, A. Sivasamy, CSIR-Central Leather Research Institute, India; A. Raheja, Indian Institute of Technology Madras, India; H. Islam, Pondicherry Center for Biological sciences, India; S. Natarajan, Indian Institute of Technology Madras, India

10:20 AM

(ICE-108-2014) The preparation and electrospinning of double layer vascular scaffold with core-shell fibers and its in vitro and in vivo evaluation

L. Ye*, X. Geng, Z. Feng, Beijing Institute of Technology, China

10:40 AM

(ICE-107-2014) Modulating Growth Factor Release through Negative Voltage Electrospinning for Emulsion Electrospun Scaffolds

Q. Zhao*, M. Wang, The University of Hong Kong, Hong Kong

11:00 AM

(ICE-104-2014) Fabrication and Characterization of β-TCP/ (PVA-PCL) Bilayer Nanocomposites –A Bone Tissue Regeneration Scaffold

U. Subramanian, S. Vasanth Kumar*, Karunya University, India

11:20 AM

(ICE-106-2014) Cell electrospinning

S. Jayasinghe*, University College London, United Kingdom

Advances in Electrospinning Theory and Modeling

Room: Metropolitan II

Session Chairs: Cagri Tekemen, Elmarco s.r.o.; Jan Lagerwall, University of Luxembourg

10:00 AM

(ICE-110-2014) Three-Dimensional Imaging and Reconstruction of Electrospun Fiber Materials (Invited)

G. Rutledge*, L. Choong, Massachusetts Institute of Technology, USA; P. Yi, Johns Hopkins University, USA

10:30 AM

(ICE-111-2014) Stability analysis of an axi-symmetric liquid jet in the presence of an externally coflowing liquid

V. Gundabala*, V. K. Modi, Indian Institute of Technology Bombay, India

10:50 AM

(ICE-113-2014) 3D modeling of melt electrospinning process

J. Ko*, M. Jun, University of Victoria, Canada

11:10 AM

(ICE-114-2014) Comparison of Current Massive Electrospinning Technology in terms of Field Intensity, Cost and Productivity

Y. Liu*, W. Chen, Tianjin Polytechnic University, China; Z. Zhang, 359th Factory of 6th Inner Mongolia Aerospace Science and Industry Corporation, China; L. Guo, D. Qi, J. Yao, Tianjin Polytechnic University, China

11:30 AM

(ICE-115-2014) Impact of chain entanglement on solution electrospinning

Y. Wang, C. Wang*, National Cheng Kung University, Taiwan

11:50 AM

(ICE-112-2014) Designing a New Nozzle System for Co-axial Electrospinning through Numerical Simulations

S. Jeon*, Seoul National University, Republic of Korea; B. Lee, Samsung Advanced Institute of Technology (SAIT), Republic of Korea; H. Park, W. Yu, Seoul National University, Republic of Korea

Ceramic Composites and Energy III

Room: Metropolitan I

Session Chairs: Simon King, University of Surrey; Hao Fong, South Dakota School of Mines and Technology

10:00 AM

(ICE-116-2014) Macroscale Alignment of Gold Nanorods in Electrospun Polymer Fibers and Polarization-Controlled Photothermal Heating (Invited)

J. B. Tracy*, North Carolina State University, USA

10:30 AM

(ICE-117-2014) One-Dimensional Au/TiO2 Composite Nanofibers Synthesis by Electrospinning and Applications

X. YANG*, V. Salles, M. Maillard, A. Brioude, University of Claude Bernard Lyon 1, France

10:50 AM

(ICE-119-2014) On the enhancement of light harvesting with hierarchical structures using electrosprayed photoactive materials

K. K. Khanum*, P. C. Ramamurthy, Indian Institute of Science, India

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BioInicia
Innovative Polymer Applications

Tuesday, August 5, 2014

Opening Remarks and Plenary Session I

Room: Metropolitan III

9:00 AM

(ICE-001-2014) Electrically-Assisted Subsonic and Supersonic Solution Blowing of Monolithic and Core-Shell Petroleum-Derived and Bio-Polymer Nanofibers: Experiments and Modeling

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

The recently developed method of the electrically-assisted solution blowing holds great promise of high production rate of monolithic and core-shell nanofibers from different polymers including those which cannot be electrospun. Moreover, this method allows formation on demand of nanofibers in the range 20-50 nm which cannot be normally reached in electrospinning. The present talk discusses the following aspects of the electrically-assisted solution blowing: (i) Formation of monolithic and core-shell nanofibers from petroleum-derived polymers using subsonic blowing. (ii) Formation of monolithic and core-shell nanofibers from different biodegradable biopolymers and material characterization of their mats. (iii) The electrically-assisted solution blowing from multiple nozzles. (iv) Supersonic blowing of the 20-50 nm nanofibers and discovery of a novel χ-phase of nylon 6 characterized by the decrease of CH2 stretching, a shift of –NH stretching, a different type of hydrogen bonds and a ten-fold increase in Young's modulus compared to the that of the post-processed macroscopic nylon 6 fibers. (v) Modeling of solution blowing.

Novel Developments in Electrospinning and Other Nanofiber Fabrication Technologies I

Room: Metropolitan III

Session Chairs: Wolfgang Sigmund, University of Florida; Il-Doo Kim, Korea Advanced Institute of Science and Technology

10:00 AM

(ICE-002-2014) Multifunctional polymer particles and fibers by electrohydrodynamic co-jetting (Invited)

J. Lahann*, University of Michigan, USA

Nano- and microparticles have been utilized in a variety of research areas, such as diagnostics, drug delivery or regenerative medicine. Electrospraying of polymer solutions is a straightforward method to fabricate particles as well as fibers by applying high electrical voltage to polymeric solutions. Building on these processes, electrohydrodynamic (EHD) co-jetting involves two or more capillary needles in a side-by-side configuration that allow different polymer solutions to be processed in parallel. Under the laminar flow regimen encountered in these systems, biphasic droplets are formed at the outlet point of the adjacent needles. Application of an electric field to the nozzle leads to a stable Talyor cone at the tip of the biphasic droplet. Rapid acceleration favors atomization of the charged jets and significantly increases the surface area. Initial work has been focused on water-soluble polymers because environmentally friendly water-based jetting systems typically exhibit lower toxicity, which are important for biomedical applications. More recently, EHD co-jetting of organic-soluble polymers have been used to fabricate anisotropic microstructures. In particular, the EHD co-jetting of organic solution of poly(lactic-co-glycolic acid) (PLGA) has been successfully used to prepare biodegradable bicompartmental particles and fibers.

10:30 AM

(ICE-003-2014) Scaling up nanofiber production (Invited)

E. Smit*, The Stellenbosch Nanofiber Company, South Africa

Electrospinning of nanofibers has grown to become one of the hot topics in materials science research in the past 15-20 years. This stems from the numerous demonstrated applications of nanofibers with significant value addition in Filtration, Energy, Electronics, and Biomedical. While we have seen definite increases in electrospinning production rates in recent years, most commercially available equipment still only yield fiber quantities in the order of tens of grams per hour. This significantly limits the commercial value that can be achieved in any of these high growth markets. This talk will focus on the many challenges associated with scaling up electrospinning and highlight some of the surprising values of everyday variables that arise when you set out to convert materials into nanofibers. Furthermore, a closer look will be taken at successful scaling up of the electrospinning process to kilograms per hour production rates using Ball ElectroSpinning Technology - SNC BEST(TM).

11:00 AM

(ICE-004-2014) Feasibility of using deflector plates for achieving fiber alignment

J. Walser*, S. J. Ferguson, ETH Zurich, Switzerland; M. D. Caversaccio, University of Bern, Inselspital, Switzerland

The aim of this study was to evaluate the use of deflector plates, to apply an alternating electrical field perpendicular to the spinning direction, in order to achieve fiber alignment. 110 poly(ε)caprolactone membranes were electrospun using additional deflector plates perpendicular to the spinning direction. Different field signal types, deflector plate voltages and frequencies have been investigated. Samples were taken from different regions of each membrane. SEM images were analyzed using ImageJ. Variance was calculated from the fiber orientation histogram data as a measure of fiber alignment. A Levene's test was conducted, to test for a statistically significant differences. Tensile tests were conducted on stripes cut in line with as well as perpendicular to the jet deflection axis. A higher deflector voltage amplitude resulted in a better fiber alignment. The best alignment was observed in the low frequency range (<5Hz). The fibers did not align parallel to the deflection axis but consistently perpendicular to it. Also samples cut perpendicular to the deflection axis displayed a higher Young's modulus and yield strength than parallel cut stripes. Fiber diameter was independent from the degree of fiber alignment. The feasibility of using deflector plates to achieve fiber alignment could be demonstrated. Low frequency deflection seems to give the natural whiplashing effect of the jet a preferred direction.

11:20 AM

(ICE-005-2014) Free Surface Electrospun Polyvinylidene Fluoride Membranes for Direct Contact Membrane Distillation

K. M. Forward*, E. Estrada, R. Oh, S. West, B. Hensley, California State Polytechnic University, Pomona, USA

Direct Contact Membrane Distillation (DCMD) is a desalination process similar to traditional distillation and reverse osmosis. In DCMD, a porous hydrophobic membrane is used to separate nonvolatile components such as salt, and other impurities from a feed stream. However, the DCMD process employs a temperature gradient instead of a pressure gradient to drive the separations of chemical species. Here, free surface electrospinning is considered to produce membranes in large quantities while maintaining high porosity and controllability over pore size for applications in DCDM. The membrane morphology and properties were characterized by scanning electron microscopy, Capillary flow porometry, and contact angle measurements. It was observed as the applied voltage is increased, the fiber diameter of the membrane decreases. In order to investigate the mechanisms responsible for the productivity of the process, various temperature gradients and flow rates were studied. It was determined that an increase in temperature gradient leads to

an increase in productivity. The current theoretical model (dusty gas model) is considered to explain the relationship between productivity, and the membrane properties and operating conditions.

11:40 AM

(ICE-006-2014) Nanospider™ – A unique way to produce nanofibers

C. Tekemen*, Elmarco s.r.o., Czech Republic

Cagri Tekmen, Fred Lybrand Elmarco Today, the innovative development in electrospinning technology enables nanofibers to be produced at industrial scale. This development translated into significant competitive, environmental and economic benefits to manufacturers in several industries. The superior properties of nanofibers such as high specific surface area, inter-connected pore structure, surface functionality and high porosity create a new value for traditional textile and fabrics, and have been integrated into a wide range of commercial applications including various segments of air filtration, liquid filtration, wound dressing, tissue scaffolds, waterproof and breathable membranes. Elmarco's "needle–free" Nanospider™ technology is well recognized by industry leaders for providing excellent web and fiber uniformity, high productivity, and ability to consistently meet key performance characteristics. This presentation introduces the recent developments in Nanospider™ technology and a new approach in air filter media design.

Polymer Nanofibers I

Room: Metropolitan II

Session Chairs: Dario Pisignano, Università del Salento; Kyung Paik, KAIST

10:00 AM

(ICE-007-2014) Cross-linked electrospun polyvinyl alcohol membranes and their potential applications (Invited)

Y. B. Truong*, S. Maisch, Y. Gao, C. P. Huynh, J. Mardel, M. Musameh, M. Hickey, I. L. Kyratzis, CSIRO, Australia

Polyvinyl alcohol (PVA) is a water soluble polymer that has been extensively studied in electrospinning. PVA electrospun fibrous membranes with well-controlled uniform nano-sized fibre diameter have been tested for a range of applications. However, its disadvantage is that it is soluble in water and requires some form of cross-linking chemistry to make it stable. Electrospun PVA has been cross-linked by using different cross-linking additives and performing post treatment chemistries to attain stability in water. Although some of the published work on post treatment such as vapour exposure and soaking in a non-solvent has been shown to be successful in producing water stable PVA membranes, it is foreseeable that there will be difficulties and obstacles in scaling up by using large quantities of glutaraldehyde vapour and solvents. A different way of cross-linking PVA is by incorporating polycarboxylic acid agents under acidic conditions and then heat treat the sample post electrospinning to achieve cross-linking via esterification reactions. In this study, with a view of imminent scale up production required, we investigated fabricating electrospun cross-linked PVA without using vapour exposure or solvents. The use of maleic acid, maleic anhydride and poly acrylic acid to produce cross linked electrospun PVA were examined and some of their potential applications will be discussed.

10:30 AM

(ICE-008-2014) Internal nanostructure of electrospun polymer nanofibers (Invited)

A. Camposeo*, National Nanotechnology Laboratory of CNR-NANO, Italy; I. Greenfeld, Technion - Israel Institute of Technology, Israel; F. Tantussi, Università di Pisa and INO-CNR Sezione di Pisa, Italy; M. Moffa, National Nanotechnology Laboratory of CNR-NANO, Italy; F. Fuso, M. Allegrini, Università di Pisa and INO-CNR Sezione di Pisa, Italy; E. Zussman, Technion - Israel Institute of Technology, Israel; D. Pisignano, Università del Salento, Italy

Electrospun nanofibers are currently exploited in different technological applications. The interest toward these nanomaterials mainly arises from their unique mechanical, electrical and optical properties, which are typically enhanced compared to the bulk counterpart, due to the particular assembly of the polymer macromolecules under the strong stretching conditions typical of electrospinning. Nevertheless, little is known about the micro- and nanoscale arrangement of polymer macromolecules, and ultimately, about the possibility to tailor and control nanofibers properties. Here we report on a detailed experimental analysis of the internal structure of electrospun nanofibers. Scanning probe microscopies are exploited to investigate the local density and mechanical properties variations with nm resolution. A dense and stiff core surrounded by a soft and less dense shell is unveiled. Moreover, scanning near-field microscopy allows for mapping of the nanoscale orientation of molecules. The results are correlated to the processing parameters by modeling the conformational evolution of chains during electrospinning. In perspective, our results open new routes to tailor electrospun fiber properties. The research leading to these results has received funding from the European Research Council under the European Union's 7th Framework Programme (FP/2007-2013)/ERC Grant Agreement n. 306357 (ERC Starting Grant NANO-JETS).

11:00 AM

(ICE-009-2014) Spontaneous Formation of Metal-Polymer Hybrid Nanostructures Using Functionalized Electrospun Polymer Nanofibers

H. Son, J. Ryu, H. Lee, Y. Nam*, KAIST, Republic of Korea

We introduce a facile templating method to synthesize highly porous noble metal-polymer hybrid nanostructures using catechol-grafted polymer nanofibers as a bio-inspired reactive template. A new redox-active polymer, catechol-grafted poly(vinyl alcohol) (PVA-g-ct), is synthesized and electrospun into reactive functional nanofibers by electrospinning. The grafted catechol is inspired by mussel adhesive proteins, which mediate binding and reduction of noble metal ions on the nanofiber templates. Highly open porous silver nanostructures are spontaneously generated by simply immersing a PVA-g-ct nanofiber mat into an aqueous solution of silver ion precursors under ambient conditions due to the reducing capability of the grafted catechols. Gold and platinum ions are partially reduced and complexed with the catechol-functionalized nanofiber templates, requiring an additional thermal treatment for their complete reduction into solid metal nanostructures. In addition, silver-gold and silver-platinum hybrid nanostructures are generated using the pre-synthesized silver nanoparticles on the PVA-g-ct nanofibers by sequential treatments with metal ion precursors. The bio-inspired metal-polymer hybrid nanofibers can be used as a functional nanomaterial for biosensors, catalytic systems, electronic devices, etc.

11:20 AM

(ICE-011-2014) Controlling the Crystallinity and Morphology of Electrospun PCL Fibres

T. Cirstea*, P. Dobson, A. Watt, University of Oxford, United Kingdom

The relation between the morphology of electrospun fibres, their crystallinity and their mechanical properties has been the focus of recent research. This study reports that the crystallinity can be

independent of the fibre diameter. An examination of the crystallinity measured by DSC and XRD revealed contradicting results. Polycaprolactone (PCL) fibres were electrospun from PCL/Hexafluoro-2-propanol (HFIP) solutions with varying polymer concentrations from 3 wt% to 7 wt%. The fibre diameter as determined by SEM increased with polymer concentration. The crystallinity was found to decrease for concentrations of 3 wt% to 7 wt% as measured by XRD, whereas the DSC measurements showed an increase in crystallinity. Tensile testing of the fibres showed superior mechanical properties at smaller diameters. Another experimental series was conducted where fibres were additionally stretched through different processing parameters. These fibres exhibited a significant increase in crystallinity measured by XRD and a substantial reduction as measured by DSC while the ultimate tensile strength increased by ~100%. From these findings it can be concluded that the crystallinity and fibre diameter can be controlled independently via the processing parameters with great effect on the mechanical properties. Further the values for the crystallinity vary between XRD and DSC results and a possible reason for this will be given.

Ceramic and Composite Nanofibers I

Room: Metropolitan I
Session Chairs: Joseph Tracy, North Carolina State University; Younan Xia, Georgia Institute of Technology

10:00 AM

(ICE-012-2014) Electrospinning Activities at the Australian National University (Invited)

A. Lowe*, Australian National University, Australia

The Electroceramics Research Group at the Australian National University have been using the electrospinning technique for ten years to fabricate many polymer and ceramic systems and here, we showcase key findings relating to functional ceramic nanomaterials. Thermoelectric studies on doped p-type cobaltite electrospun fibres will be presented that show the effect of dopant amount, valency and crystal structure on thermopower and conductivity over a wide temperature range and on how properties vary due to the hygroscopic nature of the material. Preliminary thermoelectric work performed on n-type vanadia and calcium manganate electrospun materials will be presented, with emphasis on how sample preparation is critical to performance and device design. The presentation will then introduce work on energy storage materials, with particular relevance to vanadia and manganese oxide materials, including doping and carbon alloying strategies. The advantages of using electrospinning techniques to deliberately produce non-fibrous structures will be discussed in relation to porous hollow vanadia spheres and perovskite nanomaterial thin layers. Structural analysis of zirconia electrospun fibres will be introduced to show how calcination temperature can affect tetragonal vs. monoclinic phase formation. The presentation will conclude with the development of molybdenum disulphide electrospun fibres for nanosensing applications.

10:30 AM

(ICE-013-2014) Electrospinning: A route to synthesize ceramic nanocomposites on a single fiber or particle (Invited)

J. S. Andrew*, J. D. Starr, M. A. Budi, University of Florida, USA

In many single-phase materials certain properties are mutually exclusive. Examples of this property dichotomy include strength and toughness, high electric permittivity and high magnetic permeability, and soft and hard magnetic properties. Nanostructured composite materials have the potential to overcome some of these limitation of single-phase materials. From these new materials a number of novel applications ranging from electronics to biomedical devices can be developed and realized. For example, magnetic and ferroelectric materials can be combined on a single particle or fiber, yielding new nanostructured multiferroic composites with enhanced properties, opening up new applications. By fabricating composites on a single particle or fiber in an anisotropic manner (e.g. Janus-type) the surface and bulk properties of each phase remain accessible, providing additional degrees of freedom in composite design.

11:00 AM

(ICE-014-2014) Electrospun PZT Nanofibers: Morphology Control and Rapid Thermal Processing (RTP)

A. Gevorkyan, G. E. Shter, G. S. Grader*, Technion, Israel

The research was focused on two main goals: morphology control of the electrospun PZT nanofibers and optimal thermal treatment. The morphology control was studied by the interplay between the tip to collector distance (TCD), applied potential, precursor viscosity and diameter distribution. Adjustment of the sol viscosity was shown to be the most useful way to the fiber diameter control. At high viscosity a transition from a single to a bimodal distribution was observed in electric field above 0.8kV/cm. At low viscosity a sharp transition from a large to a small diameter regime at the same electric field was occurred. The control of branching effect to yield either single or bimodal diameter distribution in a range of 100-800 nm was demonstrated. Thermal behavior of PZT nanofibers was studied by TGA/DTA/DTG/MS analyses. Based on these data prefiring at 350°C,0.5hr was found to be an obligatory part of the processing. The sintering was executed in two ways: long at 650°C,2hr and RTP at 500-800°C,30sec. Similar to long procedure, RTP above 750°C provided perovskite ceramic fibers along with considerable decrease of initial PbO excess. Finally, the sensing ability of the PZT nanofiber mats was tested under cyclic mechanical loading. In conclusion, the combination of morphology control, prefiring and RTP might be used as an efficient and environmentally friendly processing of PZT ceramic nanofibers.

11:20 AM

(ICE-015-2014) Elaboration of AlN nanofilaments by electrospinning

T. Gerges*, V. Salles, Laboratoire des multimateriaux et interfaces (UMR 5615 Université Lyon 1-CNRS), France; S. Bernard, Institut Européen des Membranes (UMR 5635-CNRS/ENSCM-UM2), France; A. Brioude, G. Ferro, Laboratoire des multimateriaux et interfaces (UMR 5615 Université Lyon 1-CNRS), France

One-dimensional (1D) nanostructures have recently attracted significant attention due to their unique properties. They are used as submicronic fillers to adjust the material properties of organic or inorganic matrix and allow the fabrication of microscale composites. Aluminum nitride (AlN) is an original material that presents piezoelectric properties making it interesting in such applications. We would like to introduce an original method to elaborate AlN nanofilaments performing shaping by electrospinning. We used a non oxide elaboration approach. It involves implementing the Polymer-Derived Ceramics (PDCs) technique. Initially, an oxygen-free Al precursor was synthesized and associated to an organic spinnable polymer in order to obtain electrospun filaments. We used the co-extrusion and simple extrusion techniques, and compared the results obtained from each method. The ceramization step was performed in a furnace at 1000°C under ammonia. The elaborated AlN filaments had a diameter of 150-200 nm. The crystallization rate increased progressively when heating beyond 1000°C. Precise analyses by electronic microscopy showed the structure quality and the filaments high purity. In conclusion, this work introduces a reproducible and optimized new method to elaborate homogeneous and long AlN nanofilaments with high quality and low oxygen content.

11:40 AM

(ICE-016-2014) Fabrication of ceramic porous LiCoOx nanofibrous mesh

Y. Aykut*, Uludag University, Turkey; S. Khan, B. Pourdeyhimi, North Carolina State University, USA

Producing materials in the form of nanofibers enhance the device performance because specific surface area of the materials tremendously increases that provide more interaction on the surface of nanofibers in the device. For instance, using nanostructured anadode and cathode in lithium ion batteries enhances the device performance since more surface is get involved in the charge-discharge process. In this regards, ceramic porous nanofibrous LiCoOx nanofibrous meshes have been fabricated via sol-gel electrospinning technique by using proper rates of lithium acetate/ cobalt acetate/ polyvinylalcohol (LiAc/CoAc/PVA) as precursor materials. As-spun precursor materials calcined in air atmosphere at 600oC to remove organic components and convert the cermic precursor into ceramic nanofibers. Finally, well crystallized LiCoOx nanofibrous mesh structures are obtained after the calcinations processes can be potentially used as cathode materials in li-ion batteries.

Novel Developments in Electrospinning and Other Nanofiber Fabrication Technologies II

Room: Metropolitan III

Session Chairs: Joerg Lahann, University of Michigan; Eugene Smit, The Stellenbosch Nanofiber Company

1:30 PM

(ICE-017-2014) Dramatic difference in morphology and core content of electrospun core-sheath fibers deposited on hydrophobic and hydrophilic substrates

D. Kim, Seoul National University, Republic of Korea; J. P. Lagerwall*, University of Luxembourg, Luxembourg

Composite electrospun fibers are attractive for cost-effective production of multifunctional materials, but their high-performance application requires nanoscale control of internal structure and morphology. Here we use Focused Ion Beam (FIB) lift-out to image core-sheath fibers with HR-TEM and analyse them chemically with nanoscale resolution using energy dispersive x-ray spectroscopy (EDS), exposing the fiber cross section with unprecedented detail. Unexpectedly, core material escapes during spinning and ends up coating the fiber exterior and target substrate. A dramatic difference in fiber morphology may be found depending on whether the substrate is hydrophobic or hydrophilic. The latter enhances post-spinning extraction of core fluid, yielding reduced filling fraction and a collapsed morphology. We can explain these differences by considering the fate of the water that condenses during spinning, after fibers have been deposited on the substrate. Moreover, in-situ produced TiO_2 nanoparticles appear strikingly different when the core fluid is present compared to when the sheath solution is spun on its own. In the latter case the TiO_2 concentration increases strongly toward the fiber center, contrary to expectation based on recent reports of enhanced polymer concentration at the center of electrospun fibers.

1:50 PM

(ICE-018-2014) A process monitoring system for a multi-jet electrospinning head

L. Bonura*, A. Cacace, G. Bianchi, A. Varesano, National Research Council of Italy, Italy

A monitoring system for a multi-jet electrospinning apparatus is presented. In a multi-jet plant, a single voltage generator supplies several electrodes: in order to monitor the processes occurring in different sections of the electro-spinning head, each needle is connected to the high voltage electrode via a separate sensing resistor. The high voltage section is isolated from ground by a data link realized via an optical fiber, while a 24V battery is used to supply the system. Data are acquired by an industrial PC with a Real-Time operating system. Experimental tests have been performed acquiring the current signals and comparing them with the video recorded by a camera equipped with a macro lens. Alternative monitoring strategies are described and compared. The monitoring system developed is able to provide data on the status of the system.

2:10 PM

(ICE-019-2014) Electrostatic template effect during alternative electrospinning and electrospraying on micropatterned collectors: Towards nanofibrous and microstructured 2D and 3D composites

G. Schlatter*, S. Nedjari, C. Wittmer, B. El Maghnouji, A. Hébraud, University of Strasbourg / CNRS, France

The present study demonstrates that by using synergistically the processes of electrospinning and electrospraying, it is possible to build well controlled 2D and even 3D microstructured composites. For this purpose, conductive patterned collectors with structures of 60 μm height and characteristic lateral sizes of several tens of μm were fabricated. Then, electrospun fibers and electrosprayed particles were alternatively deposited on these collectors. Experiments and numerical simulations show the important role of the first layer of fibers. Indeed, fiber portions suspended between neighboring patterns cannot release efficiently their electric charges forming thus a regular template of repulsive regions whereas areas where the fibers are in contact with the collector stay attractive. When electrospraying over this layer of fibers, it is observed a highly selective deposition of the particles on the attractive areas: a microstructured 2D composite is formed. After several steps of electrospinning and electrospraying, a thick 3D microstructured multilayered composite of fibers and particles could be obtained. As a conclusion, we will show that these 2D and 3D microstructured materials can find applications in different fields such as biochips, scaffolds with controlled porosity or even sensors.

2:30 PM

(ICE-022-2014) Plasma-assisted electrospinning: the many facets of a process

L. Calzà, Alma Mater Studiorum- Università di Bologna, Italy, Alma Mater Studiorum- Università di Bologna, ItalyInterdepartmental Center for Industrial Research, Italy; V. Colombo, Alma Mater Studiorum- Università di Bologna, Italy; L. Dolci, Interdepartmental Center for Industrial Research, Italy; A. Fiorani, D. Fabiani, M. Focarete, Alma Mater Studiorum - Università di Bologna, Italy; M. Gherardi, C. Gualandi, R. Laurita*, A. Liguori, Alma Mater Studiorum- Università di Bologna, Italy; S. Quiroga, Alma Mater Studiorum - Università di Bologna, Italy; P. Sanibondi, Alma Mater Studiorum- Università di Bologna, Italy; M. Zaccaria, Alma Mater Studiorum - Università di Bologna, Italy

In this work, various overlaps between plasma technology and electrospinning process and products are presented. Plasma pre-treatment of polymeric solutions as well as post-treatment of electrospun scaffolds are investigated. Two different polymers are used: Poly-L-lactic acid (PLLA) and Poly(ethylene oxide) (PEO). PLLA electrospun mats are conventionally used for tissue engineering, while PEO mats as nanofibrous separators in lithium-ion batteries. Plasma pre-treatment is used to improve electrospinnability of PLLA in a 100% dichloromethane (DCM) solution avoiding the use of dimethylformamide (DMF) solvent, which may eventually be found in traces in the products but which is conventionally added to increase solution conductivity. SEM images shows that 2 min of plasma treatment of 12 ml of polymeric solution allows the production of good quality nanofibers without defects, while untreated solution cannot be electrospun. Plasma post-treatment is focused on the improvement of electrospun PLLA scaffolds biocompatibility. Finally, results of plasma assisted nanoparticles dispersion in PEO solution is presented: a 3 min plasma treatment of PEO solution followed by 10 min of stirring allows the production

of fibers containing well dispersed fumed silica nanoparticles, in contrast with non plasma treated solutions which resulted in fibers containing agglomerates.

2:50 PM

(ICE-025-2014) Electrospinning as a Polymer Blending Technique to Fabricate Adhesives

S. Wong*, X. Ma, G. Ji, T. A. Blackledge, University of Akron, USA

This paper creates new frontiers for advancing adhesion science using electrospun polymer blends. A highly spinnable polymer was successfully blended with an adhesive polymer by the electrospinning process. Electrospinning appears to be a viable approach to forming nano-connectors between polymer-polymer and polymer-metal interfaces. The adhesion strength between polymer-polymer interfaces is stronger than that between polymer-metal interfaces. The formation of multicomponent polymer blends by electrospinning contributes to a marked increase in adhesion strength but yet continuous and/or co-continuous morphology. The electrospun polymer blend was found to produce superior adhesion properties as compared to their constituents.

3:10 PM

(ICE-026-2014) Lysozyme encapsulation in porous fibers of poly(-lactic acid)-alginate through coaxial electrospinning

A. Raheja*, Indian Institute of Technology Madras, India; A. Smith, University of Guelph, Canada; C. T. Sainathan, N. T. Srinivasan, Indian Institute of Technology Madras, India; L. Lim, University of Guelph, Canada

Porous core-shell nano-fibers for lysozyme encapsulation were produced using poly (-lactic acid) (PLA) as sheath and sodium alginate as the core material for coaxial electro-spinning (CES). Working conditions for electrospinning of PLA sheath were determined by studying the effect of process parameters viz., spinneret-to-collector distance, solution flow rate, chamber temperature, and humidity. Moreover, the effects of solution parameters viz., polymer concentration and solvent conductivity, were also evaluated. Lysozyme, being a model enzyme, was dispersed in aqueous alginate solution (pH 7), to be used as the core material for CES. The fiber morphology was characterized through fluorescence, scanning and transmission electron microscopy while its chemical composition was studied through infrared spectroscopy and differential scanning calorimetry. The results showed that alginate-PLA combination did not form core-shell fibers, instead alginate was dispersed as islands inside the fiber. However, addition of lysozyme to alginate led to the formation of an integral core-shell fiber structure. This behaviour was attributed to the ionic interactions between an anionic alginate and a cationic lysozyme under neutral buffer conditions. The encapsulation technique developed in this study shall find suitable applications in areas for stabilizing bioactives and their delivery.

3:50 PM

(ICE-027-2014) Multi-Structured Nanofibers and Their Wetting Property

Y. Zhao*, Beihang University, China

With the progresses in material sciences, the generation of microscopic materials experiences an architectural evolution process from simple to complex. Here we fabricated a series of multi-structured 1D fabric micro-/nanomaterials by electrospinning method and investigated their applications in wettablility, absorption, and water collections etc. We fabricated superhydrophobic, superhydrophilic films with tunable surface structures and composition. Moreover, we created a hydrophobic and hydrophilic composite film that exhibited novel unidirectional water penetration property. We also explored wettability of a single fiber. By mimicking the natural spider silk structures, we fabricated periodic spindle shaped microfiber that could collection water from fog. Above mentioned materials have found applications in removing oil pollution from water, smart water penetration film, and water collection.

4:10 PM

(ICE-020-2014) Effect of Relative Humidity on the Flatness of Electrospun Microtube Array Membranes (MTAMs)

T. Chu*, S. Rwei, National Taipei University of Technology, Taiwan; Y. Shu, Lee-Ming Institute of Technology, Taiwan; C. Chen, C. Chen, Taipei Medical University, Taiwan; W. Tseng, Lee-Ming Institute of Technology, Taiwan

Novel highly-aligned, microtube array membranes (MTAMs) of polysulfone (PS) were prepared via co-axial electrospinning and potentially can be used as the separation substrate in biomedical fields. The objective of this study is to investigate the effect of environmental humidity to the surface morphology and membrane flatness of MTAMs during their preparation. In present study, PS MTAMs were prepared under a range of relative humidity (RH) from 27 to 58 % and the resulting MTAMs morphology were characterized by scanning electron microscopy (SEM). It was found that overall MTAM structural integrity, such as unit length, width, wall thickness, do not affected by RH. However, their flatness do affected by RH, i.e. lower RH for better flatness. The overlapping of the microtube units increases from 12 to 25% as RH increased from 27 to 58%. With a low RH (25 – 45%), the full width half maximum (FWHM) of the distribution of the angle among three consecutive microtube units was measured at 10o, comparing to 16o with higher RH (>50%). PS MTAMs shared similar skin structure, regardless the RH. In this study, we demonstrated RH plays an important role on one of MTAM morphological characteristics, i.e. membrane flatness. This results provide guidance on the fabrication of high quality MTAMs for future utilization.

4:30 PM

(ICE-021-2014) Structural tuning of electrospun nano-porous poly-l-lactic acid (PLLA) microtube array membranes (MTAMs)

C. Chiu*, J. Yang, Taipei Medical University, Taiwan; C. Lin, National Taiwan Normal University, Taiwan; C. Chen, Taipei Medical University, Taiwan

Uniform pore size distribution is highly prized for membrane separation substrate, especially for hollow fiber membrane. To improve the morphological uniformity of the novel MTAMs, a surfactant was added to the shell dope of PLLA solution in which PEG was added as a porogen, before conducting the co-axial electrospinning process. Electrospinning operations were carried out and the resulted porous MTAMs were characterized morphologically via scanning electron microscope. Separations of nanoparticles through porous MTAMs were also conducted and outcomes were correlated to the observed morphologic results. The overall porosity, and more importantly, the uniformity of nano-pores were demonstrated to be greatly enhanced via the addition of surfactant. This enhancement is due to the suppression of larger scale phase separation during the fiber solidification process. These results pave great foundation for the future membrane separation applications of MTAMs.

4:50 PM

(ICE-023-2014) Potential of Electrospun Polymeric Microtube Array Membranes (MTAMs)

C. Chen*, J. Yang, Taipei Medical University, Taiwan; C. Lin, National Taiwan Normal University, Taiwan; H. V. Lin, National Taiwan Ocean University, Taiwan

A novel class of hollow fiber substrate, namely microtube array membrane (MTAM), has been fabricated by co-axial electrospinning. Its structural characteristics, such as micro-scale dimension and one-to-one array formation, make MTAMs potentially advanced substrates and may outperform the traditional hollow fiber in wide spectrum of applications, ranged from medical, biomedical, analytical, industrial and more. Moreover, new applications may also be realized by the smaller size and new form factor of MTAM. In this presentation, the current progress of several applications of MTAMs as well as other potential projects will be updated. The future outlook along with technical challenges will be also discussed.

Polymer Nanofibers II

Room: Metropolitan II
Session Chairs: Yen Truong, CSIRO; Andrea Camposeo, National Nanotechnology Laboratory of CNR-NANO

1:30 PM

(ICE-029-2014) Photon waveguiding and optical resonances management by electrospun nanofibers (Invited)

A. Camposeo, M. Moffa, R. Manco, Istituto Nanoscienze-CNR, Italy; V. Fasano, Istituto Italiano di Tecnologia, Italy; G. Morello, L. Persano, Istituto Nanoscienze-CNR, Italy; D. Pisignano*, Università del Salento, Italy

Optical fibers have revolutionized many high-technological applications. The new frontier of the field is represented by fibers with cores having submicron dimensions, where light propagates in a structure with size comparable to the wavelength. In such systems, interesting effects can be studied which are also relevant for applications such as optical sensing and integrated optical circuits. In this work we report on the fabrication of nanofibers for photonics by electrospinning. The versatility of the electrospinning process allows for controlling not only the fiber size, morphology and macroscopic assembly but, more importantly, for tailoring optical properties of the fiber. In particular, we investigate the emission, waveguiding, and gain properties of electrospun nanofibers made by polymers doped with optically-active chromophores and particles. The unique features of electrospinning, characterized by a high stretching rate of the polymer solution, enables the fabrication of fibers with anisotropic properties, relevant for developing nanophotonic components with novel and innovative properties. The research leading to these results has received funding from the European Research Council under the European Union's 7th Framework Programme (FP/2007-2013)/ERC Grant Agreement n. 306357 (ERC Starting Grant NANO-JETS).

2:00 PM

(ICE-030-2014) Novel nanofiber Anisotropic Conductive Films (ACFs) for ultra-fine pitch assembly (Invited)

K. W. Paik*, T. Kim, S. Lee, KAIST, Republic of Korea

ACFs have been widely used as excellent interconnection materials in semiconductor and display applications for chip-on-glass (COG), chip-on-flex (COF), flex on flex (FOF) interconnections due to their fine-pitch capability. However, less than 20 um pitch COG and COF and less than 100 um FOF assemblies become challenging because of the electrical short between neighboring electrodes by agglomerated conductive particles in ACFs. Therefore, it is necessary to restrict the conductive particles movement in ACF polymer resin during ACF bonding process at ultra-fine pitch applications such as UHD display, smartphones, and wearable electronics. For this purpose, novel nanofiber ACFs have been successfully invented for ultra fine pitch COG, COF, and FOF applications. For nanofiber ACFs, about 200 ~ 500 nm diameter polymer nanofibers with coupled conductive particles are fabricated using an electro-spinning of polymer solutions mixed with conductive particles, and then nanofiber ACFs are successfully made. This novel nanofiber ACFs show excellent electrical bump contact resistance and electrical short free at 7 um bump-to-bump gap and 20 um ultra-fine bump pitch of COG and COF applications. It is mainly because the movement of conductive particles during ACF assembly can be restricted by the nanofiber anchoring effect.

2:30 PM

(ICE-031-2014) Preparation of extracting polymer wool from polystyrene and Aliquat 336 via electrospinning and its application for online preconcentration of thiocyanate in flow injection analysis

Y. O'Bryan*, The University of Melbourne, Australia; Y. B. Truong, CSIRO Materials Science and Engineering, Australia; R. W. Cattrall, The University of Melbourne, Australia; I. L. Kyratzis, CSIRO Materials Science and Engineering, Australia; S. D. Kolev, The University of Melbourne, Australia

A novel extracting polymer wool was prepared by electrospinning from polystyrene and a commercial liquid extractant Aliquat 336. This polymer wool was used as the packing material for a sample preconcentration column incorporated in an automated flow injection system for the determination of thiocyanate. Flow injection analysis is a technique where a plug of liquid sample is injected into a stream of carrier solution in narrow tubing, which will merge with a reagent stream to form a detectable species and then reach the detector. It has been widely used in many areas such as environmental analysis because of its advantages including easy solution handling, high throughput, and ability to minimise the volumes of samples and reagents used. In this study the fibrous material prepared was inserted in a glass column and exposed to a defined amount of sample solution. The column was then eluted with a small volume of 1M sodium nitrate solution and the eluate was mixed with an iron(III) solution. This resulted in the formation of a red coloured complex ($FeSCN^{2+}$) which was detected colorimetrically. The column successfully achieved preconcenration of thiocyanate without producing high back pressure that would make pumping of the solution through a flow injection system difficult.

2:50 PM

(ICE-033-2014) Bio-Based Biocomposite Electrospun Scaffolds: From design to In-Vitro Investigation of Cell Differentiation

D. Grande*, J. Ramier, V. Langlois, E. Renard, Institut de Chimie et des Matériaux Paris-Est, France; O. Stoilova, N. Manolova, I. Rashkov, Institute of Polymers, Bulgaria; P. Albanese, Laboratoire "Croissance, Réparation et Régénération Tissulaires", France

Electrospinning coupled with electrospraying provides a straightforward and robust route toward biocomposite scaffolds for bone tissue engineering. Miscellaneous poly(3-hydroxybutyrate) (PHB)-based scaffolds were fabricated, namely mats of PHB/gelatin (GEL) blends by electrospinning a PHB/GEL mixture solution, mats of PHB/GEL/hydroxyapatite nanoparticles (nHAs) blends by electrospinning a PHB/GEL/nHA mixed solution, and mats constituted of PHB, GEL, and nHA by electrospinning a PHB/GEL solution and electrospraying a nHA dispersion simultaneously. SEM and TEM analyses showed that the nHA-blended framework contained a vast majority of nHAs trapped within the constitutive fibers, whereas the electrospinning-electrospraying approach afforded fibers with a rough surface largely covered by the bioceramic. An in-vitro cell (hMSCs) adhesion and proliferation study within a six-day period showed a faster cell development on gelatin-containing scaffolds. A long-term investigation of osteoblastic differentiation over 21 days was carried out through the assessment of alkaline phosphatase (ALP) activity and the quantitative determination of matrix biomineralization through the staining of secreted bioapatite deposits. It turned out that hMSCs seeded on the nHA-sprayed scaffold developed a significantly higher level of ALP activity and a higher mineralization rate.

3:10 PM

(ICE-034-2014) Pulsatile drug release from electrospun poly(ethylene oxide)–sodium alginate blend nanofibres

Y. Kaassis*, UCL, United Kingdom; N. Young, University of Oxford, United Kingdom; N. Sano, Newcastle University, United Kingdom; H. Merchant, University of Huddersfield, United Kingdom; D. Yu, University of Shanghai, China; N. Chatterton, London Metropolitan University, United Kingdom; G. Williams, UCL, United Kingdom

Novel and highly tuneable pulsatile drug delivery systems have been prepared through the electrospinning of a blend of poly(ethylene oxide) (PEO), sodium alginate (SA), and sodium ibuprofen (SI). The resultant fibres contain crystallites of SI embedded in a PEO–SA matrix, and rather than being obtained as flat mats on the collector plate form novel three dimensional structures extending upwards the needle. Fibres were prepared with a range of loadings of SI and SA. It was found that at pH 6.8 (reminiscent of the intestinal tract) the fibres dissolve very rapidly, freeing all the embedded drug within ca. 20 minutes. However, at pH 3 (representative of the stomach pH in the fed state or in older patients) an unusual two stage release mechanism is seen. This comprises a rapid burst release, followed by a period where no further drug is released for ca. 120–150 minutes, and then a final stage of release freeing the remainder of the drug into solution. The amount of release in the initial stage, and the length of time between the first and final drug release stages, can be controlled by adjusting the SI and SA contents of the fibres respectively. This results in highly tunable pulsatile release materials.

3:50 PM

(ICE-035-2014) Polymer Nanofiber Interleaved Carbon/Epoxy Composites and Its Performance

K. N. Shivakumar*, R. Panduranga, North Carolina A&T State University, USA; E. J. Adams, The Boeing Company, USA

Primary limitation of composite laminates is the poor interlaminar strength and toughness that causes delamination and then leading to premature structural failure. Interlaminar stresses at the free edges of a multidirectional laminates are caused due to mismatch of Poisson ratio and mechanical and thermal anisotropy between the plies. Failure or delamination initiates at the free edges and propagates to the interior of the laminate under cyclic loading. Edge delamination and its management has been a major emphasis in damage tolerant design of composite structures. A number of methods to mitigate delamination have been explored in the last three decades but the problem is still intractable. Many of the concepts explored resulted in significant increase in cost, weight, or loss of in-plane stiffness and strength. Recent advances in polymer electrospinning have led to the development of nanofiber interleaved composite laminates that has superior toughness, no loss of in-plane properties and practically unchanged weight. The objective of this paper is to review the recent advances in thermoplastic polymer nanofiber interleaved carbon/epoxy composites and their performance in in-plane properties, damping, static and fatigue strength and life.

4:10 PM

(ICE-036-2014) Thermal analysis of nanofibres: The importance of heating rate

I. Steyaert*, Ghent University, Belgium; G. Van Assche, H. Rahier, Vrije Universiteit Brussel, Belgium; K. De Clerck, Ghent University, Belgium

This study describes the importance of heating rate when analysing nanofibres using differential scanning calorimetry and illustrates some pitfalls related to the use of conventional rates (~20 K min^{-1}). The melting behaviour of several polyamide (PA) types was researched using a fast-scanning calorimeter (RHC, TA Instruments) capable of controlled heating rates above 1000 K min^{-1}. Fast heating suppresses kinetic processes such as cold crystallization, crystal reorganization and crystalline perfectioning, which can be necessary for a correct analysis of crystal structures, especially in oriented polymorphous structures such as PA nanofibres. For PA69, for instance, analysis at higher rates reveals that nanofibres have a much more stable crystal structure than bulk material (only 15% of low-melting phase vs. 71% in bulk). This difference cannot be seen at 20 K min^{-1} since this crystal phase recrystallizes during heating, indicating the importance of a higher rate. However, high heating rates may result in thermal lag and a reduced resolution. Our results indicate that this effect becomes significant for all samples at rates above 500 K min^{-1} due to the high porosity of nanofibrous samples (~90%) and thus low thermal conductivity. Finding the golden mean between suppression of kinetic processes and limitation of thermal lag is key and a comparison of the melting behaviour at high and low scan rates is recommended.

4:30 PM

(ICE-032-2014) Unbreakable Codes in Electrospun Fibers to Stop Medicine Counterfeiting

C. Huang*, Nanjing Forestry University, China

Official health institutes and pharmaceutical organizations recognize that drug counterfeiting is an ever increasing hazard to unaware consumers. To combat counterfeiting and to allow tracking and tracing a drug throughout the supply chain, the packaging of an increasing number of drugs is being 'protected' by radio frequency tags, barcodes and so on. Unfortunately, such tracking and tracing technologies are only effective if the drugs are not repackaged. Manufacturers often do not ship drugs directly to hospitals and dispensing pharmacies. Generally, drugs are sold to Wholesalers or Distributors who repackage many drugs from bulk to unit-of-use containers. These multiple transactions provide a means for counterfeit drugs to enter the legitimate drug supply chain. To overcome this, "in-drug labelling" itself, instead of on the drug packaging, could help defeat drug counterfeiters. We took up this challenge; to "digitally encode polymers", Our specific objective was to digitally encode polymers that are FDA approved for use in oral medicines, aiming to use them in trace amounts. This project launches the concept of encoding a polymer by mixing the polymer solution with a fluorophore, electrospinning the solution into micron sized fibers and encoding the polymer fibers by photobleaching.

4:50 PM

(ICE-039-2014) COOH-Functionalized Poly (3,4-ethylenedixoythiophene) Electrospun Nanofibers for Sensor Electrodes

M. Dai*, University of Massachusetts, USA; Z. Jiang, University of Massachusetts, USA; V. Rotello, University of Massachusetts, USA; S. R. Nugen, University of Massachusetts, USA

This project is to use electrospinning and vapor-phase polymerization to produce direction-oriented functionalized conductive nanofibers electrodes. Nanostructures of the conducting polymer poly(3,4-ethylenedioxythiophene) with large surface areas enhance the sensitivity of sensor as electrochemical electrodes. However, this polymer could only be functionalized by non-specific physical absorption. It results in low selectivity as sensor electrodes. Here we introduce a carboxylic functionalized monomer (EDOT-COOH) that overcomes this drawback and results in high bonding efficiency with amine group targets. Conductive nanofibers with carboxylic group are easily processable into selective electrodes which can be used in label-free DNA, antigens and microorganism detection and volatile sensors.

5:10 PM

(ICE-037-2014) Special wettability materials prepared by electrospinning

N. Wang*, J. Wu, Y. Zhao, School of Chemistry and Environment, Beihang University, China

Wettability is one of the common interface phenomena in nature and an important property governed by the solid surface. Recently, various researchers focused on special wettability because it is

important for both industry and daily life. Here, we design and fabricate several kinds of special wettability surfaces by electrospinning. 1. A composite film of poly(N-isopropylacrylamide) blended with polystyrene(PS) was obtained by electrospinning. It exhibits an interesting thermoresponsive wettability that could switch between superhydrophobic and superhydrophilic. We investigated the morphology and the wettability with different experimental conditions. 2. The composite film with heterogeneous wettability by seamless coupling polyurethane film and crosslinked poly(vinyl alcohol) film was fabricated by electrospinning. Water can spontaneously penetrate from hydrophobic side to hydrophilic side, but not for the reverse direction. Differences in surface energy and microprous structures between these two materials result in the unidirectional water penetration phenomenon. 3. A high-oil-adsorption PS film is fabricated by electrospinning. Different fiber diameter and surface morphology play roles in oil adsorption capacity and oil/water selectivity. The results showed that oil adsorption capacity of PS oil sorbent film with small diameter and porous surface structure was higher than any other samples.

Ceramic and Composite Nanofibers II

Room: Metropolitan I

Session Chairs: Adrian Lowe, Australian National University; Jennifer Andrew, University of Florida

1:30 PM

(ICE-040-2014) Large Area Electrospinning of Carbon Nanotubes and Their Undamaged Recovery for Use in Advanced Conductive Composite Materials

S. G. King*, S. P. Silva, V. Stolojan, University of Surrey, United Kingdom; A. J. Goodwin, Thomas Swan & Co. Ltd., United Kingdom

With rising fuel costs, the demand for increased efficiency has led to the need for developing further advanced materials, which can deliver increased strength and reduced weight at the same time. Due to the low-weight, high-strength properties, and having the ability to take on multi-roles, such as charge storage, composite materials are increasingly becoming the material of choice in modern applications. In order to develop composite materials to meet the modern demands for applications, electrospinning was re-engineered to produce large area arrays of highly-aligned SWNTs. The aligned CNTs can be completely recovered without introducing any damage, as confirmed by Raman spectroscopy. These nanotube arrays are shown to increase the mechanical and electrical properties drastically within a poly(ethylene oxide) (PEO) composite material.

1:50 PM

(ICE-041-2014) The influence of viscosity on the stable electrospinning of silica nanofibers

J. Geltmeyer*, K. De Buysser, K. De Clerck, Ghent University, Belgium

Most of the time organic solutions containing a carrying polymer are applied to produce silica nanofibers, but the carrying polymer is afterwards removed to produce pure ceramic nanofibers. Although the electrospinning of the pure silica nanofibers without carrying polymer is preferred, the parameters influencing the electrospinning stability have not been studied in detail. However, this knowledge is necessary for up scaling. The optimum viscosity for electrospinning of silica nanofibers via sol-gel electrospinning without carrying polymer is studied. The electrospinning of TEOS sols with different viscosities is evaluated. Also the influence of the preparation procedure is studied. Freshly prepared sols and diluted sols were both electrospun, and the electrospinning stability and uniformity of the nanofibres were compared. Both the fresh sols and diluted sols resulted in uniform nanofibres, however electrospinning of the fresh sols was more stable. A narrow viscosity region in which electrospinning was most stable could be determined, also this region corresponded with the smallest mean nanofiber diameters. Furthermore, uniform and reproducible nanofibers could be obtained in this viscosity region. Electrospinning of silica nanofibers is thus possible in a stable, reproducible manner and up scaling of the process is thus feasible.

2:10 PM

(ICE-042-2014) Iron-based electrospun nanostructures - Innovative magnetic and actuating nanocomposites

T. Fiorido, Université Lyon 1, France; J. Galineau, INSA Lyon, France; V. Salles*, Université Lyon 1, France; L. Seveyrat, F. Belhora, P. Cottinet, INSA Lyon, France; L. Hu, Université Lyon 1, France; Y. Liu, INSA Lyon, France; B. Guiffard, Université de Nantes, France; A. Bogner-Van De Moortele, T. Epicier, D. Guyomar, INSA Lyon, France; A. Brioude, Université Lyon 1, France

Iron-based electrospun nanostructures - Innovative magnetic and actuating nanocomposites Iron-based materials are interesting for their magnetic properties, especially at a nanoscale due to their high potentiality in biomedical, catalysis, spintronic technology... We show in this study how it is possible to fabricate two different kinds of nanostructures, hematite (Fe2O3,) and cementite (Fe3C), using a single route synthesis with electrospinning. We will see how it is possible to precisely control the wall thickness of the Fe2O3 nanotubes and how the structural and morphological characteristics involve a variation in the magnetic behavior of the nanostructures. In the case of cementite nanofilaments (NFs), Fe3C nanoparticles (about 10 nm in diameter) are embedded in a graphitic carbon matrix. The thickness of the thin carbon coating at the surface can be tuned and have an effect on the nanofilaments stability in air and their electrical properties. The last part is dedicated to thestudy of these Fe3C NFs as fillers inside an electrostrictive polyurethane matrix. We will show that the deflection strain of such nanocomposites under an electrical field could be six fold higher than the pure polymer host, with only 2.5 %wt of NFs. A magnetoelectric behaviour of the composite will be also demonstrated, giving the possibility to use this composite as a bifunctional sensor and actuator.

2:30 PM

(ICE-043-2014) Flexible and freestanding mats consisting of electrospun ceramic nanofibers for photo-detector application

M. Xi, Y. Zhao, X. Ma, H. Fong*, South Dakota School of Mines and Technology, USA

Two types of flexible and freestanding mats, one consisting of ~75 wt.% TiO2 nanofibers and ~25 wt.% SiO2 nanofibers while the other one consisting of ~75 wt.% ZnO nanofibers and ~25 wt.% SiO2 nanofibers, were prepared by the technique of electrospinning (via dual spinnerets) followed by the post-spinning treatment of pyrolysis. Morphological and structural properties of both hybrid nanofibrous mats were characterized with the scanning electron microscope (SEM) equipped with an energy-dispersive X-ray spectrometer (EDS), transmission electron microscope (TEM), and X-ray diffractometer (XRD). Furthermore, the two hybrid mats were investigated for the fabrications of visible light and UV photo-detectors, respectively. The fabricated photo-detectors were also flexible; they exhibited excellent sensitivity and reproducibility/reversibility under varied light intensities, and they also showed high performance under the bending condition. It is envisioned that the reported preparation method could be a general approach for making the flexible and freestanding hybrid mats containing different electrospun nanofibers of semiconducting metal oxides for various applications.

2:50 PM

(ICE-045-2014) One-pot route to Carbon Electrospun Fibers decorated with Metal-based Nanomaterials

A. Cherifi*, A. Both Engel, M. Bechelany, S. Tingry, D. Cornu, ENSCM, France

Carbon electrospun fibers (CEFs) have recently focused many attentions for their potential applications, especially in energy domain. Combining the intrinsic properties of these fibers with those of metal-based nanoparticles can allow preparing new functional composite materials. CEFs can be covered by nanoparticles in a post-fabrication step, by adsorption for instance. However the weakness of the bonding and the heterogeneity of the coating are some limitations for many applications, like biosensors and electrode materials. In the present work, starting from polyacrylonitrile solutions, we describe the one-pot and facile preparation of CEFs doped with various metals. Adjusting the pyrolysis conditions allow to prepare different kind of nanomaterials (NMs) bonded to the surface of the carbon fibers. Gold and Titanium derivatives will be presented as examples. Some of the properties and applications of these carbon@NMs composite electrospun fibers will be discussed in regards with other composite fibers made by adsorption of nanotubes and graphene on CEFs.

3:10 PM

(ICE-046-2014) Flexible PAN/ZnO photocatalyst nanofibers prepared by coaxial electrospinning

K. Chutchakul, V. Pavarajarn*, Chulalongkorn University, Thailand

Flexible polyacrylonitrile (PAN)/zinc oxide (ZnO) nanofibers were fabricated in core/sheath structure using combination of sol-gel and co-axial electrospinning techniques. The solution of 8 wt% PAN dissolved in dimethyl formamide (DMF) was used as core-solution, while the solution containing poly vinyl pyrolidone (PVP), zinc acetate, hydrochloric acid, and diethanolamine in DMF was used as sheath-solution. The concentration of PVP in the sheath-solution was varied in the range of 8 to 18 wt%. Under the applied potential of 25 kV, the uniform and bead-free co-axial nanofibers could be fabricated. The average diameter of the as-spun co-axial nanofibers was in the range of 400-510 nm. Upon the calcination, at temperature in the range of 400-500°C, PVP in the sheath was removed while ZnO sol, which was formed within the sheath-solution, was crystallized into ZnO nanoparticles attaching to the PAN core. The presence of PAN core, which could withstand the calcination, provided flexibility for the final PAN/ZnO nanofibers so that crumbling of the fibers during the use as photocatalyst could be avoided. The calcined fibers, which had average diameter of 240-310 nm, showed similar photocatalytic activity as the ZnO nanoparticles synthesized by sol-gel process.

3:50 PM

(ICE-048-2014) Nanofibre electrospinning of composite PVA-Silica

Y. Singh*, D. Ramjugernath, I. Davidson, UKZN, South Africa; L. Chetty, Ethekwini municipality, South Africa

Electrospinning is a novel way of producing polymer fibres with nano-sized diameters in the range of hundreds of nanometres. In this particular study focus has been attributed to optimization of fabricating fibres via electrospinning. The electrospinning setup consisted of a syringe, controlled by a syringe pump, and a static grounded collector plate. An optimisation investigation was undertaken to ascertain optimal fabrication parameters. These parameters are the tip to collector distance, the type of syringe tip and polymer concentration. The deposition on the collector was analyzed under an electron microscope. The investigation revealed the following interesting results: (a) at constant voltage, different nanofibre depositions were obtained for varying spinneret tips, (b) for the same spinneret tip different nanofibre depositions were obtained for varying tip to collector distances and (c) only one concentration of polymer was found to produce a viable electrospinning jet. Electron microscopy was used to identify which parameters produced the most consistent nanofibres. It was concluded that a 5cm gap distance using a 15 gauge needle to electrospin a solution containing 6.66% aqueous PVA was optimal.

4:10 PM

(ICE-049-2014) Fabrication and Characterization of a Microreactor of Au/TiO2 in Microtube Array Membrane (MTAM) for Oxidative Conversion of Carbon Monoxide

H. Chiu*, T. Yang, Z. Chu, National Taipei University of Technology, Taiwan; C. Chen, Taipei Medical University, Taiwan; S. Wang, National Taipei University of Technology, Taiwan

Hsien-Lung Chiu1, Thomas C.K. Yang 1, Zong-Han Chu1, Chien-Chung Chen 2* 1 National Taipei University of Technology, Taipei, Taiwan 2 Graduate Institute of Biomedical Materials and Tissue Engineering, Taipei Medical University, Taipei, Taiwan polyjack@tmu.edu.tw Microreactors offer numerous advantageous process in fields of chemical engineering, pharmacy, medicine and biotechnology, due to their large area to volume ratio, consequently, higher reaction/conversion rate. In this study, novel microreactors of Au/TiO2.iMTAMs were prepared by coating active agent of Au/TiO2 to the lumen of novel electrospun PLLA MTAMs. These microreactors were then characterized and evaluated by X-ray diffraction (XRD), scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDX), transmission electron microscopy (TEM) and gas chromatography with thermal conductivity detector (GC-TCD). Morphological studies indicated homogeneous dispersion of Au/TiO2 powders, with the average diameter of 2-3 nm, within the MTAM substrate. Based on the amount of carbon dioxide (CO2) produced, the CO conversion rate was calculated, thus the optimal formulation of the Au/TiO2iMTAM microreactor is then identified. This information can provide guidance for future development of MTAM based microreactors.

4:30 PM

(ICE-050-2014) Switchable Self-cleaning surfaces from electrospun TiO2 nano-rice structures

A. Venkatesan*, Singapore University of Technology and Design (SUTD), Singapore; S. Dinachali, Institute of Materials Research and Engineering, Singapore; A. Nair, Amrita Centre for Nanosciences & Molecular Medicine, AIMS Ponnekkara., India; A. Baji, Singapore University of Technology and Design (SUTD), Singapore; S. Ramakrishna, National University of Singapore, Singapore

TiO2 nano-rice structures are fabricated by electrospinning for creating robust switchable self-cleaning surfaces on glass substrates. The as-fabricated anatase TiO2 nano-rice structures (sintered at 450 °C) exhibited excellent photocatalytic and superhydrophilic (water contact angle close to 0°) properties making it highly suitable for self-cleaning applications. The photocatalytic property of the TiO2 nano-rice surface is studied by the photo-degradation of Alizarin red dye and it was observed that the surface exhibited good photocatalytic properties. The photocatalytic superhydrophilic TiO2 nano-rice surface can be easily transformed to superamphiphobic surface by fluorosilane treatment. The surface contact angle achieved using water (surface tension, γ = 72.1 mN/m) and hexadecane (surface tension, γ = 27.5 mN/m) on the superamphiphobic surface are measured to be 166° and 138°, respectively. The contact angle hysteresis for the droplet of water and hexadecane are measured to be 2 and 12°, respectively. Thus, we have successfully fabricated superior switchable self-cleaning surfaces that possess exceptional photocatalytic superhydrophilic as well as superamphiphobic properties by employing a simple, cost-effective technique called Electrospinning. Furthermore, the fabricated surface exhibited good mechanical properties with strong adherence to the glass surface.

4:50 PM

(ICE-051-2014) Controlling the morphology and microstructure of electrospun nickel oxide nanofibers

A. Khalil*, R. Hashaikeh, Masdar Institute of Science & Technology, United Arab Emirates

Nickel oxide nanofibers are of great practical interest in several engineering applications such as sensing [1] and electrochemical capacitance [2]. Whereas several physical techniques have been successfully employed for their synthesis, electrospinning has turned out to be a better choice because of its simplicity, economy and scaling capability. It has been demonstrated that electrospinning can be employed for synthesizing pure nickel oxide nanofibers, however with rough morphology [3]. However, no report exists regarding the control of their morphology. In our work, we showed that the morphology and crystalline structure of electrospun nickel oxide nanofibers can be easily controlled by changing the precursor solution composition and the electrospinning parameters. Ranging from rough, porous, discontinuous and polycrystalline to smooth, dense, continuous and highly crystalline nanofibers of nickel oxide can be fabricated via electrospinning. These nickel oxide nanofibers with varying morphology and microstructure have potential applications in sensing, catalytic, magnetic and photovoltaic domains.

Poster Session

Room: Metropolitan Foyer

(ICE-P001-2014) Simulation of core-shell flow in the Taylor-cone by finite element method

L. Christiansen*, P. Fojan, Aalborg University, Denmark

In this study the effects on the taylor cone formation during electrospinning or spraying processes, with respect to the flow in the tip of the needle and around the Taylor-cone have been investigated theoretically. To achieve this aim a finite element modelling of the area from the tip of the inner needle to the end of the Taylor-cone in a core-shell electro spinning process has been performed. A static electrostatic force has been applied in the range from the end of the outer needle and onwards. The modelling is performed as a two-phase flow. The results of this study show an increased viscosity of all components in the core-shell system resulting in an elongated Taylor-cone. In the case of a higher viscosity of the inner fluid, the outer shell is formed by a flow of the low viscosity polymer along the inner Taylor cone. In the opposite case, the inner solution flows into the outer Taylor-cone, and adapts to its velocity, but changes the diameter. The low viscosity inner solution results in more stable taylor cone formations than the high viscosity core solution. The conclusion of this study is that the change in viscosity of the two solutions in a core-shell electrospinning determines the shape of the Tayler-cone, and thereby the proportions and diameter of the resulting spun fibres.

(ICE-P003-2014) Numerical Simulation of Multiphase Flows in Electrospinning

P. Hwang*, Y. Wu, Feng Chia University, Taiwan; C. Chen, Taipei Medical University, Taiwan

In this study, a numerical study was implemented to simulate the multiphase flow dynamics during electrospinning process. For the numerical model, the finite volume method, second order scheme, algebraic mutigrid solver, VOF method and PISO algorithm are adopted. In the goal of this paper, a two-dimensional solid model of electrospinning apparatus was constructed and the mathematic model including multiphase flow was used to proceed the fluid dynamics analysis with various flow conditions. It was found that some parameters such as the strength of applied electrical field and flow rate of jet can alter the fluid dynamics dramatically. Those numerical observations agree with previous experimental investigations.

(ICE-P004-2014) Modeling the Formation of Electrospun Fibre Materials

M. Mijajlovic, V. Zivkovic, The University of Adelaide, Australia; D. J. Nielsen*, E. I. Micich, Defence Science and Technology Organisation, Australia; I. L. Kyratzis, CSIRO, Australia; M. J. Biggs, The University of Adelaide, Australia

We have developed a model-based approach to connecting electrospinning process conditions to the filtration performance of fibre mats obtained from the process. This approach requires a simulation methodology that mimics the electrospinning process to yield the three-dimensional (3D) structure of the fibre mats. By parallelizing the spring-dashpot approach of Reneker & Yarin (2000), we have been able to reproduce the secondary instabilities in the fibre motion seen experimentally. In the model the electrospinning jet is treated as a series of beads of fluid of identical mass and excess charge connected together by a spring-dashpot bond to yield the viscoelastic character of the jet material. The forces acting on the beads arise from the electric field force, repulsive Coulombic forces, viscoelastic stress, surface tension and solvent evaporation. The 3D nanofibre membrane structures generated by the model were compared to actual materials using a series of physical parameters (e.g. fibre diameter, pore size distribution). In this poster, we will outline the computational method and key results obtained using it to date.

(ICE-P005-2014) Coaxial electrospun nanofibers for protein formulation in the solid state

U. Angkawinitwong*, S. Brocchini, G. R. Williams, UCL School of Pharmacy, United Kingdom

Protein drugs are used to treat various diseases. However, the instability of liquid dosage forms during storage means that proteins must be processed into solids. A short in vivo half-life of proteins often results in a lack of a therapeutic concentration between each dose administration. Electrospinning (ES) allows fabrication protein in formulations with the potential to stabilise protein molecules in solid fibers of nano-to microsize which can prolong protein release. In this work different model proteins including bovine serum albumin (BSA), alkaline phosphatase (ALP) and antibody fragments (Fab) were coaxially electrospun in the core aqueous solution surrounded by poly-ε-caprolactone (PCL) sheath. The morphology and integrity of the core-shell fibers were characterised by scanning electron microscope (SEM), transmission electron microscope (TEM), differential scanning calorimetry (DSC), fourier transform infrared spectroscopy (FTIR) and X-ray diffraction (XRD). The structural integrity of the proteins was characterised by size-exclusion chromatography, SDS-PAGE, and dynamic light scattering. An in vitro dissolution study was conducted with each protein to determine the release rate. ALP activity was also examined as a function of release rate. The core-shell PCL/BSA fibers (324±73 nm) was achieved when 10% w/v PCL in 2,2,2-trifluoroethanol (TFE):water (90/10 v/v) was used as the sheath fluid.

(ICE-P006-2014) Ultra-violet light modified electrospun polymeric mesh: Spatial control of wettability, protein adsorption, and cell adhesion

J. S. Hersey*, J. D. Freedman, M. W. Grinstaff, Boston University, USA

A polymeric electrospun 3-dimensional mesh has been created to respond to ultra-violet (UV) light (365nm) by permanently transforming from a hydrophobic (135° water contact angle (CA)) to hydrophilic (0° water CA) material enabling control over the 3-dimensional wetting of the mesh. Since the mesh consists of both micrometer (3-5 μm beads) and nanometer (100-150 nm fibers) scale features known to enhance the hydrophobicity or hydrophilicity of a material, a large change in wettability is possible via a minor change to the chemical structure of the polymer side chains. The dynamic wetting profile associated with various UV light doses was studies through contact angle analysis and contrast enhanced x-ray micro-computed tomography imaging. One potential

application for a material with spatially tunable wettability is selective protein and cell patterning. We demonstrate spatially controlled protein adsorption identical to the 3-dimensional pattern associated with water wetting the photoactivated meshes. In addition, we find enhanced cell viability and adhesion to the hydrophilic, protein adsorbed regions of the mesh compared to the hydrophobic untreated control regions.

(ICE-P007-2014) Wound dressing based on Chitosan/Polyvinyl Alcohol Nanofibers Mesh

P. Picciani*, P. F. Lanzillotti, C. T. Andrade, Federal University of Rio de Janeiro, Brazil

Burn injuries are a serious problem. They are associated with a significant incidence of death and disability, multiple surgical procedures, prolonged hospitalisation, and high costs of health care. The development of appropriate wound dressings is one of the most important approaches for burn treatment. In this work we describe the production functional chitosan – (CTS) /PVA electrospun wovens to burn treatment. Initially a CTS solution (4 wt.%) and another PVA solution (15 wt%) were simultaneously spun under 15 KV in ambient conditions (21 ± 2°C and RH 70 ± 3%) with a fixed distance of 10 cm between the tip (i.d. 0,5 mm) and the static collector. The feed rate of solutions was controlled at 0,1 mL/h by means of a syringe pump (KD Scientific). SEM images revealed smooth and homogeneous PVA fibers with average size about 300 nm decorated with CTS nanospheres averaging 500 nm. Initial experiments demonstrated that similar non woven mats can be obtained by the addition of trimethoprim/sulfamethoxazole molecules to the PVA phase without expressive process adjustments.

(ICE-P008-2014) PVA-PLA Core-Shell Fibers by Coaxial Electrospnning

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Coaxial electrospinning emerged a few years ago as a segment of conventional electrospinning method to obtain polymeric micro and nanofibers. In this process, two solutions are ejected through coaxial capillary channels, resulting mostly in core-shell fibers structures. Furthermore, due to the flexibility in the choice of materials, several active agents can be incorporated into nanofibers, including proteins, vitamins, antibiotics, anticancer drugs and generation of scaffolds composed of living cells. In this work, the preparation of poly(lactic acid) (PLA)/ poly(vinyl alcohol) (PVA) is described. PLA which is a hydrophobic polymer widely used in biomedical applications was used to form the fibers shell, whereas PVA which is a hydrophilic, highly biocompatible and non-toxic polymer was used to form the inside part of the fiber (core). The electrospun fibers were collected on a target placed at distances of 13cm from the syringe tip. The applied voltage was 20 kV and flow rate was varied from 0.15 to 1.3 mL/h. TEM images, contact-angle measurements and FTIR-ATR analysis indicated the formation of a core/shell structure of the composite nanofibers. PLA core-shell nanofibers have several potential applications such as provide future development of tissue engineering scaffold materials, drug delivery systems, membranes for filtration and sensing for environmental applications.

(ICE-P009-2014) Nerve cuff electrode deposited with drug loaded biodegradable nanofibers for suppression of early stage inflammatory response

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The goal of this work was to develop a neural electrode for suppression of early stage inflammatory response that provides fast release of dexamethasone (DEX) in peripheral nerve. The fabrication process includes electrospinning of drug loaded biodegradable nanofibers, encapsulation of these nanofibers using a polyethylene glycol (PEG), and electrochemical polymerization of conducting polymers. Drug release profiles show that UV patterned PEG accelerates the drug release rate at the early stage dramatically. And, the conducting polymers significantly decrease the impedance and increase the charge delivery capacity (CDC) of the nerve cuff electrode.

(ICE-P010-2014) Electrospun Meshes as Simple Surface Tension Sensors for Point of Care Diagnosis

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Surface tension changes in many bodily fluids are indicative of disease or abnormal states. Materials with rough surfaces, such as electrospun meshes, are very sensitive to small changes in the surface tension of liquid drops upon them, switching from being non-wetted to fully wetted. This transition from the Cassie-Baxter to Wenzel states occurs in a range known as the critical surface tension of the material identified on a Zisman plot. Using this effect, we prepared meshes that act as simple instrument-free surface tension sensors. Specifically we electrospin meshes with tunable hydrophobicities by blending PCL with a hydrophobic copolymer and varying flow rate. The top layer is thus tuned to selectively wet in the desired surface tension range, and the lower layer is hydrophilic to fully wet and contains an indicator dye to aid visualization. We demonstrate that a mesh can differentiate milk with low lipid levels from whole milk (48 to 45 mN/m) and another mesh can discriminate normal from abnormal levels of bile acids in urine (54 to 48 mN/m). The former is important to breastfeeding mothers and the latter is an indication of liver disease. Due to their sensitivity and simplicity, these meshes might prove useful in at-home monitoring or aiding diagnosis in resource-limited environments.

(ICE-P011-2014) Electrospun maleic anhydride grafted poly(lactic acid) bio-nanocomposites reinforced with cellulose nanocrystals

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The objective of the study was to develop a fully bio-based nanocomposite scaffolds using modified PLA reinforced with CNCs and explore their potential application in the bone tissue engineering. Electrospun fibrous bio-nanocomposite scaffolds reinforced with cellulose nanocrystals (CNCs) were fabricated by using maleic anhydride (MAH) grafted poly(lactic acid) (PLA) as matrix to improve the interfacial adhesion between two components. Morphological, thermal, mechanical, and in vitro degradation properties of MAH grafted PLA/CNC (MPLA/CNC) scaffolds were characterized as well as the basic cytocompatibility using human adult adipose derived mesenchymal stem cells (hASC). Morphological investigation indicated that electrospun MPLA/CNC nanofiber diameter and polydispersity was reduced with increasing CNC content. The addition of CNCs improved both the thermal stability and mechanical properties of MPLA/CNC scaffolds. MPLA/CNC bio-nanocomposite scaffolds at 5 wt% of CNC loading showed not only superior tensile strength, of more than 10 MPa, but also improved stability during in vitro degradation compared to the MPLA and PLA/CNC scaffolds. Moreover, fibrous MPLA/CNC scaffolds were non-toxic to hASCs cells and capable of supporting cell proliferation.

(ICE-P012-2014) Electrospun chitosan nanofibers with controlled levels of silver nanoparticles. Preparation,Characterization and Antibacterial Activity

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The ideal wound dressing would have properties that allow for absorption of exudates, and inhibition of microorganism for wound protection. In this study, we utilized an electrospinning (ELSP) technique to design a novel wound dressing. Chitosan (CTS) nanofibers containing various ratios of silver nanoparticles (AgNPs) were obtained. AgNPs were generated directly in the CTS solution by using a chemical reduction method. The formation and

presence of AgNPs in the CTS/AgNPs composite was confirmed by x-ray diffraction (XRD), ultraviolet-visible spectroscopy (UV) and thermogravimetric analysis (TGA). The electrospun CTS/AgNPs nanofibers were characterized morphologically by scanning electron microscopy (SEM) and transmission electron microscopy (TEM). These nanofibers were subsequently tested to evaluate their antibacterial activity against gram-negative Pseudomonas aeruginosa (P. aeruginosa) and gram-positive Methicillin-resistant Staphylococcus aureus (MRSA). Results of this antibacterial testing suggest that CTS/AgNPs nanofibers may be effective in topical antibacterial treatment in wound care.

(ICE-P013-2014) The preparation and characterization of lysine doped polypyrrole @spider silk protein core-shell structure fibrous scaffold containing nerve growth factor

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In order to avoid the poor cell adhesion on PPy and deprotonation, it is very necessary to find a way to fabricate the conductive polymer into a structure such as coaxial cable, in which the doped PPy is the core and the polymers with good cell adhesion is the shell. Here, an electroactive lysine doped PPy@SSP containing NGF composite fibrous scaffold with core-shell structure was fabricated by co-axial electrospraying and electrospinning. The effect of the ratio of core-shell flowing rate on the morphology and electrical property of this composite fibrous scaffold were researched, and found that the morphology and electrical property are related to the ratio of core-shell flowing rate. There are an optimum ratio of core-shell flowing rate to obtain uniform composite fibers and adequate conductivity. The lysine doped PPy@SSP containing NGF composite fibrous scaffold fabricated with a core-shell flowing rate of 0.3:1.0 has uniform fibers with a core-shell structure, a conductivity of (0.23±0.07) ×10-3 s cm-1 and stable resistance. This scaffold post treated by deionized water has good mechanical properties with adequate strength, initial modulus and excellent elongation (166.2%). The lysine doped PPy@SSP containing NGF composite fibrous scaffold has potential application in nerve regeneration.

(ICE-P014-2014) Oral delivery of biopharmaceuticals by encapsulation into electrospun fish sarcoplasmic proteins

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Purpose The aim of this study was to develop an oral drug delivery platform for delivery of biopharmaceuticals based on electrospun fish sarcoplasmic proteins (FSP fibers). Experimental and Methods FSP fibers were obtained by electrospinning using insulin as a model protein. The morphology of FSP fibers was characterized using scanning electron microscopy (SEM). In vitro release of encapsulated insulin was performed in Hepes-HBSS at pH 7.4 and simulated small intestinal fluid (SSIF) at pH 6.5 buffers and quantified using RP-HPLC. Permeation studies were performed using the Caco-2 cell monolayer model and monitored by RP-HPLC and ELISA. Cell viability was confirmed by MTS/PMS assay. Results The insulin was encapsulated into FSP fibers. Insulin was released in Hepes-HBSS and SSIF buffers and transported across the Caco-2 cell monolayer. Cell viability did not change after the cells were exposed to FSP fibers, indicating that the FSP fibers were not toxic. Conclusions Our results showed a novel oral drug delivery platform for biopharmaceuticals based on electrospun fish sarcoplasmic proteins. Insulin was successfully encapsulated into the fibers and released in relevant media without modifying the insulin activity. Transport studies demonstrated that released insulin was able to permeate the Caco-2 cell monolayer.

(ICE-P015-2014) Advantages of Surface-Initiated ATRP (SI-ATRP) for the Functionalization of Electrospun Materials

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The modification of surface properties of electrospun fibers, while maintaining the bulk properties of the constituting material, is among important targets of the scientific community. In this work we use Surface Initiated Atom Transfer Radical Polymerization (SI-ATRP) to modify the surface of electrospun Poly(L)lactic acid (PLLA) fibers. Fibers grafted with brushes of poly(glycerol monomethacrylate), poly(GMMA) and poly(2-(diethylamino)ethyl methacrylate), poly(DEAEMA), were obtained with the aim to confer, respectively, non-fouling and antibacterial properties to PLLA fibres. Brushes polymerization conditions were optimized to obtain polyGMMA-grafted PLLA and polyDEAEMA-grafted PLLA fibres that maintained their original morphology. Mats were characterized to demonstrate the success of PLLA fibre surface modification: ξ-potential changed consistently in the presence of the grafted chemical species; XPS analysis of PolyGMMA-grafted fibres revealed the presence of alcoholic carbons, alcoholic oxygens and α-carbons of GMMA, while the peak ascribable to the tertiary amino groups of DEAEMA was detected in PolyDEAEMA-grafted fibres; modified fibres are instantaneously wetted by water while unmodified PLLA fibres are highly hydrophobic. Future work will verify the non-fouling properties of PolyGMMA-grafted PLLA and the antibacterial properties of PolyDEAEMA-grafted PLLA.

(ICE-P016-2014) Comparative performance of collagen nanofibers electrospun from different solvents and stabilized by different crosslinkers

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Collagen electrospun scaffolds potentially couple high biomimetism of the biological material with the fibrous morphology of the protein. However, there are conflicting reports in the literature addressing the presence of ultrastructure of collagen in electrospun fibers. In this work collagen type I fibers were obtained by electrospinning from two different solvents, trifluoroethanol (TFE) and dilute acetic acid (AcOH) and characterized by SEM, ATR-IR, Circular Dichroism and WAXD. We demonstrated that collagen electrospun fibers contained a very low amount of triple helix with respect to pristine collagen and that triple helix denaturation occurred during polymer dissolution. Collagen scaffolds were crosslinked for the first time by using 1,4-butanediol diglycidyl ether (BDDGE), in addition to the commonly employed 1-Ethyl-3-(3-dimethylaminopropyl) carbodiimide (EDC) crosslinker. We proved that BDDGE is able to successfully crosslink collagen and preserve at the same time the scaffold fibrous morphology. Mesenchymal stem cell experiments demonstrated that collagen scaffolds crosslinked with BDDGE are biocompatible and support cell attachment.

(ICE-P017-2014) Electrospun-hybrid scaffolds for bone tissue engineering

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The purpose of this work was to explore the concentration effect of self-assembling (SA) peptides on the electrospinning of enriched poly-caprolactone (PCL) solutions. Four different concentrations of SA peptides have been tested and the obtained scaffolds were characterized in terms of both physical-chemical properties (ninhydrin assay, XPS analysis, wettability behavior) and morphological (SEM) structure. A correlation between morphological parameters (mean fiber diameter and porosity) and SA peptides concentration have been also investigated by design of experiment. The obtained model,

revealed an increase of mean diameter as a function of a growing SA peptides concentration; this behavior has been hypotized to be related to an increase in the viscosity of electrospun solutions.

(ICE-P018-2014) Atmospheric plasma surface modification of electrospun poly(L-lactic acid): effect on mat properties and cell culturing

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Various studies in the field of tissue engineering demonstrate that cell cultures on plasma modified scaffolds display better proliferation and viability compared to pristine materials. In the present work, atmospheric pressure non-thermal plasma treatment of an electrospun poly(L-lactic acid) scaffold is used to improve its hydrophilicity, introducing carboxyl groups at fiber surface. Thermo-mechanical properties, morphology, hydrophilicity and water uptake of plasma-treated scaffolds are studied. The amount of carboxyl functional groups at the scaffold surface is evaluated using fluorescein isothiocyanate conjugation. Fluorescence signal measured for treated sample results from 2 to 5 times higher than the value of the pristine sample and the hydrophilicity increase is preserved after 72h from the plasma treatment. In view of biomedical applications, embryonic fibroblasts growth and cell shape-factor is investigated on both treated and untreated electrospun PLLA scaffolds. While fibroblasts on untreated PLLA result small and with a star-like shape, those grown on plasma-treated PLLA assume a very elongated shape. Results show an enhancement of scaffold biocompatibility, demonstrating that atmospheric plasma technology is a flexible process that can be integrated in 'in-line' procedures of biomaterial fabrication and functionalization.

(ICE-P019-2014) A facile method for electrospinning of poly (vinyl alcohol)/ chitosan/graphene oxide biocomposite nanofibers

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Poly (vinyl alcohol) (PVA)/chitosan (CS)/graphene oxide (GO) biocomposite nanofibers have been successfully prepared using aqueous solution by electrospinning. CS colloidal gel in 1% acetic acid can be changed to homogeneous solution by using electron beam irradiation (EBI). The uniform distributions of GO sheets in the nanofibers were investigated by field emission scanning electron microscopy (FESEM) and Raman spectroscopy. FESEM images illustrated the spread single GO sheet embedding into nanofibers were formed via self-assembly of GO sheet and PVA/CS chains. And the average diameters of the biocomposite nanofibers decreased (200, 173, 160 and 123 nm) with increasing the contents of GO (0.05, 0.2, 0.4 and 0.6 wt%). Raman spectra verified the presence of GO in the biocomposite nanofibrous mats. The mechanical properties of as-prepared materials related with GO contents. It revealed the highest tensile strength was 2.78 MPa, which was 25% higher than that of neat PVA/CS nanofibers. Antibacterial test demonstrated the addition of GO to PVA/CS nanofiber had great ability to increase inhibition zone till 8.6 mm. Overall, these features of PVA/CS/GO nanofibers which prepared by eco-friendly solvent can be a promising candidate material in tissue engineering, wound healing and drug delivery system.

(ICE-P020-2014) Compressed Electrospun Gelatin-Honey Membranes for Dental Applications

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Current biomaterials used as membrane barriers in extractions are often difficult to handle, degrade quickly, and offer no enhanced wound regeneration which is paramount for complete and timely closure of the tissue over the bone graft. The purpose of this study was to engineer a membrane with antibacterial and regenerative properties that degrades within 6-12 weeks allowing for retention of the graft while promoting a more rapid closure of the overlying tissue. To achieve this, gelatin was dissolved in 1,1,1,3,3,3-hexafluoro-2-propanol (HFP) or 9:1 acetic acid:deionized (DI) water and electrospun with MEDIHONEY® (0-50 wt.%). Electrospinning using HFP or acetic acid:DI water as a solvent resulted in scaffolds with micron- and nano-sized fibers, respectively. Membranes (crosslinked and non-crosslinked with 25 mM 1-Ethyl-3-(3-dimethylaminopropyl)carbodiimide) were compressed (one or multiple layers) using a hydraulic press. Compressed membranes have increased handleability, are less porous, and maintain non-compressed fiber diameter. Less porous scaffolds are desired for this application to provide guided regeneration for tissue closure. Furthermore, it is documented that larger fibers and the addition of honey (antimicrobial by nature) can independently enhance the pro-regeneration response. This study will further analyze the regenerative response of human dermal fibroblasts seeded on composite membranes.

(ICE-P021-2014) Controlled release of dexamethasone loaded in core-shell SF/PEO nanofibers to modulate inflammatory response

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The aim of this study is to develop a novel type of drug delivery carrier with the capability of encapsulation and controlled release drug. Dexamethasone (Dex) was successfully incorporated into core-shell SF/PEO nanofibers by means of emulsion electrospinning. In vitro drug release studies demonstrated that Dex can sustain release over 360 h and core-shell nanofibers showed more slower release of Dex compared with the blending electrospun nanofibers. Anti-inflammatory activity in vitro showed that the released Dex can reduce the pig hip artery endothelial cell (PIEC) inflammatory injury which induced by lipopolysaccharide (LPS). The SEM picture showed that the diameter distribution of nanofibers is uniform. TEM picture showed core-shell structure of nanofibers. The release behavior study was tested by HPLC method and showed that there was no burst release from the electrospun mats. The protective effect of the fibrous mats on LPS-induced PIEC inflammatory injury was determined by MTT assay and anti-inflammatory activity in vitro showed that released Dex could reduce the PIEC inflammatory injury, which induced by LPS. We Successful prepare the core-shell SF/PEO nanofibers that can control release of Dex by emulsion electrospinning. It is safe, non-toxic and environment friendly and is potential to be an anti-inflammatory drug carrier for clinical application.

(ICE-P067-2014) The Effects of Electrospinning Parameters on Nanofiber Diameter of a Polymeric Biocomposite for Biomedical Application

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Electrospinning is increasingly used to fabricate nanofibrous scaffold resembling extra-cellular matrix. Despite relatively early introduction of this technique, effects of process and material parameters

on the properties of the produced fibers are still under investigation both theoretically and experimentally. For instance, controlling fiber diameter which influences important biological properties (i.e. cell adhesion, spreading, migration, proliferation and lineage specification) of the electrospun mats. The aim of the present work is to analysis the effects of blend ratio, flow rate and drum velocity on fiber diameter of Hydroxyethyl Cellulose/ Polyvinyl Alcohol (HEC/ PVA) biocomposite. The solution viscosity and conductivity of the blend solution along with fiber diameter was measure. It was found that among three selected factors, blend ratio was most effective one. According to our results, with the increasing HEC fraction from 30% to 60%, the viscosity of the blend solutions decreased from 81.6 to 59.2 cPa, while the conductivity increased from 681 to 890 μs/cm, both of which affected fiber diameter parallel and resulted in decreasing the fiber diameter. To sum up, our study showed that it is possible to design scaffolds with different topographical structure controlling electrospinning parameters.

(ICE-P022-2014) Tungsten Oxide Nanofibers From Electrospun PVP-Based Aqueous Precursors

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Tungsten oxide nanofibers with different morphologies, including ribbon-like structures, were successfully crystallized from electrospun polyvinylpyrrolidone (PVP) fibrous meshes with various content of ammonia metatungstate (AMT). Within the nearly entire range of tested polymer/salt ratios, electric potential and other process parameters, it was possible to produce uniform PVP/AMT fibers with the diameters in the range from 200 nm to 800 nm and flat ribbon-like structures with the width-to-thickness ratios up to 20. As-prepared PVP/AMT fibrous samples were then annealed at temperatures up to 900 °C in air to explore the effect of temperature and annealing time on the crystallization of tungsten oxide. It was found that the crystallization of WO_3 was consistent with the temperature and time of annealing. Scanning Electron Microscopy, Raman, X-ray Diffraction, X-Ray Photoelectron spectroscopy, and FTIR spectroscopy confirmed the formation of pure monoclinic phase WO_3 nanofibers with the size of crystallites and the surface morphology depending on the annealing temperature and time. This work was supported in part by the National Science Foundation award #1261154.

(ICE-P024-2014) Microstructural and piezoelectric characterization of BST fibers

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This work objective was to produce and characterize Barium Strontium Titanate fibers obtained by electrospinning. Barium and Strontinum Acetate, Titanium Propoxide and polyvinylpyrrolidone were used as precursors. Different compositions where prepared varying the Barium/Strontium ratio (Ba1-xSrxTiO3 with 0≤x≤0.25). Viscosity and conductivity of the mixtures where tested to evaluate the potential of the solution to produce fibers. The applied voltage was tested to establish the optimum parameters for fiber production, considering the fibers diameters, the secondary jets and the amount of fibers produced. The heat treatment was executed in two steps: initially, a temperature increase of 5°C/min was used to reach 350°C remaining on this temperature for 30 minutes. The samples were then heated up to 800, 900, 1000, 1100 or 1200°C for 60 minutes or, 1000°C for 4 hours. SEM, TEM and XRD where used to characterized the morphology, the crystalline phases and crystallite diameter. Piezoelectric properties where measured by Thermo Stimulated Current (TSC) tests. It was observed the higher the amount of strontium and the heat treatment temperature used, the smaller the diameter of the fibers. The TSC tests indicate that the fibers have a piezoelectric response at temperatures around 65°C.

(ICE-P025-2014) Influence of electrospinning and heat treatment conditions on TiO2 fibers properties

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The electrospinning operational parameters can affect the morphology of the obtained fibers. In the ceramic fiber technology, besides these parameters, the heat treatment conditions can affect morphology and phase composition. In this work, the effect of the viscosity and conductivity of the precursor solution, the intensity of the applied electrical field and needle diameter during the electrospinning process and, the heat treatment temperature (500 to 700 °C) of TiO2 fibers were evaluated. It was used as precursors titanium isopropoxide, acetic acid, anhydrous ethanol, polivynilpirrolidone and polivynilbutiral. Using SEM and TEM it was possible to observe that systems with low viscosity produced very thin beaded fibers. And, on the other hand, higher viscosity systems produce smooth and thicker fibers with uniform diameter. The applied electrical field had an important role in the diameter distribution: the higher the electrical field the smaller is the size distribution and the diameter of the fibers. The surface area increases with the increase of the heat treatment temperature until 650°C (142 m2/g), when the sintering process begun. The heat treatment temperature had also an influence on the morphology and phase formation: the higher the temperature, the smaller is the diameter of the ceramic fibers and the higher is rutile to anatase ratio.

(ICE-P026-2014) Characterization of hollow BaTiO3 nanofibers and intense visible photoluminescence

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BaTiO3 hollow nanofibers were fabricated by electrospinning and then subsequent calcination of as-spun nanofibers with a heating rate of 2.5 °C /min. SEM and TEM results indicated that the heating rate had a significant effect on the morphology of the BaTiO3 hollow nanofibers. The X-ray diffraction, Raman spectroscopy, and TEM results indicate the prepared BaTiO3 hollow nanofibers have tetragonal phases. From the results of the XPS analysis, in the amorphous BaTiO3 nanofiber, peaks at 457.2 eV for Ti 2p3/2 were also found, which corresponded to the Ti3+ ions. However, in the crystalline BaTiO3 nanofibers, peaks of Ti 2p3/2 showed the Ti4+ ions. Intense visible photoluminescence was observed in the amorphous BaTiO3 nanofiber which is calcined below a temperature of 500 °C. The observed intense photoluminescence was ascribed to a multiphonon process with localized states within the band gap of the highly disordered states. In the crystalline BaTiO3 hollow fiber, low intensity of PL showed at the visible region which is originated from an intrinsic Ba defect.

(ICE-P027-2014) Process optimization of electrospun Ceramic Nanofibers from Preceramic Polymers and their use for Hierarchically structured fibers production

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Silicon oxycarbide fibers were successfully fabricated by electrospinning a mixture of commercially available polymethylsilsesquioxane (MK) or polymethylphenylsilsesquioxane (H44) preceramic polymers and polyvinylpyrrolidone, followed by cross-linking and pyrolysis at 1000°C in Argon. Process optimization was carried out in ordet to decrease the mean fiber diameter of MK ceramic fibers and to avoid beads formation on H44 based fibers. For the MK/isopropanol system, the introduction of 20 vol% N,N-dimethylformamide (DMF) enabled to decrease the diameter of the as-spun fibers from 2.72±0.12μm to 1.65±0.09 μm. For the H44/DMF systems, beads-free fibers were obtained by adding 50 vol% choloroform. The addition of a suitable cross-linking catalyst was indispensable for maintaining the fiber shape during the high temperature thermal treatment. After pyrolysis, the resultant SiOC fibers derived from MK and H44 resins possessed uniform morphology, with an average diameter of 0.97±0.07 μm and 1.07±0.08 μm, respectively. Polymer-derived fibers decorated with Si2N2O nanowires were also obtained

(VLS growth mechanism) and it has been found that the amount of nanowires formed in H44-derived samples was much larger than that formed in MK-derived samples, due to the higher carbon content in H44-derived samples.

(ICE-P028-2014) Effect of grain size distribution on the magnetic behavior of CoFe2O4 nanofibers

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The synthesis of the CoFe2O4 nanofibers was carried out by the electro-spinning in order to study the effect of grain size distribution achieved on the magnetic properties when measured at low temperatures. In this work, the precursor solution was compose of 8%Wt of PVP, with molecular weight Mw 1, 300 K, and 7.65 g of Co(NO3)2.6H2O and Fe(NO3)2.6H2O in water. The solution was heated at 60 °C with vigorous stirring for 3 h and then delivered into a metallic needle at a constant flow rate of 0.3 ml/h. After collecting the fibers, these were annealed at 750°C by 1 h. The characterization was carried out by X-ray diffraction (DRX), Transmission Electron Microscopy (TEM) and Vibrating Sample Magnetometry (VSM). XRD patterns exposed a CoFe2O4 as the main phase present in the nanofibers with a cell parameter a = 8.3381 Å. Characterization of morphology carried out with TEM revealed a wide distribution of grain sizes, ranging from 40 to 240 nm. Finally, magnetic properties of calcined samples characterized by VSM, shown a strong temperature dependence of hysteresis loops shape, going from single-phase loops for room temperature to wasp-waisted shaped loops for low temperatures. It show up a change in the magnetic interactions as temperature goes down because the grain size distribution of nanoparticles composing the nanofibers, being these underlying responsible of the hysteresis loops shape.

(ICE-P029-2014) Preparation of flexible YSZ ceramic nanofibers by sol-gel assisted electrospinning

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Flexible YSZ ceramic nanofibers were prepared by a facile sol-gel assisted electrospinning method. A spinnable sol was prepared with zirconium acetate as the precursor, PVP-K90 as the spinnable aid, yttrium nitrate as the phase stabilizer and ferric nitrate as the additive. Gel fibers were firstly formed by electrospinning, and then dried and calcined at 500~800 °C in air. The effect of calcination temperature on the morphology and crystalline structure was thoroughly examined. The as-synthesized YSZ ceramic nanofibers display diameters ranging from 80 to 400 nm and lengths over several centimeters, and pure tetragonal phase could be obtained by 800 °C calcination. It is also found that the ferric nitrate influences significantly on the grain size of the fibers. Remarkably, the as-prepared YSZ ceramic nanofibers display good flexibility and tensile strength, which can be finely controlled by regulating the calcination temperature and the sol composition. With good flexibility and intrinsic low thermal conductivity, the as-prepared YSZ ceramic nanofibers could find a wide range of applications in high-temperature filtration, heat insulation, ceramic reinforcement and etc.

(ICE-P030-2014) Synthesis and properties of hollow structure Li2-xMnSixP1-xO4 nanofibers by electrospinning method

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Lithium ion batteries are promising for electronic devices as HEV, EV because of their high energy density, high voltage, high capacity and etc. Recently Li2MnSiO4 and LiMnPO4 materials have attracted attention as cathode materials for lithium ion battery. Li2MnSiO4 has high theoretical capacity of ~333mAh/g because of the potential to facilitate the insertion/extraction of two lithium ions. Unfortunately, this material has definitely low ionic and electronic conductivity. So we redesigned Li2-xMnSixP1-xO4 as novel cathode material. Incorporating Li3PO4 into Li2MnSiO4 could improve its ionic conductivity because Li3PO4 is a lithium ion conductor. To improve these problems additionally, we have used electrospinning method that can be obtained the hollow type nanofibers structure easily with high surface areas and submicron sizes. Effects of electrospinning method are easy to diffuse lithium ion due to reduce ionic path and can be carbon coating in a single step to enhance electronic conductivity. In this work, we investigated surface morphology and crystal structure through field emission scanning electron microscope (FE-SEM), transmission electron microscope (TEM) and X-ray diffraction (XRD). Then we analyzed electrochemical properties by electrochemical impedance spectroscopy, cyclic voltammetry, initial charge-discharge and so on.

(ICE-P031-2014) Preparation and characterization of conductive polyurethane composite nano fibers via electrospinning

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In this study, we demonstrate the preparation of copper oxide (CuO) particles incorporated polyurethane (PU) composite nano fibers by using electrospinning. Two step processes were adopted to incorporate the CuO particles in PU nano fibers. In the first step, the cupric acetate was added to poly(vinyl alcohol) to obtain a thin film by wet casting. Then the thin film as calcined at 500 degree celcius and ground to prepare the CuO particles. In the second step, these CuO particles were incorporated in the PU to obtain composite nano fibers. Different types of nano fiber mats were prepared by varying the concentration of CuO particles. The surface morphology, structure, bonding configuration, thermal, optical and electrical properties of the resultant nano fibers were characterized by means of scanning electron microscopy (SEM), X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), UV–vis (ultraviolet visible) spectroscopy, thermogravimetric, photoluminescence and current–voltage analysis. The electrical conductivities of the PU/CuO composite nano fibers were markedly improved than that of pristine PU nano fibers. The improvement of electrical properties is attributed to the better carrier transport in the composite nano fibers.

(ICE-P032-2014) Environmental Pollutants Degradation using Photocatalyst-Carbon Nanofiber composites

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For the practical applications of TiO2 photocatalysis, a number of studies are based on immobilizing TiO2 on different substrate materials. Previously, we reported that the TiO2 particles embedded carbon nanofiber (CNF) prepared by electrospinning exhibited the efficient photocatalytic activities. However, the photocatalytic activities were limited because the photoactive TiO2 nanoparticles were entirely embedded on CNF and could not directly absorb the UV light. Therefore, we tried to make the photocatalytically active nanostructured TiO2 materials covered on the surface of CNF which differentiating with the nanostructured TiO2 material deposition by coating method. In this study, we synthesized the core-shell structured CNF-titanate nanotubes (TiNT) by the electrospinning, carbonization and subsequent alkaline hydrothermal treatment. The formation of TiNT on the surface of CNF is observed by the SEM, HR-TEM, XRD, and XPS analysis. Core-shell structured CNF-TiNT exhibited the efficient photocatalytic activities for CH3CHO oxidation, which was attributed to that the photocatalytically active TiO2-TiNT composites were existed on the surface of CNF and they could easily absorb the UV light. Additionally, the increased surface area by alkaline hydrothermal treatment could be also responsible for the efficient photocatalytic activity of core/shell structured CNF-TiNT.

(ICE-P033-2014) Effective nickel oxide nanofibers toward methanol oxidation: advantage of the nanofibrous morphology

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In this study, the influence of the morphology on the electrocatalytic activity of nickel oxide nanostructures toward methanol oxidation is investigated. Two nanostructures were utilized: nanoparticles and nanofibers. NiO nanofibers have been synthesized by using the electrospinning technique. Briefly, electrospun nanofiber mats composed of polyvinylpyrolidine and nickel acetate were calcined at 700°C for 1 h. Interestingly, compared to nanoparticles, the nanofibrous morphology strongly enhanced the electrocatalytic performance. The corresponding current densities for the NiO nanofibers and nanoparticles were 25 and 6 mA/cm2, respectively. Moreover, the optimum methanol concentration increased to 1 M in case of the nanofibrous morphology while it was 0.1 M for the NiO nanoparticles. Actually, the one-dimensional feature of the nanofibrous morphology facilitates electrons' motion which enhances the electrocatalytic activity. Overall, this study emphasizes the distinct positive impact of the nanofibrous morphology on the electrocatalytic activity which will open a new avenue for modification of the electrocatalysts.

(ICE-P034-2014) Electrospun CdS-TiO2 doped carbon nanofibers for visible- light-induced photocatalytic hydrolysis of ammonia borane

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CdS/TiO2 NPs-decorated carbon nanofibers were introduced as a novel photocatalyst working under visible light radiation for the effective hydrolytic dehydrogenation of ammonia borane. Calcination of electrospun nanofiber mats composed of titanium tetraisopropoxide, poly (vinyl pyrrolidone) (PVP), and cadmium acetate dihydrate with a few drops of ammonium sulfide in argon atmosphere at 850 °C led to the production of CdS-TiO2 decorated carbon nanofibers. As-synthesized nanocomposite exhibited a strong photocatalytic activity for catalytic hydrolysis of ammonia-borane. The favorable electrons-transfer properties, better dispersion, high surface area, and adsorption property are the main features of nanocomposites that exhibit high catalytic efficiency.

(ICE-P065-2014) Fabrication and characterization of polyvinylpyrrolidone /Cu^{2+} nanofibers

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Polymer/transition metal salt composite nanofibers have gained considerable attention in recent years. Doping of transition metla salt into the polymer matrix allows the fabrication of naonofibers with special functions. We developed polyvinylpyrrolidone(PVP)/ Cu^{2+} nanofibers with diameter of 200-900 nm by electrospinning. In this study, coper(II) nitrate trihydrate was added to PVP electrospinning solution. The electrospun nanofibers were characterized by scanning electron microscope(SEM), energy dispersive microscopy(EDS), and ultraviolet–visible spectroscopy(UV-vis). The results indicated that Cu^{2+} was successfully doped into PVP system and the electrospun PVP/ Cu^{2+} nanofibers have shown absorption bands on the absorption spectrum. The fibers became fine and had higher absorption intensity with PVP/$Cu(NO_3)_2$ ratio decreasing.

(ICE-P035-2014) Biocatalytic polymer nanofibers for stabilization and delivery of enzymes

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Activity retention and storage stability of immobilized enzymes remains an important challenge in medical, diagnostics, and food applications. Immobilized enzymes are integrated into bioactive packaging and continuous processing systems in the food industry to increase working efficiency and reduce processing waste. Using electrospun nanofibers as enzyme supports has potential to overcome the difficulties that result from traditional enzyme delivery systems by increasing the surface area available for material modification and reducing diffusion limitations while enabling enhanced stability in storage. In this study, lactase was electrospun into polyethylene oxide nanofibers with Pluronic F-127 (polyethylene oxide / polypropylene oxide copolymer nonionic surfactant) for incorporation into bioactive packaging and processing systems. The nanofibers were characterized to be cylindrical fibers with an average diameter of 305 nm. After electrospinning, enzymes retained up to 92% of their native activity. After 4 weeks storage, the immobilized enzyme fiber retained up to 44% of the activity of the original fiber when stored in a low humidity environment. These results suggest that incorporating enzymes in a polymer nanofiber matrix can improve activity retention and storage stability compared to traditional enzyme delivery methods, and can expand overall enzyme use in bioprocessing applications.

(ICE-P036-2014) Effect of heat treatment and composition in the photoactivity of Sn-Si-TiO_2 fibers

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Nanostructured fiber mats have large surface area, high reactivity and low agglomeration tendency. These are advantages if compared with nanoparticles for photocatalytic application. In this work, the effect of heat treatment on the microstructure characteristics and the photoactivity of the electrospun fibers in comparison with a commercial P25 TiO2 were studied. Anatase titanium dioxide fiber doped with silica or with tin were produced by electrospinning technology using titanium propoxide, tetrapropoxysilane and tin 2-ethylhexanoate; hydrolyzed in acetic acid and mixed with an alcoholic solution of 10wt% PVP. After the electrospinning process, a thin, porous fiber-mat was obtained. These fibers were heat treated from 500 to 800°C for 3 h at a heating rate of 1.4°C/min. The fibermats were characterized using BET, X-ray diffraction, SEM and TEM. The photoactivity under acid and basic pH was studied using as model system the degradation of methyl orange in water under UV-A and visible light. Raw fibers are amorphous but become crystalline after heat treatment. Quite the opposite happens with the rutile to anatase ratio and the crystallite sizes, which increase with higher heat treatment temperatures. The photoactivity increases with the increment in heat treatment temperature until 650°C, when the fibers start to become densified and the surface area drops significantly due to sintering.

(ICE-P037-2014) NOx reduction during methane combustion using electrospun fibers

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The 3-way catalysts are generally formed by the support, stabilizers, promoters metal and transition metals (platinum group) and are used to control combustion emissions. The use of cerium as a promoter is usually related to its ability to store oxygen and structural aspects such as the property of increasing the dispersion of metals and slow change of phase of the stabilizing support. On the other hand, the metal copper was explored as a possible replacement for palladium and platinum in the reduction of NO and CO emissions. In this work, electrospun fibers of cerium oxide doped with copper were obtained from cerium acetate, copper nitrate and PVB. After heat treatment, cerium oxide fibers were obtained. These fibers were characterized structurally by scanning electron microscopy (SEM), had their specific surface area determined by BET method, were subjected to thermogravimetric test to determine their thermal stability and were analyzed by X-ray diffraction. The catalytic activity was assessed by the amount of O2 consumed and CO and CO2 formed for the combustion of methane and air. SEM images show randomly oriented fibers and TEM images show that the diameter of the fibers is approximately 100 nm and the size of its crystallites are around 20 nm. In the presence of the catalyst, the combustion reaction started around 500°C and no emission of NO or NOx gases were detected.

(ICE-P038-2014) A novel functional biodegradable electrospun membrane for nutrient recovery

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The growing shortage of essential nutrients, such as nitrogen and phosphorous, is prompting researchers to find advanced recovery processes from wastewater derived from sewage treatment plants and other wastewater sources. In this work we propose a novel compostable electrospun filtration membrane based on poly(L-lactic acid) (PLLA), for nutrient recovery through struvite crystallization from water. Composite electrospun PLLA fibers were fabricated starting from a suspension of PLLA solution and struvite crystals. Struvite within PLLA fibers worked as a nucleant agent for additional crystallization of magnesium, ammonium and phosphate hexahydrate out of water. Morphological, structural and physical properties of the obtained membranes were studied and the ammonium concentration decrease in the analyzed water samples was measured and correlated to struvite precipitation on the electrospun membranes. The obtained compostable struvite-rich membrane can be used in agriculture to provide a nutrient-rich humus for direct application to the land.

(ICE-P039-2014) Integrated Coal Gasification and Electrochemical Fuel Cell Combined Cycle

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An integrated power generation cycle combining the coal gasification reaction and a fuel cell system is to be analysed by comparing the performance of the resultant practical plant. The coal gasification system is combined with solid oxide fuel cell (SOFC) module and a gas turbine, so that maximum conversion of hydrogen is obtained. It is expected that the SOFC module combination will give a higher conversion or efficiency than that for the case without SOFC module. Analysis of the efficiency relation with the utilization factors and few other parameters has been carried out. Moreover, a detailed study of gas turbine integration has also been presented.

(ICE-P066-2014) Polymers in conventional electrospinning and coaxial electrospinning

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As a relatively advanced technology, electrospinning attracts many researchers' concentration in recent years. Different processing parameters, like the electric field strength, which needs to be high enough to overcome the surface tension of the solvent; capillary size; flow rate; distance between the needle and the collector will affect the diameter of the electrospun fibers. Also, the concentration of the solution should be considered since it decides the viscosity of the solution. What's more, the modifications of conventional electrospinning, like the coaxial electrospinning can produce ultrafine core/shell nanofibers. We used polyvinylpyrrolidone(PVP) in ethanol and Cellulose Acetate(CA) in acetone as the inner and the outer solution. Also, we tried only PVP or CA solution to do the conventional electrospinning. Compared with conventional electrospinning, the coaxial electrospinning fibers have better applications: it can prepare fibers from high concentration solutions, the core/shell nanofibers have better mechanical properties, narrower distribution of fiber diameters and smoother surfaces. Much more research about coaxial electrospinning in our lab is under way.

(ICE-P040-2014) Preparation of Carbon Nanofiber Contenting Plasma-Modified CNT via Electrospinning Process for Supercapacitor Applications

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In this study, we used plasma-modified carbon nanotube (CNT) grafted maleic anhydride (MA) to increase affinity with organic solvents. The well dispersion CNT-MA in polyacrylonitrile (PAN) solution was electrospun to polymer nanofiber. Following, PAN/CNT-MA nanofiber was carbonized at 800 degree Celsius to form carbon nanofibers (CNF) content CNT. The surface morphology of the nanofibers is smooth at low CNT concentration and rough at high concentration. The diameter of nanofibers was slightly increase from 120nm to 145nm for 1wt.% CNT. TEM images showed that CNT well aligned along the axis of the electrospun nanofibers. The conductivity of CNF/CNT mat increased by 3.67 times (0.6 to 2.2 s/cm) for 1 wt.% CNT. The characteristic of CNF/CNT mats as supercapacitor electrode were examined by cyclic voltammetry at 50mV/s in a 1.0 M H2SO4 solution as the electrolyte. All samples showed a symmetrical rectangular shape. CV cure of CNF/1wt.% CNT decreased more quickly at 1V, it means the internal resistance decreased with increasing CNT concentrations. Meanwhile, CNF/1wt.% CNT had the largest CV cure area and the highest specific capacitance value of 382 F/g. The specific capacitance increased by 2.65 times. The supercapacitor comprising of CNF/CNT mat that has high power density and energy density could be easily obtained by this method.

(ICE-P041-2014) NixCo1-x Alloy nanoparticles-doped Carbon nanofibers as Effective Non Precious Catalyst for Ethanol Oxidation

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Non precious electrocatalysts based on alloy structure and nanofibrous morphology are introduced. Briefly, NixCo1-x alloy nanoparticles incorporated in carbon nanofibers are investigated as electrocatalysts for ethanol oxidation. Preparation of the introduced nanofibers could be achieved by calcination of electrospun nanofibers composed of nickel acetate tetrahydrate, cobalt acetate tetrahydrate and poly(vinyl alcohol) in argon atmosphere at 800 oC. The catalytic activity of cobalt enhanced the carbonization of the utilized polymer which resulted in producing nickel/cobalt alloys nanoparticles embedded in carbon nanofibers. Electrochemical investigation of the introduced nanofibers toward ethanol oxidation indicated that the alloy structure has a strong influence. For instance, the corresponding current densities of Ni- and Ni0.9Co0.1-doped carbon nanofibers were 37 and 142 mA/cm2, respectively. Moreover, very low onset potential (-50 mV vs. Ag/AgCl) was observed when Ni0.1Co0.9 -doped carbon nanofibers were utilized. Furthermore, Ni0.9Co0.1-doped carbon nanofibers could oxidize ethanol solution up to 5 M due to the observed active layer regeneration.

(ICE-P042-2014) Improved Reproducibility of the Morphologies and Photovoltaic Performances of P3HT Electrospun Nanofibers through Control Over the Evaporation Rate

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Electrospun fibers with undesirable morphology are sometimes obtained in humid season. Because performance of some applications such as OPV devices is significantly influenced by the fiber morphology, method to remove beads on the surface of fibers and improve reproducibility is crucial for device preparation. Here, we study the reason of the morphological change and suggest the solution for the problem in humid season. Evaporation rate of solvent and efficiency of OPV devices are measured at various relative humidity to investigate the effect of relative humidity. The beaded morphology originates from the slow evaporation rate of the solvent in humid season. To increase the evaporation rate in humid season, warm air is applied on the electrospinning system. As a result, beads of electrospun fibers are completely removed, and power conversion efficiency of the OPV device fabricated in humid season is restored. The results indicate that the proposed method is a simple and effective approach to improve the reproducibility of electrospinning regardless of relative humidity and performance of applications.

(ICE-P043-2014) Cd-doped Co nanoparticles as effective and stable electrode for capacitive deionization technology

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Because of the low energy requirement and the environmentally safe byproducts, the capacitive deionization water desalination technology has attracted the attention of many researchers. The important requirements for electrode materials are good electrical conductivity, high surface area, good chemical stability and high specific capacitance. In this study, metallic nanoparticles that are encapsulated in a graphite shell (Cd-doped Co/C NPs) are introduced as the new electrode material for the capacitive deionization process because they have higher specific capacitance than the pristine carbonaceous materials. Cd-doped Co/C NPs perform better than graphene and the activated carbon. The introduced nanoparticles were synthesized using a simple sol-gel technique. A typical sol-gel composed of cadmium acetate, cobalt acetate and poly(vinyl alcohol) was prepared based on the polycondensation property of the acetates. The physiochemical characterizations that were used confirmed that the drying, grinding and calcination in an Ar atmosphere of the prepared gel produced the Cd-doped Co nanoparticles, which were encapsulated in a thin graphite layer. Overall, the present study suggests a new method to effectively use the encapsulated bimetallic nanostructures in the capacitive deionization technology.

(ICE-P044-2014) Study of the effect of silica and tin oxide nanoparticles on electrospun separator properties

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In this work we develop nanostructured electrospun separators for lithium batteries made of Poly(vinylidene fluoride) (PVDF) loaded with either fumed silica or tin oxide nanoparticles. The use of high porosity and wide surface area material allows a massive electrolyte uptake; oxide nanoparticles are added to the polymer to increase mechanical, thermal and electrical properties of the separator with the aim to fulfil capacity and safety requirements of lithium batteries. Fiber morphology was observed by SEM and the presence of the additives inside the material was revealed by energy dissipation spectroscopy (EDS). Tensile tests, thermogravimetric measurements and differential scanning calorimetry are carried out to study mechanical properties of the separators, to quantify the inorganic fraction and to evaluate thermal properties. TEM was used to evaluate the quality of nanoparticle dispersion inside the fibers. Conductivity measurements and dielectric spectroscopy on membrane are carried out to ensure low values of electron carriers conductivity. Finally, the electrospun separators are soaked in electrolyte solution to estimate their uptake. The most remarkable effect of nanoparticles addition is a significant improvement of separator mechanical properties, namely the increase of stress at break and elongation at break.

(ICE-P045-2014) Construction of an electrospinning device for fast nano-material synthesis

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Herein we report on the construction, testing and first spinning results of a homemade electrospinning (ES) apparatus. The aim of our research project, during my phD thesis, is the synthesis and characterization of new nanostructured composite materials via ES. Targets are energy materials for battery applications and kinetically stabilized compounds with complex polyoxoanions. An ES setup consisting of a commercial high voltage supply, two syringe pumps, an Aluminum collector and a double nozzle, which has been constructed and built by ourself. The double nozzle is connected to the syringe pumps via silicon tubes in order to create core-shell structures. First fibers have been prepared in an ES process of the starting material. By variation of the internal (molecular weight of polymer & concentration) and external (voltage, feedrate, diameter of needle & distance between tip & collector) parameters the fiber production has been optimized. Based on the results, we reproduced polyethylene oxide nanofibers in the range of 500 nm to 1,6 µm. Targets are cathode materials for batteries and complex species containing polyoxoanions using a polymer solution with different kind of soluble salts to create new composite materials. Different substance classes will be addressed and materials characterization by X-ray diffraction, elementary analysis and electrochemical measurements will be discussed.

(ICE-P046-2014) Influence of nitrogen doping on the catalytic activity of Ni-incorporated carbon nanofibers for alkaline direct methanol fuel cells

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In this study, the influence of nitrogen doping on the electrocatalytic activity of carbon nanofibers with nickel nanoparticles toward methanol oxidation is introduced. The modified carbon nanofibers have been synthesized from calcination of electrospun nanofiber mats composed of nickel acetate tetrahydrate, poly(vinyl alcohol) and urea in argon atmosphere at 750oC. The utilized physicochemical characterizations indicated that the proposed strategy leads to form carbon nanofibers having nickel nanoparticles and doped by nitrogen. Moreover, due to the high-applied voltage during the electrospinning process, the utilized urea chemically bonds with the polymer matrix, which leads to form nitrogen-doped CNFs after the calcination process. Investigation of the electrocatalytic activity indicated that nitrogen doping NiCNFs strongly enhances the oxidation process of methanol as the current density increases from 52.5 to 198.5 mA/cm2 when the urea content in the original electrospun solution was 4 wt% urea. Moreover, the nanofibrous morphology exhibits distinct impact on the electrocatalytic activity. Also, nitrogen-doping enhanced the stability of the introduced Ni-based electrocatalyst. Overall, the present study introduces effective and simple strategy to modify the electrocatalytic activity of the nickel-based materials.

(ICE-P048-2014) Electrically conductive nanostructured membranes for filtering application

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Electrically conductive polyurethane nanostructured systems had been prepared combining the electrospinning of polymer nanofibres (NFs) with the electrospraying of pristine multiwall carbon nanotubes (MWCNTs) in both separated and simultaneous processes. Three different arrangements of spray and spinning sources had been evaluated for the simultaneous deposition system. Samples had been characterized by morphological (SEM, TEM), spectroscopic (UV-Vis, Raman) and analytic (ICP-MS) techniques. Stability of nanotubes adhesion to nanofibre surfaces had been verified too. Large membranes with a surface resistance of about 10^4-10^5 Ω with a CNTs concentration less than 0,3% w/w (equal to 0,01 mg/cm2) had been obtained. These membranes, which exhibit antistatic properties, could be a good candidate for filtration in dangerous environment.

(ICE-P049-2014) Novel biobased polymeric electrospun nanofibers with high antibacterial efficacy

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Development of antibacterial electrospun non-woven meshes is of critical importance in several areas such as healthcare products, food packaging, water and air filtration. In this work a novel biocidal polymer, which results active against Escherichia coli and Staphylococcus aureus, was synthesized starting from the biobased ricinoleic acid monomer (RA) and processed through electrospinning in combination with a biodegradable polymer poly(butylene

succinate) (PBS), through a blending approach. The optimization of electrospinning process parameters allowed fabrication of defect-free nanofibers with uniform fiber diameter distribution. The chemical, physical and mechanical properties of the obtained non woven meshes were characterized and related to mesh structure and composition. The electrospun constructs were microbiologically evaluated and antibacterials tests confirmed their high biocidal efficacy. Mortality rate of E.Coli and S.Aureus was very high and it increased with the amount of PRA in the blends. Notably, the antimicrobial performances of the meshes were retained after 3 cycles of incubation with cell bacterial suspension. The obtained biobased and biodegradable antibacterial electrospun meshes can find useful application in several sectors.

(ICE-P068-2014) Use of nanofibre membranes for the treatment of wastewater effluent

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Previous studies on electrospun nanofibre membranes showed the need for an anti-fouling mechanism on the membranes. Functional agents such as TiO2 that have both photocatalytic and antimicrobial properties could be used to avoid fouling. Polyamide-6 (PA-6) nanofibre membranes containing TiO2 nanoparticles were successfully prepared by electrospinning. Different types of TiO2 functionalization methods (inline functionalisation and post-functionalization) were tested with two types of TiO2 nanoparticles. A colloidal solution consisting of TiO2 nanoparticles with average dimensions of 6 nm was prepared and the performance of these nanoparticles was compared with commercially available Degussa P25 nanoparticles. Since recent studies have shown that natural organic matter (e.g., humic and fulvic acids) is a major foulant during filtration of surface water, the ability of nanofibre membranes functionalized with TiO2 were screened for their use in humic acid removal. The results demonstrated the photocatalytic activity of TiO2 nanoparticles immobilized in and on the nanofibrous structure. After 4 hours of UV-irradiation, a degradation up to 74% of the humic acids was observed. This result is comparable with literature when using 1 g TiO2 /l with the advantage that in this study TiO2 is immobilized. Immobilization of TiO2 in a photoreactor omits the need for photocatalyst separation in a subsequent process.

(ICE-P069-2014) Development of silver-containing nanocellulosics for effective water disinfection

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Electrospun cellulose nanofibers and cellulose-graft-polyacrylonitrile (Cell-g-PAN) copolymer nanofibers containing silver nanoparticles (AgNPs) were synthesized for effective water disinfection. Surface morphology, AgNPs content, physical distribution of AgNPs, levels of silver leaching from the fibers in water and antimicrobial efficacywere studied. Scanning electron microscope images revealed that AgNPs in cellulose nanofibers were more evenly dispersed than in Cell-g-PAN copolymer nanofibers, but with the certainty that Cell-g-PAN copolymer nanofibers had higher AgNPs content. This was confirmed by energy dispersive X-ray analysis and atomic absorption analysis. Both cellulose nanofibers and Cell-g-PAN copolymer nanofibers containing AgNPs had excellent antimicrobial activity against Escherichia coli, Salmonella typhi, and Staphylococcus aureus, with cellulose-nAg nanofibers killing between 91 and 99 % of bacteria in a contaminated water sample and Cell-g-PAN-nAg copolymer nanofibers killed 100 %. Neither Cell-g-PAN copolymer nanofibers nor cellulose nanofibers leached silver into water.

(ICE-P047-2014) Waterproof-breathable PVDF membranes prepared in one-step by Electrospinning

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The target of this research is the one-step synthesis of waterproof-breathable membranes by electrospinning. Nonwoven mats of PVDF with homogeneous thickness of few tens of microns have been produced by electrospinning dissolutions of PVDF on different moving substrates. These membranes showed a contact angle of 120° instead of 90°, as in bulk PVDF. The liquid water pressure entry (LEP) for membranes with thickness of 50 microns is between 1 - 1.2 bar while being highly permeable to water vapor (954,93 gr/hm2). These low weight PVDF membranes are being adapted for their incorporation in technical textiles.

(ICE-P050-2014) Wet-electrospinning for producing multi-core fibers, with diameters ranging from submicron up to the tens of microns

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Electrospinning has been broadly used with a vast variety of polymers to produce polymer fibers with diameters ranging from few microns down to tens of nanometers. However, producing fibers in the tens to hundreds of microns is rather difficult with this technique, particularly when the polymer dissolution exhibit a rather high electric conductivity. A novel approach, consisting in the combined use of an electric field and a coagulation bath for stretching and collecting the fibers, has been tuned to produce fibers with controlled diameters that may be in the range of the tens of microns. A side-by-side electrospinning spinneret has been used to produce double-channel fluorescent PVDF fibers. By adjusting the controlling parameters, the diameter of the multi-core fibers can easily reach 500 nm or almost 100 microns.

(ICE-P051-2014) Use of a modified McIntyre cannula needle as a low cost spinneret assembly for coaxial electrospinning

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Coaxial electrospinning (CES) is an efficient process for synthesizing core-shell nano fibers and bioactive encapsulation wherein it makes use of a spinneret, with concentrically arranged needle tubes. The present work evaluates the use of a McIntyre cannula needle, conventionally used for ophthalmic surgeries, as a CES spinneret to synthesize hollow polymer fibers and for encapsulation of bioactives. After slight modification, the McIntyre cannula needle was used to synthesize hollow fibers of nylon 6 with nylon 6 solution as sheath and hydrogen peroxide as core. In addition encapsulation of bioactives viz., red blood cells, bacterial cells and proteins was attempted, using the individual aqueous suspensions as core, with poly(-caprolactone) solution as sheath. The fiber morphology was characterized by optical, fluorescence, scanning and transmission electron microscopy. Moreover, depending on the nature of bioactives, preliminary assays were performed to verify their stability. Resulting fibers had an integral core-shell structure, indicating a successful coaxial electrospinning process. Therefore apart from being a clinical device, a modified McIntyre cannula needle can also serve as an economic alternative to conventional coaxial spinneret assemblies.

(ICE-P052-2014) Nanoparticle dispersion in PEO polymeric solutions via plasma treatment for the production of electrospun lithium batteries separator

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The use of electrospun mats is considered an innovative solution for the production of separators for lithium-ion batteries. Furthermore, the addition of oxide nanoparticles is known to be a suitable way to increase mechanical, thermal and electrical properties of the electrospun separators. Conventional techniques such as mechanical stirring, sonication, ball-milling and sol-gel methods have been investigated in the past in order to improve nanoparticle dispersion. This work is focused on a novel treatment, where an atmospheric pressure plasma is employed to treat the polymeric solution thus facilitating nanoparticle dispersion. Poly(ethylene oxide) (PEO) is dissolved in bidistilled water and fumed silica nanoparticles (average size = 7 nm) are added to the solution. The electrospinning solution, either before or after nanoparticle addition, is exposed to a plasma jet driven by high voltage nanosecond pulses. In addition, mechanical stirring is performed both on treated and reference samples. A very good particle dispersion in the electrospun fibers of plasma treated polymeric solutions is observed by means of transmission electron microscope. In particular, when a 3 minutes plasma treatment of the solution is followed by 10 minutes stirring of nanoparticles, an outstanding dispersion of fumed silica is obtained in the produced nanofibers.

(ICE-P053-2014) Atmospheric pressure plasma enhanced electrospinnability of poly (L-lactic acid) solutions

V. Colombo, Alma Mater Studiorum- Università di Bologna, Italy; D. Fabiani, M. Focarete, Alma Mater Studiorum - Università di Bologna, Italy; M. Gherardi, Alma Mater Studiorum- Università di Bologna, Italy; C. Gualandi, Alma Mater Studiorum - Università di Bologna, Italy; R. Laurita*, Alma Mater Studiorum- Università di Bologna, Italy; M. Zaccaria, Alma Mater Studiorum - Università di Bologna, Italy

The influence of atmospheric pressure non-equilibrium plasma treatment on the electrospinnability of poly(L-lactic acid) (PLLA) solutions is investigated. PLLA is a biocompatible and biodegradable polymer and can be processed into nanofibers by electrospinning, dissolving it in dichloromethane (DCM) and dimethylformamide (DMF). The latter is added to DCM to increase the dielectric constant of the solution, thus ensuring its electrospinnability. The boiling temperature of DMF is around 153°C, higher than that of DCM (40°C): it is therefore difficult to completely avoid traces of residual DMF in the electrospun nanofibers. The production of scaffolds for biomedical applications without any trace of residual organic solvents would be a great chance in order to increase material biocompatibility. In this work we treat a solution of PLLA in plain DCM by using an atmospheric pressure non-equilibrium plasma jet, in order to improve its electrospinnability in the absence of DMF. The plasma jet is driven by several different high voltage waveforms: sinusoidal, triangular and square waveforms with nanosecond or microsecond rise times are here employed. Considerations on the effects of voltage waveform, peak voltage, frequency and treatment time will be presented. In particular, the beneficial effect of using nanosecond high voltage pulses will be highlighted.

(ICE-P054-2014) Enlarging Pore Size for Improving Cell Infiltration in Electrospun Scaffolds by Positive Voltage and Negative Voltage Electrospinning

Q. Zhao*, O. So, M. Wang, The University of Hong Kong, Hong Kong

Small pore size, which limits cell infiltration, is a major problem for electrospun tissue engineering scaffolds, hampering their progress towards clinical applications. Most of current methods for enlarging pore size in electrospun scaffolds affect the nanofibrous structure or scaffold mechanical properties. This study investigated a new approach for enlarging pore size without causing aforementioned problems. The dual-source dual power electrospinning technique was employed to fabricate intermeshed nanofibrous membranes, and power supplies of negative voltage (NV) and positive voltage (PV) were used to produce polymer fibers with different electrical charges (polarity and magnitude). Scaffolds composed of PLGA fibers were electrospun using different polarity combinations (NV+NV, PV+PV, PV+NV) and different applied voltages (±10, ±15 and ±20 KV). The electrical charge of resultant scaffolds was measured using an electrostatic voltmeter. It was found that PLGA scaffolds made by high voltages (either PV or NV) would bear corresponding charges which were retained at about 30% of its initial charge value after one week. The porous structure was different for scaffolds made in different conditions. Scaffold made by PV+NV showed enlarged average pore size. Cell culture experiments are now conducted to assess cell infiltration in different scaffolds.

(ICE-P056-2014) Development of pulse electrospinning installation and getting micron length of polymer fibers

Y. Aliyev*, B. Dabynov, G. Ustayeva, D. Igimbayeva, M. Nazhipkyzy, Z. Mansurov, Institut of combustion problems, Kazakhstan

The aim of this work is the development and construction of the pulse electrospinning to produce nano-sized particles, with the ability to control their size. The prefix " nano" means that the dimensions of the particles to range from 10 to 500 nm in at least one dimension. The prototype of the pulse electrospinning setup is a classic electrospinning setup, which operates at a constant voltage. In the pulse electrospinning setup unlike classical setup high voltage is applied in the form of controlled pulses, which allows to obtain a controlled fiber length. We have designed and developed a pulse electrospinning setup, which has a higher amplitude of the high voltage - 16 kV (which is 6 kV more than the above settings). In the present apparatus for producing a pulsed high-voltage high-frequency transformer is used. A schematic diagram and photo of pulse electrospinning setup is showed. The experimental results suggest following conclusions: It was designed and created a newest installation of pulsed electrospinning to obtain short fibers; Short fibers was obtained experimentally . For example, short fibers with diameter of 500 nm and a length of 5 microns was obtained from cellulose acetate and ABS polymer.

(ICE-P057-2014) Surface modification of electrospun poly (Acrylonitrile-co- Styrene) copolymer nanofibers towards developing a dye removal

M. El-Aassar*, City of Scientific Research and Technology Applications, Egypt; M. El-Kady, Engineering Faculty, Egypt-Japan University of Science and Technology, Egypt; H. Shokry, City of Scientific Research and Technology Applications, Egypt

Electrospun nanofibers with a high surface area to volume ratio have received much attention because of their potential applications for heavy metal and dyes removal. In this study, firstly, poly (Acrylonitrile-co- Styrene) (poly (AN-co-ST)) copolymer nanofibers with an average diameter form 80 nm to 1 μm were synthesized by solution polymerization of Acrylonitrile (AN) monomer and ST monomer crosslinker in the presence of Potassium persulfate (K2S2O8) initiator. Secondly, electrospinning of poly (AN-co-ST) copolymer in dimethyl formide (DMF) solvent have been investigated. Poly (AN-co-ST) nanofiber was modified and functionalized through introducing terminal carboxylic acid groups on the surface. The modified nanofiber was followed by Attenuated Total Reflectance Fourier Transformed Infrared (FTIR) measurements. The surface morphology and thermal behavior of the poly (AN-co-ST) nanofiber and their modified form were also characterized by scanning electron microscopy (SEM) and thermogravimetric analysis (TGA) techniques further confirming modification.

(ICE-P058-2014) Multiwall carbon nanotubes (MWCNT) embedded in oriented Poly(vinylidene fluoride) (PVDF) nanofibers by electrospinning

J. P. Santos, A. B. Silva, R. E. Bretas*, Universidade Federal de São Carlos, Brazil

In this work we propose the incorporation of multiwall carbon nanotubes (MWCNT) into a Poly(vinylidene fluoride) (PVDF) matrix through electrospinning technique as an strategy to disperse, align and orientate the MWCNT through the PVDF matrix. Solutions of PVDF/MWCNT were prepared using N,N-dimethylformamide (DMF) and acetone (3:1, v/v). Four concentration of MWCNT in the PVDF matrix were used: 0, 5, 10 and 20 wt %. The solutions were then electrospun to form the nanofibers mats. The mats morphology was analyzed by scanning and transmission electron microscopy (SEM and TEM, respectively) while the number-average diameter of the nanofibers and its distribution were calculated. The polymorphic behavior of the nanofibers was studied by wide-angle X-ray diffraction (WAXD) and infrared spectroscopy (FTIR). The SEM and TEM micrographs show that nanofibers mats of PVDF/MWCNT nanocomposites were successfully produced by the electrospinning technique. MWCNT were embedded, dispersed, aligned and oriented inside the nanofibers. The higher the speed rotation, the higher the nanofibers alignment. The Beta-PVDF phase was formed as a result of a strong alignment induced by electrospinning.

(ICE-P059-2014) Electrospun core-sheath PEO/Eudragit S100 nanofibers for enhanced magnetic resonance imaging

M. Jin*, G. Williams, University College London School of Pharmacy, United Kingdom; A. Bligh, University of Westminster, United Kingdom; D. Yu, University of Shanghai for Science and Technology, China

Magnetic resonance imaging (MRI), is a medical diagnostic tool used for detecting abnormal organs and tissues, often using Gd(III) complexes as contrast-enhancing agents. Polymer nanofibers have been prepared using coaxial electrospinning, with the intent of delivering Gd-DTPA (gadolinium (III) diethylene triamine pentaacetate hydrate) to specific tissues. Experiments were performed to make composite fibers with Eudragit S100 and Gd-DTPA-loaded PEO (polyethylene oxide) as the sheath and core matrix respectively. The systems were studied using scanning and transmission electron microscopies, differential scanning calorimetry and X-ray diffraction. The Gd-DTPA-loaded PEO / Eudragit S100 fibers were found to be homogeneous with average diameters of 272 ± 73.2 nm, and to have distinct core / sheath phases. The components in the fibers were dispersed in an amorphous fashion. The fibers were also studied using Fourier transform infrared spectroscopy, which indicated good compatibility between the Gd complex and polymers. In vitro dissolution tests showed that nanofibers coated with Eudragit S100 did not exhibit any release in acidic solution (pH 1), but sustained release at pH 7.4. This simple and straightforward approach thus offers a new technique for the design and fabrication of nanofibers to release Gd-DTPA to the colon-targeting.

(ICE-P060-2014) Piezoelectric Properties of Polylactic Acid based Electrospun Nanofiber Webs

K. Kim*, S. Lee, Y. Ahn, A. Prabu, Kyung Hee University, Republic of Korea

Typical piezoelectric polymers such as polyvinylidene fluoride (PVDF) and its copolymer with trifluoroethylene based electrospun nanowebs have found diverse applications in biomedical sensors, energy generation, etc. However, their higher production cost has led many researchers to focus their attention on low-cost and environmental friendly alternatives such as polylactic acid (PLA). In our study, we prepared 4032D (Nature works, USA) PLA based electrospun nanoweb fibers from 10 wt.-% solution using CHCl3: DMAc solvent mixture (3:1 ratio). The electrospun materials were characterized using spectral and morphological measurements, and after the fabrication of sensors using conductive fabric as top and bottom electrodes, their piezoelectric properties were studied under the periodic external pressure in the vertical direction as a function of varying nanoweb layers. For the single nanoweb layer of PLA, the piezoelectric sensor gave an output voltage of about 2.5 V which further increased to 4.5 and 6 V in the case of 3 and 5 layers, respectively. Further studies were carried out by varying the parameters such as changing the active and electrode areas, frequency of the imparting pressure, etc. The output voltage obtained in our piezoelectric sensor might be useful for powering portable electronic devices with better commercial and technical performance than PVDF based sensors.

(ICE-P061-2014) Electrospun Poly(vinylidene fluoride) Nanowebs Coated with Silicone Rubber as Piezoelectric Sensors for Healthcare Monitoring

Y. Ahn*, A. Prabu, K. Kim, Kyung Hee University, Republic of Korea

Poly(vinylidene fluoride) (PVDF) is one of the most widely electrospun materials for applications such as scaffold, nanogenerator and piezoelectric sensor. In the present work, we studied the vital signal from a piezoelectric sensor fabricated using electrospun PVDF nanoweb with/without silicone rubber (SR) coating and embedded to the elastic band for measurement. Type-I sensor device used only PVDF nanoweb as the active material and conducing fabric as top and bottom electrodes. The output piezoelectric signal was observed to be very weak (1~2 V) and also exhibited structural damage during cyclic measurement. This problem can be avoided by applying SR coating over Type-I device. Under periodic external pressure, the SR coating in Type-II device served to increase the area of impact and also protect the nanoweb from structural damage. Type-II device generated a higher output voltage (2~3 V) than that observed for Type-I case. In the case of Type-III device where the SR layer is coated all over the PVDF nanoweb layer, followed by conducing fabric as top and bottom electrodes, the output voltage is the least observed (<1 V) due to the SR coating acting as an insulator. Further studies were carried out by varying the parameters such as changing the number of stacked nanoweb layers, active electrode areas, frequency of the imparting pressure, etc.

(ICE-P062-2014) Catalytic Oxidation of Low Concentration Gaseous Organic Pollutants over Electrospun Nanofibrous Catalysts

K. Soukup*, P. Topka, V. Hejtmanek, O. Solcova, Institute of Chemical Process Fundamentals of the ASCR, Czech Republic

In the past few years, the electrospun nanofibrous membranes have been attracted a plenty of attention due to their distinctive properties and superiority. Especially, electrospun membranes seem to be promising porous carriers for the immobilized catalysts. Their sufficiently high specific surface area together with generally low transport resistance can compete with the traditionally supported porous catalysts. Our study is focused on the preparation of electrospun nanofibrous support based on poly(2,6-dimethyl-1,4-phenylene oxide) (PPO). Electrospun PPO support with the mean fiber diameter 150 nm exhibited high porosity (80%) and suitable transport properties. Platinum and palladium catalysts were supported on electrospun nanofibers by the wet impregnation technique and subsequent activated by calcination in air at 175 °C. The catalytic activity of the prepared catalysts was tested in the total oxidation of methanol and ethanol in air as the model reactions. It was found that the catalytic performance of electrospun catalysts depended linearly on the mean size of platinum nanoparticles. On the other hand, palladium catalysts exhibited the same catalytic performance irrespective of the varying mean Pd particle size. The different particle-size sensitivity of Pt and Pd catalysts was tentatively ascribed to the different nature of both noble metals.

(ICE-P063-2014) The post-spinning stretching effect on the uniaxial orientation of PAN electrospun precursor web for carbon nanofiber

J. Youm*, K. Yang, Chonnam National University, Republic of Korea

For enhancing the mechanical properties of carbon nanofibers, uniaxial alignment of the electrospun precursor fibers is necessary. However, it is difficult to introduce perfect fiber alignment along winding direction because of the higher whipping speed than the pick-up speed on the drum winder. In this study, high speed wind-up was performed to improve alignment along the winding direction and followed by stretching to enhance molecular orientation in the electrospun precursor fibers. The spinning solution was prepared by dissolving polyacrylonitrile (MW, 150,000) powder in N,N-dimethyl formamide(DMF). Electospinning was performed on the drum winder over 2,000 m/min. For improving the uniaxial molecular orientation of spun fibers, the web was stretched along the fiber direction at elevated temperatures. The fiber morphology and its diameter of stretched electrospun fiber web were observed by X-ray diffraction and transmission electron microscope (TEM), and scanning electron microscope (SEM). The uniaxial stretching of the web improved fiber alignment and reduced fiber diameter. The effects of stretching on the mechanical properties are to be evaluated and characterized further.

(ICE-P064-2014) Characteristics of PVDF-HFP based nanocomposite gel polymer electrolytes dispersed with MWCNTs for li-ion batteries

R. Sharma*, A. Sil, S. Ray, Indian Institute of Technology, India

In this work we have investigated the effect of multi walled carbon nanotubes on the electrical properties of PVDF-HFP based gel electrolytes. The length and diameter of MWCNTs used in the present work are 10-30μm and 10-20 nm, respectively. The nanocomposites polymer electrolytes have been synthesized by solution casting technique with varying the weight ratio of MWCNTs. By analysis of impedance spectroscopy it has been demonstrated that the incorporation of MWCNTs into PVDF-HFP–(PC+DEC)–LiClO4 gel polymer electrolyte system significantly enhances the ionic conductivity of the electrolyte. The enhancement of ionic conductivity seems to be correlated with the fact that the dispersion of MWCNTs to PVDF-HFP prevents polymer chain reorganization due to the high aspect ratio of MWCNTs, resulting in reduction in polymer crystallinity, which gives rise to an increase in ionic conductivity. The decrease of crystallinity of PVDF-HFP due the addition of MWCNTs has been confirmed by XRD. The interaction of MWCNTs with various constituents of polymer electrolytes has been studied by FTIR spectroscopy. TEM results show that the fillers (MWCNTs) has distributed uniformly in the polymer electrolytes. Moreover MWCNTs added gel polymer electrolytes offer better thermal stability as compared to that of MWCNTs free electrolytes as confirmed by TGA analysis.

(ICE-024-2014) 3D Self-supported Electrospun Nanomats of Cerium doped Titania Photocatalysts

S. Topcu*, P. Gouma, Stony Brook University, USA

There is a significant interest in developing novel photocatalytic technology for applications ranging from water remediation to solar energy formation vis water splitting. There is also a growing need to develop self-supported nanocatalysts that do not disperse in aqueous media. Thus, a novel synthesis method has been developed, the 3D photocatalytic nanogrid synthesis, a pioneering concept that came out of our research lab. In this abstract, Ce-doped TiO2 nanofibers were successfully synthesized by a single step blend electrospinning process of a sol-gel solution. The crystalline structure, surface morphology and optical properties of samples were characterized using XRD, SEM, TEM and UV-Vis. The process maps for the synthesis of the nanomats has been compiled and the nanomats have been optimized in composition and morphology so that the Ce-doped TiO2 mats exhibit higher photocatalytic activity than pure TiO2. Electrospinning has been proved to be a versatile and cost-effective effective method to manufacture nanomats. The capability to an extensive control over the diameter and composition of the nanomats makes this technique preferable to produce catalyst. In our research, we produced nanomats with different concentration of cerium doped TiO2. The average diameter of the fiber and the morphology are essential to improve the efficiency of photocatalyst.

Wednesday, August 6, 2014

Plenary Session II

Room: Metropolitan III

9:05 AM

(ICE-052-2014) Functional polymer nanofibers: opportunities and challenges

L. Persano*, A. Camposeo, National Research Council-CNR, Italy;
D. Pisignano, Università del Salento, Italy

System level multifunctionality is one of the most desired capability for device interfacing. Health monitoring and interactive multimedia technologies simplifying complex daily tasks are examples of the enormous possibilities offered by next generation multifunctional materials and devices. In this respect, 1D nanostructuring of organic materials is gaining continuous research interest, and polymer nanofibers, as building blocks of complex architectures, can lead to advances in many fields including photonics and electronics. In particular, properly designed functional nanofibers capable of sensing, storing and converting energy have been demonstrated. Mechanical flexibility, ease of processing, good chemical resistance and large sensitive areas are some of the properties associated to such novel materials. This in turn enables the exploitation of deformations induced by small forces through pressure, mechanical vibration, elongation/compression, as natural sources of power. Other interesting perspectives for devices in nanophotonics have been opened by the enhanced optical properties of electrospun nanofibers, including, among others, enhanced emission efficiency and waveguiding capability. In this scenario, leading electrospinning towards industrial applications will provide more and more opportunities for developments well beyond existing, consolidated technologies.

Biomedical Applications of Electrospun Materials I

Room: Metropolitan III

Session Chairs: Xiumei Mo, Donghua University; Jingwei Xie, University of Nebraska Medical Center

10:00 AM

(ICE-053-2014) Applications of Electrospun Membranes (Invited)

I. Kyratzis*, Y. B. Kyratzis, CSIRO, Australia

Novel fibrous structures, especially from nano- and micro-fibres, show great potential in applications such as energy, environmental remediation especially of water, filtration and sensing. These structures can be composed of organic and / or inorganic materials. Electrospinning is amenable to making nanofibre based materials with enhanced properties compared to films. In the energy domain electrospun membranes have been developed with enhanced mechanical chemical, and temperature stability as well as better electrolyte wetting properties. In the environmental remediation applications electrospun membranes have been successfully used for the extraction of heavy metals, such as cadmium, zinc, nickel, copper, and anions such as arsenates and phosphates from water. Electrospun membranes have also been designed for the detection of trace metals and gases. These enhanced properties can be obtained through interpenetration fibrous networks, composites layers amongst other methods. CSIRO has an active research and

development program in these areas and the latest results will be presented.

10:30 AM

(ICE-054-2014) Electrospun Nanofibers at Work in Biomedical Research (Invited)

Y. Xia*, Georgia Institute of Technology, USA

Electrospun nanofibers can be easily prepared with tunable and controllable composition, diameter, porous structure, and surface property for a variety of applications. Owing to the small feature size, high porosity, and large surface area, a non-woven mat of electrospun nanofibers can serve as a scaffold to mimic the extra cellular matrix (ECM) for cell attachment and proliferation. The nanofibers themselves can also be functionalized through encapsulation or attachment of bioactive species such as ECM proteins, enzymes, and growth factors. In addition, the fibers can be further assembled into a variety of arrays or hierarchical structures by manipulating their alignment, stacking, or folding. All these attributes make electrospinning a powerful tool for generating nanostructured materials for a broad range of biomedical applications that include controlled release, drug delivery, and tissue engineering. In this talk, I will discuss how the conventional setup for electrospinning can be modified to control the composition, structure and alignment of nanofibers. Specifically, I will focus on the use of aligned nanofibers to control the differentiation of embryonic stem cells into different types of lineages for various biomedical applications. I will also discuss how nanofiber scaffolds can be designed for injury repair at the insertion site between tendon and bone, and as substitutes for dura mater in brain surgery.

11:00 AM

(ICE-055-2014) Cell-laden Nanofibrous Scaffolds Made by Concurrent Electrospinning and Cell Electrospraying

Q. Zhao*, M. Wang, The University of Hong Kong, Hong Kong

3D cell-laden structures are critical but difficult to make for electrospun tissue engineering scaffolds. Normal cell seeding can only put cells on scaffold surfaces. We therefore investigated the fabrication of 3D cell-laden scaffolds using concurrent electrospinning and cell electrospraying. For cell electrospraying, coaxial electrospray was employed. The coaxial device had an inner tube, which was supplied with a cell suspension of human umbilical vein endothelial cells (HUVEC), and a coaxial outer tube, which was fed with a polymer blend solution (gelatin and sodium alginate; at different ratios). Electrospraying formed hollow microspheres (5~15 μm), encapsulating cells. Effects of processing parameters (voltage, flow rate, etc.) were studied for forming microspheres. HUVEC cell viability was investigated after dissolving the water-soluble polymer shell and cell culture, and processing parameters were optimized for cell electrospraying. 3D cell-laden scaffolds were constructed via concurrent electrospinning and cell electrospraying using PLGA for forming nanofibers. They were then immersed in cell culture medium to dissolve polymer shell for releasing cells. Subsequently, in vitro biological studies were conducted to assess cell viability, cell location in scaffolds and cell proliferation. The results showed good cell viability and cells proliferated with increasing culture time.

11:20 AM

(ICE-056-2014) Electrospun Polymer Nanofiber Scaffolds for Tissue Engineering

R. Vera-Graziano*, Universidad Nacional Autónoma de México (National Autonomous University of México), Mexico; F. Sabina-Ciscar, Universidad Nacional Autónoma de México, Mexico; A. Maciel-Cerda, F. Sánchez-Arévalo, Universidad Nacional Autónoma de México (National Autonomous University of México), Mexico; R. Montiel-Campos, N. Batina, Universidad Autonoma Metropolitana (Metropolitan Autonomous University), Mexico; J. Cornejo-Bravo, Universidad Autónoma de Baja California (Autonomous University of Baja California), Mexico; A. Raya-Rivera, Hospital Infantil de México Federico Gómez (Infant Hospital of Mexico Federico Gomez), Mexico; F. Rivera-Torres, Universidad Pedagógica y Tecnológica de Colombia (Pedagogic and Technologic University of Colombia), Colombia; A. Ospina-Orejarena, Universidad Nacional Autónoma de México (National Autonomous University of México), Mexico; L. Villareal-Gómez, Universidad Autónoma de Baja California (Autonomous University of Baja California), Mexico; S. Alcántara-Barrera, Centro de Investigación Aplicada en Tecnologías Competitivas (Applied Research Center on Competitive Technologies), Mexico; L. Ávila-Gutíerrez, A. Navarro-Cerón, R. Romero Aragón, A. Monrroy-Brera, Universidad Nacional Autónoma de México (National Autonomous University of México), Mexico

The effects of electrospinning processing parameters on morphology and main physical, chemical and biological properties of nanofiber polymer scaffolds were studied. Biocompatible polymers and composites based on poly(lactic acid), poli(caprolactone), poly(-carbonate-urethane), poly(glycerol sebacate), quitosan, collagen, hydroxiapatite, and bioglass were studied as scaffolds for tissue engineering. The materials were analyzed by FTIR, NMR, DSC, and DMA. Morphology and porosity of the scaffold were determined by AFM, SEM, HRTEM, XRD, and SAX. An optimized electrospinning set-up was used to prepare the scaffolds. Models based on homogenization and differential replacement methods were developed to study the mechanical properties. Biological viability and biocompatibility of scaffolds were also analyzed. The electrospun materials show physical properties, nanometric diameters, porosity, and high surface/volume ratio similar to those of living tissues. The electrospinning set-up proved to be reliable to make nanofiber scaffolds with reproducible morphology and properties. Modeling was useful to correlate structure and properties of scaffolds. Biological test in vitro and in vivo showed the biological viability and biocompatibility of scaffolds. Our results suggest that the studied scaffolds are potentially useful for tissue engineering.

11:40 AM

(ICE-057-2014) A bioinspired nanofiber-hydrogel mimic of the cartilage extracellular matrix

F. A. Formica*, ETH Zürich, Switzerland; K. Maniura-Weber, A. M. Bühlmann, EMPA, Switzerland; M. Zenobi-Wong, ETH Zürich, Switzerland

Cartilage's unique mechanical properties are intricately tied to the collagen fiber/glycosaminoglycan gel structure of the extracellular matrix. The aim of this study was to develop a mimetic fiber-hydrogel composite for use in cartilage tissue engineering. Electrospun fibers based on poly(methyl methacrylate) (PMMA) were embedded in alginate hydrogels to provide a mechanically stable 3D matrix that: a) preserves the phenotype of the embedded chondrocytes and b) provides a sustained release of a cartilage therapeutic drug. A standard electrospinning device was used to produce PMMA fibers having diameters between 500-2000nm. Fluorescein and 4-methylumbelliferyl acetate (MU-Ac) were used as model drugs while the effect of biologically relevant molecules, e.g. the kinase inhibitors and anti-inflammatory drugs, was contemporarily explored. Drug-release studies of fluorescein from PMMA fibers showed a slow release rate over a period of 3 weeks, which was tunable by adjusting the PLGA content (0%-10%). Human chondrocytes seeded for 7 days on scaffolds loaded with MU-Ac showed excellent viability

(>90%). Moreover, a round cell morphology characteristic of chondrocytes in vivo was observed in the PMMA fibers/alginate hydrogel constructs. This hybrid system has the potential to improve the healing capacity of cartilage lesions due to its unique mechanical, chondrogenic and anti-inflammatory properties.

Energy Storage and Harvesting with Electrospun or Sprayed Materials I

Room: Metropolitan II

Session Chairs: Avinash Baji, Singapore University of Technology and Design; You-Lo Hsieh, University of California, Davis

10:00 AM

(ICE-058-2014) Molecular Orientation, Degradation and Gelation in Environmentally Sustainable Polymers: Electrospun Nanofibers of Poly(hydroxybutyrates) and Their Copolymers (Invited)

J. F. Rabolt*, L. Gong, B. Chase, University of Delaware, USA; I. Noda, Meredian Bioplastics, USA

Poly (hydroxybutyrate) (PHB) is a biodegradable, aliphatic polyester that can be produced by chemical processes or bacterial fermentation. However, bacterially produced PHB is a highly crystalline polymer that is brittle and lacks flexibility. In order to modify these properties 3-hydroxyhexanoate (3HHx) has been added as a co-monomer and these new materials, referred to as PHB-HHx, exhibit a significantly reduced crystalline content, resulting in improved mechanical properties and processability. While this approach definitely leads to important improvements, there is always the question of concomitant changes in other important properties such as electrospinability and this has been addressed using a wide range of copolymers with different amounts of 3HHX comonomer varying from 3.9-13 mol%. In addition, we have explored the correlation between structure, processing and chain orientation/crystallinity and tested the hypothesis that improved chain orientation in electrospun nanofibers can increase modulus and tenacity even while crystallinity is disrupted by appropriate comonomer compositions. We have also explored an alternate processing approach (thermoreversible gelation + lyophilization) to produce fibrous structures similar to an electrospun membrane without significantly changing the desired properties.

10:30 AM

(ICE-059-2014) Electrospinning of Multifunctional Hybrid Fibers (Invited)

W. Sigmund*, University of Florida, USA

This talk will present the fabrication and characterization of multifunctional fibers for diverse applications. The author will discuss how porous and nanofibers can be tailored to achieve responsive surfaces or control thermal properties. Material properties of these nanostructures will be discussed for energy storage and photocatalysis.

11:00 AM

(ICE-060-2014) Mesoporous Metal-Doped Carbon Nanofibers as Cathode for Lithium-Air Batteries

S. Martinez Crespiera, D. Amantia*, C. Pelegrín, E. Knipping, C. Aucher, M. Faccini, L. Aubouy, LEITAT, Spain

Electric car is considered as the most promising technical solution for automotive transports in 21st century. Nowadays, worldwide attentions have been turned to the extremely high density and high capacity lithium air batteries. According to this, LEITAT Technological Centre is studying the performance of metal-doped carbon nanofibers synthesized by electrospinning as new cathode materials in lithium-air batteries. Our studies focus on the influence of the cathode porosity and the inclusion of catalytic nanoparticles into the electrochemical performance of the Li/O2 battery. On the one side, carbon nanofibers with increased macroporosity as well as mesoporosity have been produced. The macroporosity permits oxygen diffusion and the mesoporosity increases the ability of the cathode to accommodate a substantial amount of Li- peroxide without blocking the cathode pore orifices. On the other side, the synthesized carbon nanofibers with small size diameter and homogeneously distributed metal nanoparticles (MnO2, Co and Pd) allow enhanced catalysis of the oxygen reduction reaction (ORR) that takes place in the cathode. In summary, the electrochemical characterization of these free-standing nanocomposite carbon nanofibers (without the need of binders and carbon cloth) show high specific capacity values, long life cycling and good safety.

11:20 AM

(ICE-062-2014) Design of 3D Nanofiber Electrodes for Future Energy Devices

W. A. Zhang*, V. Esposito, S. Søren Simonsen, W. Zhang, S. Ramousse, J. Oluf Jensen, Technical University of Denmark, Denmark; P. N. Pintauro, Vanderbilt University, USA

Electrochemical devices for clean energy conversion such as proton exchange membrane fuel cells (PEMFCs) and solid oxide fuel cells (SOFCs) are currently and for the foreseeable future very much in the spotlight. Although these developing energy technologies have seen a rapid development, new break-through developments are needed to improve their durability, efficiency, power density and cost to make them commercial viable. Electrospinning provides possibilities of generating composite networks from a rich variety of materials with the ability to control composition, morphology and secondary structure. The objective of this presentation is to show the potential of electrospinning in designing nanostructures of both organic and inorganic materials in electrochemical devices. Herein, we present results on 1) Nafion/ Pt-C composite cathodes for PEMFCs; 2) ceramic nanofiber cathode for SOFCs. Exceptionally high power densities and platinum mass activity are achieved when using the nanofiber mat as cathode in PEMFCs. The nanofiber cathode also exhibits outstanding stability in accelerated durability tests. In case of SOFCs, lanthanum strontium cobaltite ion perovskite nanofibers were synthesized by combining sol-gel synthesis, electrospinning and sintering.

Filtration, Textiles and Other Topics I

Room: Metropolitan I

Session Chairs: Gregory Rutledge, MIT; Jennifer Andrew, University of Florida

10:00 AM

(ICE-063-2014) Advanced Electrospinning of Nanofiber Nonwovens and Nanofiber Yarns (Invited)

T. Lin*, Deakin University, Australia

Electrospinning is a simple, but efficient and versatile, technology to produce nanofibers. This technique has been shown many advantages such as universality in processing polymeric materials, eases of controlling fiber diameter and functionality, and flexibility to generate fibrous membranes of various geometries. Although the novel applications of electrospun nanofibers have been extensively explored, the technology development for mass electrospinning of nanofibers has been hampered. In most of the cases, nanofibers are electrospun into nonwoven webs. Nanofiber yarns, i.e. nanofiber bundles with continuous length and interlocked fibrous structure, are expected to create new opportunities to develop more complicated fibrous structures with well-defined 3D architectures and better mechanical performance, but still remain difficulties to produce. In our recent study, we have developed advanced electrospinning techniques to mass-produce nanofiber nonwoven and nanofiber yarns. By examining the effect of various parameters on nanofiber and yarn diameters, production rate, and yarn twist, we have found that electric field and the intensity distribution are

important parameters to control fiber quality and productivity. Yarn twist can be controlled through an intermediate collector. Drawing treatment considerably improves yarn tensile properties. This talk introduces our recent research progress in these areas.

10:30 AM

(ICE-064-2014) Imaging of Particulates within a Nanofibre Network

D. J. Nielsen*, E. I. Micich, M. Jamriska, D. Chong, R. Hebden, Defence Science and Technology Organisation, Australia

The nanofibre membranes produced via electrospinning consist of a fibre network with fully interconnected network of pores. These attributes make nanofibre membranes promising candidate materials for aerosol particulate and vapour filtration applications when used as scaffolds for adsorbent particles. Such adsorbent-nanofibre composites suggest potential uses in defence applications, e.g. as hazardous particulate filtration layers in protective fabric or respirator cartridges. Confocal microscopy is a technique that can generate sub-micron resolution images of materials containing suitable fluorescent dyes. Work at DSTO has shown that electrospun nanofibre membranes are well suited to 3D imaging using confocal microscopy. In addition to the nanofibre scaffold, particles greater than approximately 1 μm in size both trapped within the fibre network and the fibres themselves are able to be visualised and discriminated. The results presented here describes work to visualise the deposition profiles of aerosolised particulates through electrospun nanofibre networks with different fibre diameter, fibre shape and membrane porosity parameters. These profiles will contribute to the understanding of aerosol filtration mechanisms in nanofibre membranes, and will also inform a computational model of nanofibre performance when employed as a particulate filter.

10:50 AM

(ICE-065-2014) Polymeric Electrospun Nanofibrous Mats to Enhance the Mechanical Behavior of Composite Laminates

J. Belcari, O. Bocchi, T. Brugo, A. Celli, M. Focarete, C. Gualandi, A. Mazzotta, G. Minak, University of Bologna, Italy; F. Moroni, R. Palazzetti, Strathclyde University, United Kingdom; L. Pesola, University of Bologna, Italy; A. Pirondi, Strathclyde University, United Kingdom; H. Saghafi, L. Sisti, A. Zucchelli*, University of Bologna, Italy

Carbon Fiber Reinforced Plastic (CFRP) materials are widely used in many modern applications due to their high stiffness and strength combined with low specific weight. Nevertheless their usage is still restricted and, in some cases, precluded because of some limits such as sensitivity to damages induced by accidental loading, moderate intrinsic damping, difficult maintenance or repairing, low resistance in hostile environments. Recently the integration of electrospun nanofibrous membranes into laminates opened new perspectives to overcome some of the cited limits. In this work we present the results of a wide research investigation about the influence of polymer electrospun nanofibrous membranes and nanofibrous composite membranes to enhance the delamination strength and the damping properties of CFRP laminates. Two types of CFR-Epoxy laminates were considered: unidirectional and plane wave. Nanofibrous membranes were produced by Nylon6,6 and Polycaprolactone (PCL), while composite membranes were obtained by spinning Nylon6,6 and PCL at the same time. DCB and ENF specimens were used to measure respectively the fracture behavior under Mode I and Mode II, while bump test was used to estimate damping property of nanomodified laminates. Results showed significant increment in GI and GII as well as the laminates damping factor was improved.

11:10 AM

(ICE-066-2014) Nanostructured membranes as advanced solutions for VOCs control: the synergy of graphene and TiO2 nanoparticles

M. Roso*, A. Lorenzetti, C. Boaretti, D. Hrelja, M. Modesti, University of Padova, Italy

According to a pressing need of new solutions in pollution sensing and prevention by using adequate nanostructures with unique properties, the purpose of the study is the development of "active" filtering media, as advanced solution for volatile organic compounds (VOCs) control. Experiments have been carried out on nanostructured membranes based on electrospun scaffolds and electrosprayed graphene/titania based catalysts. Three different catalytic systems were studied: neat TiO2, TiO2 plus graphene and TiO2/graphene composite, obtained by hydrothermal method from graphene oxide. Furthermore, graphene content and TiO2 nanoparticles have been varied for having a better understanding of their effect on the photocatalytic performance. Tests on methanol gas-phase degradation revealed a higher reaction rate of graphene based catalysts wherein an effective charge transfer, enhanced by graphene, has been supposed to reduce the charge recombination increasing the photocatalytic activity of TiO2 nanoparticles. Looking at the graphene content, it has been found an optimum concentration, over which the photocatalytic performance tend to get worse, because of the reduced permeability and porosity of the membranes themselves.

11:30 AM

(ICE-067-2014) Polyethersulfone Electrospun Nanofibrous Membranes for water purification

J. Bae*, H. Kim, H. Choi, Gwangju Institute of Science and Technology, Republic of Korea

Electrospinning is a simple and versatile method for fabricating continuous fibers with diameters ranging from micrometers to several nanometers that is useful in water purification. Highly porous electrospun nanofibrous membranes currently gain considerable interests in water filtration applications. Polyethersulfone (PES) was selected as a polymer to synthesize the nanofibrous mats, due to its low cost to synthesis, high porosity and physical strength of membrane characteristics, and good electrospinning properties. A PES nanofibrous mats are fabricated by electrospinning PES solutions in N-Methyl-2-pyrrolidone. The goal of the present study is to further the understanding of relationships between the structural parameters of PES electrospun nanofibrous membranes (i.e., average fiber diameter, fiber diameter size distribution, membrane thickness and porosity) and microfiltration performance for water purification.

Biomedical Applications of Electrospun Materials II

Room: Metropolitan III

Session Chairs: Luana Persano, Nanoscience Institute of CNR; Ilias Louis Kyratzis, CSIRO

1:30 PM

(ICE-068-2014) Electrospining Nanoyarn Scaffold for Tissue Engineering (Invited)

X. Mo*, Donghua University, China

In this paper a dynamic electrospinning method were developed to fabricate the nanoyarn scaffold for tendon tissue regeneration. By this way electrospun poly(L-lactide-co-ε-caprolactone)/collagen (P(LLA-CL)/Col) nanofibers were deposited and twisted into yarns in a water vortex before collecting on a rotating mandrel to form a nanoyarn scaffold. The nanoyarn scaffold contained 3D aligned microstructures with larger interconnected pores and higher porosity comparing with nanofiber scaffold. Pig iliac endothelial cells (PIECs) and MC3T3-E1 pre-osteoblastic cells cultured on the nanoyarn scaffolds showed significantly higher proliferation rates

than that on traditional electrospun nanofiber scaffolds. Histological analysis demonstrated that cells infiltrate throughout the nanoyarn scaffolds. Moreover, confocal microscopy images indicated that cells cultured on the nanoyarn scaffolds exhibit an extremely elongated morphology Furthermore, tendon cells proliferation and infiltration, and the expression of tendon-related ECM genes, were significantly enhanced on the nanoyarn scaffold compared with that on the random nanofiber and aligned nanofiber scaffolds. After implanting the nanoyarn scaffold seeded with tendon derived stem cells into the nude mice, the fluorescence imaging indicated that the cells had long-term survival, and the macroscopic evaluation, histology examinations showed high-quality neo-tendon formation in vivo.

2:00 PM

(ICE-069-2014) Microskin-seeded Electrospun Nanofiber Scaffolds for Skin Regeneration (Invited)

J. Xie*, J. Jiang, M. A. Carlson, University of Nebraska Medical Center, USA

Burn injuries requiring treatment occur in 500,000 patients and cause about 3,500 deaths per year in USA. In clinical practice, autologous split thickness skin grafts (STSG) is still the gold standard for the current treatment of burn skin injury over large areas and remains the mainstay of treatment to provide permanent wound coverage and achieve healing. Current STSG is limited by low expansion ratio and scar formation between grafts due to delayed re-epithelialization. One alternative strategy for cultured epithelial autografts is a combination of multiple nanostructured cues to obtain rapid re-epithelializaion and microskin grafts to achieve a high expansion ratio. The aim of this study was to design and fabricate sandwich-type implants consisting of radially-aligned nanofibers at the bottom, nanofiber membranes with square arrayed microwells and nanostructured cues at the top, and microskin tissues in between as microskin grafts for skin regeneration applications. This novel skin graft was applied for skin regeneration in a skin excisional injury animal model. The grafts exhibited an even distribution of microskin grafts, greatly improved the 'take' rate of microskin grafts, and promoted re-epithelialization on wound in vivo. The sandwich-type scaffolds show great potential as microskin grafts for skin regeneration.

2:30 PM

(ICE-071-2014) PCLCol/PVAHA coaxial nanofiber coating on titanium implant osseointegration

W. Ren*, Wayne State University, USA; D. Markel, Providence Hospital, USA

Introduction: Failure of osseointegration is the main cause of implant failure and loosening. The aim of this study was to determine the osseointegration efficiency of PCLCol/PVAHA nanofibers (NF) as an implant coating in a rat tibia model. Methods: A total of 32 rats were used in this study. Rats were divided into 2 groups. A hole was drilled through the intercondylar eminence and a 1.0-mm titanium (Ti) wire was inserted from the proximal tibial into the medullary canal. Ti rods deposited with PCLCol/PVAHANFs were inserted into the channel. Rats were sacrificed at 4, 8 and 16 weeks after surgery. Results: Image analysis of H&E stained tissue sections showed that new bone formation around implant. It was observed that NF coated Ti pin significantly increased osteoblasts proliferation as compared with uncoated Ti pin. Quantitative image analysis revealed that NF coatings significantly induced osteogenesis ($P < 0.05$). Micro CT scanning was performed in interested area around implant-bone interface. Bone volume fraction (BV/TV) with NF-coated implant was significantly enhanced after implantation for 4 and 8 weeks. Conclusion:Our study demonstrated that PCLCol/PVAHA NF represents promising coating materials in enhancing implant osseointegration, thus to prevent bone implant failure and loosening.

2:50 PM

(ICE-072-2014) Co-culture of neuron stem cells (NSCs) and astrocyte on poly-l-lactic acid microtube array membranes (MTAMs)

C. Tseng*, J. Ciou, Biomedical Materials and Tissue Engineering, Taiwan; K. Chen, Tatung University, Taiwan; Y. Wang, Taipei Medical University, Taiwan; S. Chou, C. Chen, Biomedical Materials and Tissue Engineering, Taiwan

Cell-cell interactions play an important role for maintaining normal tissue function; however, cell–cell interactions have been difficult to be simulated in a typical co-culture system. In present study, a novel microtube array membrane (MTAM) scaffold was utilized as a co-culture system for its unique highly aligned tunable structures and tunable porosity. This system provides (1) cultured rat fetal neural stem cells (NSCs) physical separation from astrocyte, (2) directionally guidance in the lumen of MTAMs, and (3) grants the transportation of biological compounds in systems. NSCs-astrocyte interactions were monitored by immunofluorescence analysis and western blot. Cells morphology were characterized by scanning electron microscopy. The proliferation of co-cultured system were remain the same in MTAMs and control dish, which also confirmed by immunofluorescence. The neurite outgrowth and regulation of neuron-specific markers were clearly observed in MTAMs co-culture system, indicating stronger interactions between neurons and astrocytes. In summary, MTAMs may serve as a functional co-culture systems for cell interaction study, especially for nerve tissue.

3:10 PM

(ICE-073-2014) Blending Highly-ionized Synthetic Polypeptides with Elastin-like Polypeptides leads to Novel Fiber Formation by Electrospinning

D. T. Haynie, D. Khadka*, USF, USA

Hypothesis that blending polypeptides of radically different amino acid composition will enable the realization of novel and potentially advantageous material properties has been tested. The polymer feedstock consisted of a novel recombinant elastin-like peptide (ELP) or a mixture of an ELP and a synthetic polypeptide, co-poly(l-glutamic acid4, l-tyrosine1) (PLEY), dissolved in water. Suitability of the polymers for materials fabrication has been assayed by electrospinning. Polymer structure in cast films and electrospun fibers by infrared (IR) spectroscopy. Scanning electron microscopy (SEM) analysis has revealed unique morphological properties of fibers spun from polymer blends of ELP and PLEY, properties not displayed by either polymer alone. Fluorescence microscopy showed that little if any phase separation occurred in the blended fibers. The materials of this research may present advantages for electrospun fiber applications in drug delivery and other areas. More generally, the present results will advance the growing field of peptide-based materials.

3:50 PM

(ICE-074-2014) Electrospinning of silk fibroin/poly(N-vinylcaprolactam) to form hybrid nanofibres

N. Roy Choudhury*, J. Whittaker, N. Dutta, Ian Wark Research Institute, Australia

Due to its superior strength, biocompatibility, biodegradability, and good oxygen and water vapour permeability Bombyx mori (B. Mori) silk fibroin has excellent potential for biomedical materials development. In this work, Silk fibroin has been electrospun with Poly(N-vinylcaprolactam) (PVCL), a synthetic, hydrophilic, thermo-responsive polymer with a flexible structure and reversible lower critical solution temperature (LCST) behavior at approximately 35 oC. Dynamic light scattering (DLS) studies of the solution behavior of silk fibroin/PVCL blends show with increasing silk fibroin content, the LCST of PVCL is tuned from approximately 32 oC to 18 oC. In addition, rheological studies have shown a systematic change in the viscosity with increasing silk fibroin content in the blend. It was observed that a viscosity was of 0.75 Pa.s or higher was

required for successful electrospinning and formation of nanofibres. From the DLS and rheology measurements, it was concluded that the silk fibroin/PVCL system is miscible. Scanning electron microscopy (SEM) was used to analyse the hybrid electrospun fibres. We have observed the formation of blended fibres in the size range of hundreds of nanometers. Thus, for the first time silk fibroin/PVCL electrospun fibres we produced and analysed for the tuneability of the mechanical and stimuli-responsive properties.

4:10 PM

(ICE-076-2014) Electrospun 5-fluorouracil loaded bovine serum albumin-polyvinylpyrrolidone nanofibers for anti- cancer therapeutics

U. E. Illangakoon*, UCL, United Kingdom; A. Haidery, J. Inal, N. Chatterton, London Metropolitan University, United Kingdom; G. Williams, UCL, United Kingdom

Electrospun nanofibers have attracted much interest for use as drug delivery vehicles in recent years. Herein, we encapsulated 5-flurouracil (5-FU) and bovine serum albumin (BSA) into a polyvinylpyrrolidone (PVP) matrix. A series of 5-FU loaded BSA/PVP nanofibers were prepared and characterised. In –vitro dissolution studies were performed at pH 7.4 and cytotoxicity studies were performed using MOLM-13 cells. SEM images showed that fibers have smooth surfaces with diameter around 600nm. FTIR indicated that BSA and 5-FU are well distributed in PVP matrix, forming H-bonds. XRD and DSC results demonstrated that BSA and 5-FU were distributed in the fiber matrix in an amorphous state. Fluorine distribution from EDX spectroscopy implies that 5-FU was uniformly distributed in the fiber matrix. NMR and SDS-PAGE gel electrophoresis showed that 5-FU and BSA did not degrade during fabrication. HPLC data showed that more than 90% of the drug was encapsulated. Nanofibers show improved dissolution rate compare to pure 5-FU. The results of cytotoxicity studies show that the fibers significantly enhanced cytotoxicity compared to pure 5-FU. In conclusion, we have prepared albumin containing nanofibers for anti-cancer drug delivery. These fibers could comprise a versatile drug delivery system for encapsulation and fast release of 5-FU, and indeed other anti-cancer therapeutics.

4:30 PM

(ICE-078-2014) Role of Gellan-Based Electrospun Nanofibers in Wound Healing

P. Vashisth*, H. Singh, P. A. Pruthi, R. P. Singh, V. Pruthi, IIT Roorkee, India

Polymeric nanofibers with biomimetic properties have emerged as an alternative wound dressing material to their traditionally used counterparts as they provide modified chemical environment, facing the physiological conditions of wound for rapid healing. In this investigation, the electrospun gellan-based ultrafine nanofibers were fabricated by using a blend mixture of gellan and polyvinyl alcohol (PVA). As determined by FESEM, the fiber morphology and average diameter of the electrospun nanofiber was found to be influenced by solution viscosity, surface tension, specific gravity, flow rate, tip-to-collector distance and applied voltage. The equal ratio (1:1) of gellan-to-PVA was documented as an optimum polymeric ratio to fabricate uniform bead free nanofibers with an average diameter of 40±15.8nm. DSC and FTIR analysis confirmed the stability as well as the crosslinking within the polymers. The crystalline nature of gellan-PVA nanofibers was assessed using XRD analysis. Furthermore, human primary keratinocytes were cultivated on fabricated blend nanofibers in order to investigate the effect of gellan-based nanofibers on the differentiation and proliferation of keratinocytes. Study revealed that these nontoxic, nonallergic and nonsensitizing gellan-based nanofibers could be employed as a novel wound healing material.

4:50 PM

(ICE-079-2014) Hybrid electrospun scaffold for muscle bioengineering

O. Evrova*, ETH Zurich, Switzerland; R. Tauscher, University Hospital Zürich, Switzerland; G. Palazzolo, ETH Zurich, Switzerland; V. Milleret, University Hospital Zürich, Switzerland; M. Zenobi-Wong, ETH Zurich, Switzerland; T. Sulser, J. Buschmann, D. Eberli, University Hospital Zürich, Switzerland

Many polymers offering extracellular cues for myofiber formation can disturb the contractility by being stiff/slow degrading. In this study we aim to develop a hybrid electrospun platform for muscle bioengineering. Here we use a fast degrading poly(lactic-co-glycolic acid)/polyethylene oxide (PLGA/PEO) electrospun scaffold. PLGA offers mechanical stability and PEO acts as a porogen on the micro fibers affecting the mechanical/morphological properties of these scaffolds. Blends of 6 wt% polymer solution containing different wt% of PLGA/PEO were prepared in chloroform/ethanol and electrospun. Scaffolds were characterized using SEM and weight loss (%) up to 30 days. Human muscle precursor cells (hMPCs) or C2C12 myoblasts were seeded on the scaffolds and new myotube formation was assessed up to 14 days by immunostaining. Differences in cumulative release of incorporated FITC-BSA by emulsion electrospinning was done by fluorescence spectroscopy. Our results show that increasing PEO % allowed pore formation on fibers, scaffold shrinkage and faster degradation. Faster degradable scaffolds allowed proliferation and myotube formation by hMPCs and C2C12 myoblasts. Burst release of FITC-BSA was visible up to 2 days and a sustained one up to 10 days. In conclusion, varying PLGA/PEO content can tune the degradation rate/pore formation of the fibers optimizing them for muscle bioengineering and acting as delivery system for biomolecules.

Energy Storage and Harvesting with Electrospun or Sprayed Materials II

Room: Metropolitan II

Session Chairs: John Rabolt, University of Delaware; Alexander Yarin, University of Illinois at Chicago

1:30 PM

(ICE-080-2014) Electrospun Fibers for Functional and Electroactive Applications (Invited)

A. Baji*, Singapore University of Technology and Design, Singapore; Y. Mai, University of Sydney, Australia; S. Ramakrishna, National University of Singapore, Singapore; V. Ganesh, Singapore University of Technology and Design, Singapore

One-dimensional fibers have attracted unprecedented level of interest as they possess a wide variety of outstanding properties, including superior ability to generate voltages in response to stimuli. This is attributed to their ability to display electroactive behaviour orders of magnitude higher compared to their bulk counterpart. Here, we summarize our progress in using electrospinning (ES) techniques for the fabrication of two types of electroactive fibers viz. polyvinylidene fluoride (PVDF) and bismuth ferrite ($BiFeO_3$) fibers. Among the different crystalline forms of PVDF, the β-crystals exhibit the highest electroactive behaviour as they have the highest polarization per unit cell. We use ES to obtain PVDF fibers and demonstrate that conformal changes induced by ES improves the β phase content and leads to the formation of extended chains within the fibrous matrix. These structural developments within the fibers also play a role in improving the strength and stiffness of the fibers. In a separate approach, we use sol-gel based ES technique to fabricate $BiFeO_3$ fibers and demonstrate the co-existence of both electric and magnetic order parameters within these fibers. The move towards using PVDF as well as $BiFeO_3$ fibers for fabrication of energy harvesting devices will be discussed and the potential

of developing microelectronic devices using these fibers will be highlighted.

2:00 PM

(ICE-081-2014) Hierarchical Biopolymer Functional Hybrids (Invited)

Y. Hsieh*, University of California, Davis, USA

Biopolymers including polysaccharides, proteins and polyphenolics are responsible for structure integrity and/or functions of living organisms and are among the most abundant renewable resources. When isolated, these natural polymers are valuable platform materials for advanced products, provided they can be processed. This paper presents diverse approaches to solubilize and electrospin natural polymers into ultra-fine fibers with unique hierarchical structural hybrids and functional properties. Electrospinning of polyphenolics and proteins has been made possible by optimizing aqueous processing. Robust solubility and electrospinning of cellulose, chitin and chitosan have been achieved via their chemical derivatives. The potential of these assembled fibers has been exploited by coupling reactions with layer-by-layer or self- assembling approaches to create unique morphologies (multi-component hybrids, sheath-core, hierarchical porosity, etc.) and chemistries (protein/enzyme binding, ligand binding, antimicrobial) for applications in catalysis, separation, biochemical/drug-delivery and imaging, etc.

2:30 PM

(ICE-082-2014) High pressure sensitivity in piezoelectric devices based on nanofibers

L. Persano*, National Research Council-CNR, Italy; C. Dagdeviren, Frederick Seitz Materials Research Laboratory, and Beckman Institute for Advanced Science, University of Illinois, USA; Y. Su, Y. Zhang, Northwestern University, USA; S. Girardo, National Research Council-CNR, Italy; D. Pisignano, Università del Salento, Italy; Y. Huang, Northwestern University, USA; J. Rogers, Frederick Seitz Materials Research Laboratory, and Beckman Institute for Advanced Science, University of Illinois, USA

Efforts to optimize human-like manipulation schemes for applications which involve the integration with the human body or, in the field of robotics, the development of multifunctional, portable and flexible devices are particularly valuable in the emerging field of self-powered electronics. For these and related applications, piezoelectric polymers, in forms that enable bending and stretching, are attractive for pressure/force sensors and mechanical energy harvesters. Here we present our work on large area, flexible piezoelectric materials that consist of a free-standing, three-dimensional architectures of aligned piezoelectric polymer nanofibers. These enable ultra-high sensitivity in the low pressure regime (0.1 Pa). Experimental and theoretical studies reveal both the intrinsic properties as well as the behavior of various realized devices. Quantitative analysis provides detailed insights into the pressure sensing mechanisms, and engineering design rules for applications that range from self-powered micro-mechanical elements, self-balancing robots and sensitive impact detectors. The research leading to these results has received funding from the European Research Council under the European Union's 7th Framework Programme (FP/2007-2013)/ERC Grant Agreement n. 306357 (ERC Starting Grant NANO-JETS).

2:50 PM

(ICE-084-2014) The electrochemical performance of supercapacitor with the parameters of pore structure and electrical conductivity

C. Kim, Chonnam National University, Republic of Korea; B. Kim, Deagu University, Republic of Korea; K. Yang*, Chonnam National University, Republic of Korea

Supercapacitors as one of promising energy storage tools have attracted lots of attention from our society because of their intrinsic characteristics, such as high power densities(over 10 kW/kg) and long-time durability(over 106 cycles). To improve the electrochemical performances of carbon-based supercapacitors, researchers have been developing various types of advanced materials by controlling the pore size distribution, modifying the electrical conductivity, introducing electro-active polymers or metals, and optimizing device construction. In this work, we synthesized porous carbon nanofibers by incorporating tetraethoxy orthosilicate(TEOS) into polyacrylonitrile(PAN) using the electrospinning and the subsequent gas phase-activation. Then we evaluated the porous carbon nanofiber as an electrode for supercapacitor. The adsorption isotherms indicate the predominant presence of type I(micropore). In addition, porous carbon nanofiber, prepared using an activation temperature of 900oC and CO2 as activating gas, showed a broad distribution of micropore size between 0.6 and 0.9 nm an electrical conductivity of 1.0-3.0 S/cm. Such kinds of pore structure and high electrical conductivity will allow us to have excellent electrochemical performance as electrode for supercapacitors in ionic liquid of EMI-TFSI(1-Ethyl-3-methylimidazolium-bis(trifluoromethylsulfonyl)imide).

3:10 PM

(ICE-085-2014) Electrospun carbon fibers as promising electrodes for enzymatic biofuel cells

A. Both Engel, A. Cherifi, M. Bechelany, S. Tingry, D. Cornu*, ENSCM, France

Enzymatic biofuel cells (BFCs), which can be seen as electrical generators in which enzymes are linked to conductive electrodes, are promising candidates for the production of clean energy from biosourced fuels. Their performances have however not yet allowed bridging the gap between laboratory research and massive industrialization. The limiting points, like short lifetime and poor power density, are directly connected with the BFC electrodes performances. These performances can be improved with better electrode materials, better enzyme-electrode electrical coupling, higher enzyme loading rate and better enzyme stability. An overview of the works performed in our group for the last couple of years will be presented. A mat of electrospun carbon fibers (ECFs) was employed as new electrode. ECFs have interesting properties that meet the demands of BFCs electrodes, like a high specific surface allowing the immobilization of a larger amount of enzymes. In order to enhance properties like electrical conductivity, different nanomaterials, like carbon nanotubes (CNTs), were adsorbed on the surface of the ECFs. The electrodes were then modified by laccase enzyme and employed in the catalytic reduction of oxygen. We observed that current densities increase about 50% for CNT modified electrodes, with values that double those already reported for the laccase enzyme.

3:50 PM

(ICE-086-2014) Electrospinning of Non-Polymeric Systems: Green and Polymer-free Electrospun Nanofibers from Cyclodextrins and Cyclodextrin Inclusion Complexes

T. Uyar*, A. Celebioglu, F. Kayaci, Bilkent University, Turkey

We have successfully achieved the green electrospinning of polymer-free nanofibers from cyclodextrins (CD) and CD inclusion complexes (CD-IC). In general, electrospinning involves high molecular weight polymers, if not, for small molecules, electrospraying occurs which yields only beads. Hence, electrospinning of nanofibers from non-polymeric systems is quite challenging. Nevertheless, we obtained electrospun nanofibers from CD and CD-IC without using a carrier polymer matrix. CD are natural and nontoxic cyclic oligosaccharides having a toroid-shaped molecular structure which can form non-covalent host-guest CD-IC with a variety of molecules. Here, green and polymer-free approach was applied for electrospinning of nanofibers from CD types (modified, natural CD) by using water as a solvent, also, we produced nanofibers from CD-IC of functional agents (antibacterial, flavor/fragrance) and CD/AuNP composite system. Electrospinning of CD

is quite similar to polymeric systems in which the solvent type, the solution concentration/viscosity and the solution conductivity are the governing factors for obtaining uniform nanofibers. In brief, CD and CD-IC nanofibers would be quite appealing by combining high surface area of nanofibers with specific functionality of CD and CD-IC for molecular filtration, nanocomposites and release systems.

4:10 PM

(ICE-087-2014) Electrospun Carbon Nanofibers from Kraft Lignin for EMI shielding Application

Y. Li*, F. Ko, University of British Columbia, Canada

Lignin-based carbon nanofibers with electromagnetic properties were successfully prepared by electrospinning and subsequent carbonization. The electrical conductivity was introduced to the lignin based carbon nanofibers through carbonization. Magnetic properties were incorporated into lignin composite nanofibers by embedding magnetic nanoparticles using in situ synthesis. By combining magnetically permeable and electrically conductive functions, a new family of hybrid lignin composite nanofibers has been created. The electromagnetic interference (EMI) shielding effectiveness of lignin based carbon nanofiber was found to be comparable to that of conventional petroleum-based carbon nanofiber. The electrospinning process was demonstrated to be a versatile process for the manufacturing of lightweight and thin EMI shields.

4:30 PM

(ICE-088-2014) Direct deposit of polyvinyl alcohol/silicon/graphene nanoribbon nanofiber for a facile production of high capacity lithium-ion battery anodes

Y. Kim, G. Shoorideh, Cornell Univ, USA; Z. Li, B. Patel, S. Chakrapani, S. Lee, AZ Electronic Materials Corp, USA; Y. L. Joo*, Cornell Univ, USA

Despite high theoretical capacity in lithium-ion batteries, silicon (Si) anodes are still vulnerable to severe capacity fading due to dramatic volume expansion and formation of solid-electrolyte interface on their surfaces. Herein, we prepared a novel anode of polyvinyl alcohol (PVA)/Si nanoparticles (NPs)/graphene nanoribbon (GNR) nanofibers directly on the current collector via gas-assisted electrospinning. This facile direct deposit approach using water as solvent eliminates the use of toxic solvents like NMP and by-passes conventional paste preparation steps such as sonication, blading, calendaring. Furthermore, PVA acts as a dispersant to disperse highly loaded GNRs in water, which are unzipped from carbon nanotubes. Battery cells using PVA/Si/GNRs nanofibers exhibit an initial discharge capacity over 5000 mAh/g at 0.1C due to the synergy between well-dispersed GNRs and Si NPs. Hybrid nanofibers also exhibit much less charge transport resistance and higher peak current density than Si NPs. Even at 1C, they show a capacity around 1800 mAh/g owing to highly conductive GNRs within nanofibers, and a very stable cycle retention over 90% during 200 cycles. Such excellent cycle retention is attributed to crosslinked PVA covering Si NPs, which not only prohibits the volume expansion but also alleviates the formation of SEI layers.

4:50 PM

(ICE-090-2014) Free-standing film electrode composed of nanostructured TiO2/C nanofibers for lithium ion batteries

Y. Sha*, B. Zhao, Z. Shao, Nanjing Tech University, China

There is increasing interest in flexible, safe, high-power thin-film lithium-ion batteries which can be applied to various modern devices. Here we show a simple way to prepare highly flexible self-standing thin-film electrodes composed of mesoporous rutile TiO2/C nanofibers with low carbon content by electrospinning technique with outstanding electrochemical performance. Big size flexible thin film is obtained after heat treatment under 10%H2–Ar at 900 oC for 3 h. After optimization, the diameter of fibers can reach as small as 110 nm, and the as-prepared rutile TiO2 films show very stable reversible capacities of ~122, 92, and 70 mA h g–1 are achieved respectively at 1, 5 and 10 C rates with negligible decay rate within 100 cycling times. For further study, we treat the embedded rutile TiO2 with hydrothermal treatment, finally developing a three-dimensional (3D) porous architecture with TiO2 nanotubes connecting onto a conductive carbon nanofiber network. Specific mechanism is analysed and excellent electrochemical performances are achieved without the application of any additional conductive agent or binder (214 mA h g–1 at 5 C rate, 180 mA h g–1 at 10 C rate, 138 mA h g–1 at 20 C rate and 112 mA h g–1 at 30 C rate). Moreover, the electrode shows stable cycling performance, especially at a high rate of 30 C, without undergoing decay after 1000 cycles.

5:10 PM

(ICE-083-2014) Fabrication and energy harvesting property of 1-D lead-free KNN nano materials

Y. Zhuang*, F. Li, Xi'an Jiaotong University, China; S. Zhang, Materials Research Institute, Pennsylvania State University, USA; X. Zhuo, Xi'an Jiaotong University, China

As we know, (A1A2)NbO3 (A1=K, Pb; A2=Na, Mg et al) materials are difficult to fabricate by wet chemical method for the difficulty of Nb solubility. Up to now, rare researchers pay their attention to fabricate (A1A2)NbO3 materials by wet chemical method, especially for the nanostructure materials. Here, KxNa1-xNbO3 (KNN) one dimensional (1-D) nano materials were firstly successfully prepared by a cheap sol-gel combined electrospinning method. The 1-D KNN materials with different shapes are obtained by changing the electrospinning parameters. The microstructure of the KNN 1-D nano materials was investigated. The d33 (higher than 100 pm/V) of single KNN nanowire was lower than bulk KNN materials. However, the value is still higher than barium titanate or zinc oxide nano materials. The output of the KNN nanowires was higher than BaTiO3 and ZnO materials that have reported, too.

Filtration, Textiles and Other Topics II

Room: Metropolitan I

Session Chairs: Tong Lin, Deakin University; David Nielsen, Defence Science and Technology Organisation

1:30 PM

(ICE-091-2014) Separation of Oil-in-Water Emulsion Using Electrospun Mats

L. Choong*, Y. Lin, G. Rutledge, MIT, USA

Stable oil/water emulsion i.e. oil emulsion with size < 20 μm, is separated most effectively by membrane filtration. Electrospun mats are promising in filtration applications because of their high surface-to-volume ratio (10-500 m2/g for 10-500 nm fiber diameter) and high porosity (>0.9), which results in high permeability constants. In this study, the feasibility of separating oil emulsion of size <1 μm using electrospun mat as a microfilter is studied. The test emulsion was made with dodecane, stabilized by sodium dodecyl sulfate, and the mean emulsion size was (264 ± 5) nm. The emulsion was filtered by electrospun poly(trimethyl hexamethylene terephthalamide) PA6(3)T mat with fiber diameter of (210 ± 20) nm. The permeate flux at 1psi, which was normalized by the flux of pure water at corresponding operating pressure, was higher than that at 2psi early in the filtration process (<100s) but the normalized fluxes are similar at longer filtration time. The normalized flux of emulsion with concentration of 100ppm was up to four times higher than that with concentration of 500ppm. These results indicate that the main resistance to the flux comes from the oil emulsion fouling the membrane. The rejection of dodecane emulsion of the mats tested was up to 50%.

1:50 PM

(ICE-094-2014) Efficient Nanofibrous Adsorbents for Removal of Toxic and Heavy Metal Ions from Water

M. Faccini*, D. Amantia, D. Morillo, M. Sánchez, L. Aubouy, Leitat Technological Center, Spain

Nowadays, pollution of water from the contamination of heavy metals is a serious environmental problem. Metals such as chromium, copper, iron, lead, cadmium, and zinc or semi-metals like arsenic, are highly toxic and pose a major threat to human health and the environment. In this talk we will present the latest advances made by LEITAT Technological Centre in the development of highly efficient systems for the up-take of metallic pollutants from water. High surface area nanofibers were fabricated by electrospinning and then modified to provide selectivity to the target ions. The resulting nanofibers are mechanically strong and chemically resistant. The adsorption capacity of each material was determined as functions of several parameters such as pH, contact time and concentration of metals. In addition, selectivity experiments were performed trying to mimic real conditions. The nanofibrous membrane prototypes exhibit fast adsorption kinetics, good selectivity and high retention capacity towards target metal ions, such as As(V), Pb(II), Ni(II), Cd(II) and Cu(II). www.cerampol.eu The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under grant agreement nr. 280995

2:10 PM

(ICE-095-2014) Turning Nanofibre into Products

I. Hosie*, S. Feasey, Revolution Fibres Ltd, New Zealand

Revolution Fibres is a nanofibre manufacturer based in Auckland New Zealand. Strong advocates of nanofibre's potential in many sectors; its mission is to enable companies to produce superior products using Revolution Fibres' designed functional nanofibres. Nanofibre alone is not a product. It is a platform technology that requires customization to suit a wide variety of uses. Revolution Fibres has commercialized products with various clients in the areas of filtration, skin health, composites, acoustics, biotech and energy. The requirements of these sectors are vastly different, and this is a challenge for nanofibre manufacturers. Revolution Fibres will introduce its Services program designed to help nanofibre get out of the laboratory and into the marketplace. Nanofibre has huge potential. It can be readily functionalized, has incredible physical properties, and is very marketable. It is also easy to produce at research level – hence the high number of papers and patents in this field. But is the level of innovation reflective in examples of commercialization? The trend of high research but little commercial manufacture is harmful to the nanofibre industry. Revolution Fibres is one company that bridges the gap between research and product development. Based on our experiences, we will share hints for researchers on how to address manufacturing hurdles if their research is to reach the multiple markets so often referenced in academic papers.

2:30 PM

(ICE-097-2014) Piezoelectric behaviour of Poly(vinylidene fluoride) electrospun mat

J. Belcari, A. Celli, D. Fabiani, M. Focarete, University of Bologna, Italy; M. Gazzano, ISOF - CNR, Italy; C. Gualandi, G. Pasini, L. Sisti, M. Zaccaria, A. Zucchelli*, University of Bologna, Italy

It is well known in literature that Poly(vinylidene fluoride) (PVDF) shows piezoelectric properties in peculiar crystallinity phases. Usually PVDF is manufactured through conventional production techniques in form of laminated film. Only few studies, on the contrary, have been performed on fibrous PVDF, showing piezoelectric behavior, e.g. through electrospinning (ES). Fibers can be an interesting biomimetic structure for the use in artificial muscles or biomedical applications and can be applied to different substrates, creating multifunctional or smart materials in the field of sensors. In this work we explored the influence of electrospinning apparatus setup and process conditions in order to obtain piezoelectric strips sensors made of PVDF nanofibers and composite nanofibers. In particular composite nanofibers were produced by adding conductive nanofillers to polymer solutions. The ES spinneret was equipped with a variable geometry collimator system and nanofibers were collected at a high speed rotating drum: several combinations of collimator positions, applied voltage values and drum speed have been investigated in order to obtain aligned nanofibers having the higher level of PVDF piezoelectric crystalline phase. XRD characterization was used to relate the ES process parameters to piezoelectric phase, while electromechanical tests were done to study the piezoelectric response of produced membranes.

2:50 PM

(ICE-098-2014) Spraybase®: Customizing electrospinning technology

G. Hendy*, S. Finnegan, M. Maguire, Profector Life Sciences, Ireland

Spraybase® is an integrated instrument that enables electrospinning and electrospraying technologies for life science applications. Compatible with a diverse range of polymers, chemicals and biologics, Spraybase® accelerates science. Designed with your ease of use, safety, flexibility and scalability in mind the Spraybase® instrument fits in your lab and is useable by all researchers with varying levels of experience in science and engineering. Spraybase® instruments can be used to form colloids and fibers of varying shape and size depending on your specification or application. We have recently introduced the Hot Melt Electrospinning equipment and we will discuss all aspects of these technologies. Some applications that are being considered include Regenerative Medicine, Tissue Engineering, Encapsulation and Particle Generation.

3:10 PM

(ICE-099-2014) Nanovascularization of polymer matrix: generation of nanochannels and nanotubes by sacrificial electrospun fibres

C. Gualandi*, J. Belcari, M. Focarete, A. Zucchelli, University of Bologna, Italy

A 3D interconnected vasculature in composite materials is desired for several uses (e.g. filtration, self-healing, self-cooling, bioengineering, chemical reactors). Known methods for creating vascular structures produce channels with millimetric or micrometric diameters, are time-consuming and scalable with difficulty. Here, we propose the use of sacrificial electrospun fibres to generate nanovascularized composites containing interconnected channels and tubes having sub-micrometric and nanometric diameters. Pullulan was chosen as sacrificial material since it is commercially available, soluble in water and it is thermally and morphologically stable up to 250°C. We show that the empty nanochannels created in a thermoset polymer matrix by dissolving pullulan fibres can be re-filled by a liquid substance. Moreover, by using core-shell electrospun nanofibres with a sacrificial core we created nanoubes with walls coated with a material that can impart additional functionality to the channels (e.g. remediation properties, release of active molecules, etc.). The proposed method can be realistically coupled with current composite manufacturing, thus widening possible applications of these kind of innovative materials that can potentially display new and enhanced functionalities thanks to the nanoscale features of the cavities.

3:50 PM

(ICE-101-2014) Electrospun Chitosan Nanomembrane as a Novel Sorbent for Sequestration of Toxic Metal Ions

N. Horzum*, Izmir Katip Celebi University, Turkey; A. Eroglu, Izmir Institute of Technology, Turkey; T. Shahwan, Birzeit University, Palestine, State of; M. Demir, Izmir Institute of Technology, Turkey

Ground water pollution forms a detrimental problem to environment. Sorption of aqueous metals can be realized by employing sorbents that contain functional groups possessing metal binding ability. Chitosan has been reported as an effective sorbent of metal ions. To enhance the sorption capacity, physical and chemical methods have been used for modification. Chitosan nanofibers were fabricated by electrospinning. The growth of nanoparticles of zero-valent iron on the surface of the fibers was achieved by reducing iron ions using sodium borohydride. The fibrous materials were characterized using SEM, XPS, XRD, and FTIR. The ion concentrations in the supernatant solutions were determined by ICPMS. Sorption efficiency of chitosan nanofibers were examined toward Fe(III), Cu(II), Ag(I), and Cd(II) ions at pH of 6.0. The shaking time, metal ion concentration, and temperature have strong influence on the sorption of the metal ions. Chitosan fibers did not show any affinity to arsenic species at pH of 6.0. Therefore, we focused on the fabrication of a new functional material which allows for advantageous combination of nZVI particles and electrospun chitosan fibers. High sorption capacity was achieved over a wide range of pH. The ease of preparation of chitosan fiber or chitosan-supported nZVI particles can offer a very convenient way for the development of sorption-enhanced materials.

4:10 PM

(ICE-102-2014) Fabrication of porous carbon nanofibers by carbonization of electrospun poly(vinyl alcohol) nanofibers

S. Nagamine*, T. Matsumoto, M. Ohshima, Kyoto University, Japan

Porous carbon nanofibers were fabricated from electrospun nanofibers of poly(vinyl alcohol) (PVA) and their applicability for electric double layer capacitor (EDLC) was investigated. The precursor PVA nanofibers were prepared by electrospinning a PVA aqueous solution containing diammonium phosphate (DAP) and sodium dodecyl sulfate (SDS). The nanofibers were stabilized by heating at 623 K in air to facilitate the intramolecular dehydration of PVA by DAP. The stabilized nanofibers were carbonized in N2 at 1173 K. By these thermal processes, SDS was decomposed and the particles of sodium phosphate and sulfate were produced on the surface and inside of the fibers. These particles could be removed by leaching with water and the ink-bottle type pores of ca. 100 nm in diameter were formed. The fiber diameter and the pore volume were controllable by the SDS concentration in the spinning solution. EDLC cells were fabricated using the obtained carbon nanofibers as the electrodes and the performances were investigated by charge-discharge tests. The capacitances of the carbon nanofiber electrodes were ca. 100 F/g. The internal resistance was reduced with increasing the volume of 100 nm-sized pores, demonstrating the contribution of the pores inside of the fibers to the ion transport.

4:30 PM

(ICE-092-2014) Superhydrophobic Nonwovens for Medical Textile Applications

M. Dasdemir*, H. Ibili, University of Gaziantep, Turkey

Medical textiles are very convenient environments for infections, pathogens and bacteria. In order to protect the wearer from them, a high level of water and adequate level of alcohol repellencies are needed for these fabrics. These can be achieved by imparting superhydrophobic characteristic on textile surfaces. In this study, the electrospraying technique is utilized to apply superhydrophobicity with repellent chemicals on to the SMS nonwoven fabrics that is widely used in drapes, surgical and examination gowns, face mask and caps in medical textiles. As a functional repellent material fluorochemicals are used. The concentration of the fluorochemical and the application time have taken as variables. In order to characterize solution properties, conductivity, surface tension and viscosity measurements of the electrosprayed solutions were taken. After the application of the functional chemicals via electrospraying, contact angle measurements and fabric pick-up rate determination were performed. Results showed that both concentration and application time have great influence on the surface contact angle. Also, low concentration rate (3%) was found to be enough to obtain satisfied results. Compared with padding electrospraying technique yielded superior results. Thus, a superhydrophobic surface on medical nonwoven fabric with a contact angle over 150° were successfully achieved using very less chemicals.

4:50 PM

(ICE-093-2014) Electrospun Polysulfone (PS) Microtube Array Membranes (MTAMs) as Advanced Blood Filtration Substrates

C. Chen, Taipei Medical University, Taiwan; Z. Chu, National Taipei University of Technology, Taiwan; C. Tseng, Taipei Medical University, Taiwan; M. Wu, Taipei Medical University Hospital, Taiwan; C. Chen*, Taipei Medical University, Taiwan

Enhancing accuracy by preventing the interference of blood cell is still a challenge for sample pre-treatment of clinical diagnostics. Electrospun microtube array membranes (MTAMs) possess several structural characteristics, such as smaller diameter, thinner wall, and higher active surface area, therefore, making them excellent filtration substrate candidates for blood filtration. This study described the development of a blood filtration substrate of polysulfone (PS) MTAM produced by co-axial electrospinning. Scanning electric microscopy (SEM) and capillary flow porometer were used to characterize morphology and pore size distribution. Pore diameter on the microtube wall of MTAM was measured about 213±0.1 nm, while the average cross sectional dimension (length and width) of unit microtube were about 49.3±5.9 and 25.7±5.9 μm, respectively. Blood filtration efficiency was confirmed and proved by recovery test and particle size analyzer. Biocompatibility test was performed in accordance with the international standards ISO 10993. Through these tests, blood cell was successfully separated with no hemolysis. Because of its structural characteristics, MTAM shows overall enhancement of blood filtration. These results provide sound bases for the future blood separation application of MTAMs.

Thursday, August 7, 2014

Plenary Session III

Room: Metropolitan III

9:05 AM

(ICE-103-2014) Advances in Functional Metal Oxide Nanofibers

I. Kim*, Korea Advanced Institute of Science and Technology, Republic of Korea

Electrospinning has been recognized as one of the most efficient techniques for producing non-woven fiber webs on the order of several hundreds of nanometers by electrically charging a suspended droplet of polymer solution with/without inorganic precursors. Various types of materials with a high degree of porosity, a large surface area, and modified surface functionalities, have been electrospun into nanofiber structures. Thus far, electrospun nanofibers have served as highly optimized and versatile material platforms for a broad range of applications, such as for the filtration of liquids/gases, chemical sensors, nanofiber reinforced composites, active electrode materials for electrochemical cells, photo-electrodes, and in the biomedical field related to enzyme immobilization, wound dressing, and tissue engineering based drug release. More recently, significant efforts have been focused on practical applications of functional metal-oxide nanofibers. In this talk, I will introduce a collection of advances focused on the synthesis, characterization,

and utilization of electrospun functional metal-oxide nanofibers, which are optimized for applications in exhaled breath sensors, novel catalysts for photoelectrochemical cells and Li-Air batteries, high capacity anode materials for Li-ion batteries.

Biomedical Applications of Electrospun Materials III

Room: Metropolitan III

Session Chairs: Florian Formica, ETH Zürich; Ricardo Vera-Graziano, Universidad Nacional Autonoma de Mexico (National University of Mexico)

10:00 AM

(ICE-105-2014) Electrospun Polycaprolactone-nano hydroxyapatite composite fibers for Bone defect applications

P. Harikrishnan*, A. Sivasamy, CSIR-Central Leather Research Institute, India; A. Raheja, Indian Institute of Technology Madras, India; H. Islam, Pondicherry Center for Biological sciences, India; S. Natarajan, Indian Institute of Technology Madras, India

Aim of the present study is to develop a synthetic bone graft material which is clinically efficient and cost-effective. A blend of nano-hydroxyapatite (nHAP), synthesized by sol-gel/microwave method and polycaprolactone (PCL) was electrospun to obtain a nanofiber matrix.The fiber morphology was characterised by scanning electron microscopy while its composition was verified through infrared spectroscopy, energy dispersive X-ray analysis and powder X-ray diffraction. MG63 osteoblastic cells were cultured onto the prepared nano-composite fiber mat to evaluate its biocompatibility. Cell adhesion was observed through fluorescence, confocal and scanning electron microscopy. Moreover, in vitro cell growth was quantified using MTT (3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) assay while its osteogenic activity was inferred by measuring calcium load, Alkaline phosphatase activity and expression of bone gene biomarkers namely Osteocalcin, Osteonectin, Osteopontin and Beta actin.The in vitro experiments revealed that the PCL-nHAP composite fiber mats showed better cell adhesion and osteogenic activities compared to control PCL mats. Thus, the developed PCL-nHAP nano fiber mat being both osteoinductive and osteoconductive could serve as an efficient bone graft material for bone defects and may enhance bone healing.

10:20 AM

(ICE-108-2014) The preparation and electrospinning of double layer vascular scaffold with core-shell fibers and its in vitro and in vivo evaluation

L. Ye*, X. Geng, Z. Feng, Beijing Institute of Technology, China

The smooth muscle cells(SMCs) plays a very important role in the regeneration of vascular graft for vascular tissue engineering because it involves the presence of elastin and collagen and is mainly responsible for affording both the mechanical strength and compliance to the regenerative grafts. Thus, a double layer vascular scaffold with the fibers of core-shell structure was designed and electrospun herein in order to prompt the immigration, growth and proliferation of SMCs from surface to interior in the scaffold wall. The inner layer was electrospun from PCL with a loose fiber network and the outer layer with core-shell fibers was made by coaxial electrospinning where the core was short peptide VAPG with BSA protein and the shell was also made from PCL. The core-shell structure was demonstrated by TEM. The SMCs were seeded on the inner surface and its immigration from surface to the interior was characterized by SEM and HE stain. The in vitro release behavior of VAPG showed its sustainable release which may contribute to the immigration of SMCs. Consequently, the designed double layer structure and the loading of VAPG via coaxial electrospinning can promote the SMCs to immigrate from surface to interior of the scaffold wall. The in vivo evaluation of this double layer scaffold cultured with SMCs is under investigation now.

10:40 AM

(ICE-107-2014) Modulating Growth Factor Release through Negative Voltage Electrospinning for Emulsion Electrospun Scaffolds

Q. Zhao*, M. Wang, The University of Hong Kong, Hong Kong

Conventional emulsion electrospinning for incorporating growth factors (GFs) in scaffolds uses positive voltages. Loss of GF bioactivity and undesirable GF release behavior are still major problems. Negative voltages may be used in emulsion electrospinning for incorporating GFs bearing positive charges such as basic fibroblast growth factor (bFGF), minimizing possible electrospinning damages to GF and modulating GF release behavior. This study investigated negative voltage emulsion electrospinning for forming nanofibrous scaffolds incorporated with bFGF. A bFGF-containing aqueous solution was firstly mixed with a PLGA solution (1:10) to form an emulsion. The emulsion was subjected to either positive voltage (10, 15, or 20 KV) or negative voltage (-10, -15, or -20 KV) for electrospinning. The scaffolds formed were characterized using various techniques. Nanofibers in all scaffolds exhibited core-shell structures, with the bFGF-containing water phase being the fiber core. Scaffolds made at certain voltages carried electrical charges. The intensity and retention time of the charge increased with an increase in applied voltage. In vitro scaffold degradation tests and in vitro bFGF release tests (using ELISA) were conducted separately for scaffolds. Results showed the bFGF release behavior was modulated by negative voltage electrospinning, indicating the charge effect.

11:00 AM

(ICE-104-2014) Fabrication and Characterization of β-TCP/ (PVA-PCL) Bilayer Nanocomposites –A Bone Tissue Regeneration Scaffold

U. Subramanian, S. Vasanth Kumar*, Karunya University, India

Aim of the present study: In this present study composite scaffold based on PVA-PCL nanofibrous bilayer incorporated with beta-tricalcium phosphate is fabricated. PVA and PCL were physically blended with TCP and electrospun to prepare uniform polymer-ceramic nanocomposites as bone matrices. Experimental design and methodology: β Tricalcium phosphate ceramic was synthesized using wet precipitation route and used to reinforce nanofibers in composite mats produced via electrospinning of poly (vinyl alcohol) (PVA), polycaprolactone (PCL) and (PVA: PCL) bilayers. Summary of results: The role of TCP ceramic on morphology of nanocomposites, crystalline structure, functional groups and thermal behaviour of nanocomposites were characterized by SEM, EDAX, XRD, FTIR and DSC analysis. The obtained nanocomposites were morphologically investigated with SEM and all fabricated composites consisted of fibers with average fiber diameter (AFD) around 100 nm. XRD profile presented the main peaks of β-TCP (JCPDS 090169 and JCPDS 70-2065). The thermal stability was enhanced after adding TCP filler particles in all the polymer composites. The biocompatibility of the (PVA-PCL: TCP) composite scaffold has also been investigated by culturing MG-63 osteoblast cells on it; primary results showed that the cells adhered and proliferated well on the composite scaffold.

11:20 AM

(ICE-106-2014) Cell electrospinning

S. Jayasinghe*, University College London, United Kingdom

Electrospinning, a technology for directly forming fibres from polymers have been a technology investigated for over a century. Several composite materials have been spun exploring this technology for forming cell-friendly surfaces etc for carrying out both in-vitro and in vivo studies. Although many milestones have been achieved using such scaffolds for carrying out investigative studies most interesting to regenerative biology and medicine, the process is time consuming and has some drawbacks. Cell electrospinning pioneered in 2005 exposes this technology for directly handling living cells with a

polymer for forming cell bearing scaffolds for direct implantation for repair, replacement and rejuvenation. Thus cell electrospinning has several interesting implications therefore introducing this technology for its direct application to both the biological laboratory and clinical medicine. The presentation will introduce the discovery and discuss the development of cell electrospinning to date while demonstrating its implications and advantages to the vast field of regenerative medicine including therapeutics and diagnostics.

Advances in Electrospinning Theory and Modeling

Room: Metropolitan II

Session Chairs: Cagri Tekemen, Elmarco s.r.o.; Jan Lagerwall, University of Luxembourg

10:00 AM

(ICE-110-2014) Three-Dimensional Imaging and Reconstruction of Electrospun Fiber Materials (Invited)

G. Rutledge*, L. Choong, Massachusetts Institute of Technology, USA; P. Yi, Johns Hopkins University, USA

The characterization of the pore structure of electrospun fiber mats is important for a wide variety of applications, including separation membranes, filters, and tissue scaffolds. While characterization of the fibers themselves is fairly well-advanced, to date the pore structure of electrospun mats has only been inferred indirectly, by mercury porosimetry for example; interpretation of such data generally requires use of an over-simplified model of the pore geometry. To remedy this deficiency, we report the use of confocal laser scanning microscopy with fluorescent markers and index matching to collect 3D digitized images of electrospun fiber mats and a borosilicate glass fiber standard. By embedding the fluorescent dye in either the material component (fibers) or pore space component (the index matching fluid), acquisition of both positive and negative images of the porous fibrous materials is demonstrated. Image analysis techniques are then applied to the 3D data sets to extract important structural metrics for both the material and pore space components of the electrospun fiber mats, the results of which are in good agreement with experimental measurements where available. The network structure of the pore space is characterized for the first time using metrics such as the Euler-Poincaré characteristic, the connectivity ratio, and size distributions of cavities and gates.

10:30 AM

(ICE-111-2014) Stability analysis of an axi-symmetric liquid jet in the presence of an externally coflowing liquid

V. Gundabala*, V. K. Modi, Indian Institute of Technology Bombay, India

Traditionally, electrospinning and electrospray are carried out with either air or vacuum as external medium. More recently, it has been shown that electrospray can be successfully implemented inside a liquid insulator bath and also in the presence of an external flowing liquid. In both the cases, whipping instability, a typical characteristic of electrospinning process, is also observed. We envisage that implementation of electrospinning process in the presence of an external liquid coflowing with the electrospinning solution will allow greater control on the fiber deposition and morphology. In the present work, to gain fundamental understanding on the behaviour of an electrified liquid jet in the presence of an externally coflowing liquid, we perform stability analysis on the system. We start with performing stability analysis on an axisymmetric liquid jet in the presence of an external liquid flowing at constant velocity. The classical Rayleigh-Plateau instability and an electrically induced axisymmetric instability were identified. The effect of the viscosity, velocity, and permittivity of the external liquid on the two instabilities was studied. It was found that both the growth rate and the critical wave numbers were strongly influenced by the above parameters.

10:50 AM

(ICE-113-2014) 3D modeling of melt electrospinning process

J. Ko*, M. Jun, University of Victoria, Canada

The process of melt electrospinning is gaining attention due to its ability to fabricate controlled micro-scale fibers without using any solvents. The melt elctrospun fibers can be very useful for biomedical engineering such as artificial organ, tissue engineering, drug delivery, and etc. However, there are several difficulties in order to apply the technique to all applications. One of the main challenges is controlling electrospun fibers. Mathematical modeling allows an enhanced understanding of the parameters that determine fiber properties. The objective of this study is to build three types of mathematical models. First, we modeled the melt electrospinning process by incorporating parameters such as nozzle size, counter electrode distance and applied voltage that significantly influence fiber diameter and topology. Our second model demonstrated electrospun fibers' movement, so called helix movement, by applying Lorentz force law that influence radius of helix movement. Third model described the build-up of the electrospun microfibers on flat and round surfaces using data from our first modeling. These models were confirmed through the use of experimentally obtained data. Scanning electron microscopy (SEM) was used to image the electrospun fibers and the fiber diameters were measured using Quartz-PCI Image Management Systems® in SEM.

11:10 AM

(ICE-114-2014) Comparison of Current Massive Electrospinning Technology in terms of Field Intensity, Cost and Productivity

Y. Liu*, W. Chen, Tianjin Polytechnic University, China; Z. Zhang, 359th Factory of 6th Inner Mongolia Aerospace Science and Industry Corporation, China; L. Guo, D. Qi, J. Yao, Tianjin Polytechnic University, China

In this study, the currently used massive electrospinning technologies including Nanospider, multineedle, disc, spring, sawtooth, and helical blade technologies were comparatively investigated in terms of field intensity, cost and productivity, based on finite element analyses. The results indicated that, at the similar electrospinning conditions, (1) the linear type of electrospinning heads such like linear sawtooth, metal wire and linearly arranged multineedle electrospinning heads have higher field intensity, lower productivity but lower cost effect; (2) the area type of electrospinning such as rotating roller, spiral spring, spiral blade, and spiral sawtooth electrospinning technologies have higher productivity and higher cost, lower field intensity; (3) among the existing area types of electrospinning technologies, the spiral sawtooth technology is expected to have highest field intensity, lowest cost effect and highest productivity, the spiral blade type of technology is anticipated to have medium level of field intensity, cost effect and productivity, and the spiral spring type of technology is expected to have lowest field intensity, cost effect and productivity.

11:30 AM

(ICE-115-2014) Impact of chain entanglement on solution electrospinning

Y. Wang, C. Wang*, National Cheng Kung University, Taiwan

Nanofibers of different polymers have been readily prepared by electrospinning. Bead-free fibers are generally produced provided that a semi-dilute solution with entangled chain conformation is used. Solutions with a lower concentration yield fibers with a lower diameter. This phenomenon is associated with the different entanglement density developed in the electrospinning solution. To date, the quantitative relation between the fiber diameter (d) and chain entanglement density is not clear yet. In this work, nine polymer solutions are investigated to reveal the impact of chain entanglement. A simple relation is derived; d= df (ϕ/ϕe)^2.49, where ϕ and ϕe are the solution concentration and entanglement concentration, respectively, and df is the diameter of phantom fibers electrospun from the solution with a concentration of ϕe.

11:50 AM

(ICE-112-2014) Designing a New Nozzle System for Co-axial Electrospinning through Numerical Simulations

S. Jeon*, Seoul National University, Republic of Korea; B. Lee, Samsung Advanced Institute of Technology (SAIT), Republic of Korea; H. Park, W. Yu, Seoul National University, Republic of Korea

Co-axial electrospinning, a versatile process to manufacture core/shell nanofibers, have been studied to develop multifunctional nanofiber assemblies for filter membranes, gas sensors and energy storage devices. For successful co-axial electrospinning, the material composition for core and shell layers is an essential factor, promoting various attempts made to choose the right materials. The co-axial electrospinning system itself, however, remained without changes, for a long time, which was probably due to the lack of understanding of the fluidic behavior of multi-fluids during electrospinning. In this study, multi-fluidic behaviors of polymer solutions in the co-axial nozzles were numerically simulated to design a co-axial nozzle system for stable co-axial electrospinning. A nozzle system with different exit pipe length, so-call core-cut nozzle, was found to reduce the jet instability significantly. Finally, experiments were carried out to demonstrate that the new nozzle system is highly suitable for stable electrospinning of multi-layered nanofibers (e.g. tri-layered nanofibers).

Ceramic Composites and Energy III

Room: Metropolitan I

Session Chairs: Simon King, University of Surrey; Hao Fong, South Dakota School of Mines and Technology

10:00 AM

(ICE-116-2014) Macroscale Alignment of Gold Nanorods in Electrospun Polymer Fibers and Polarization-Controlled Photothermal Heating (Invited)

J. B. Tracy*, North Carolina State University, USA

This talk will summarize the large-scale synthesis of gold nanorods (GNRs) and their macroscale alignment within electrospun polymer fibers measuring 40-3000 nm in diameter. GNRs are of interest for their tunable longitudinal surface plasmon resonance (LSPR), which depends on the nanorod aspect ratio. GNRs also exhibit an optical anisotropy, such that the LSPR can be selectively excited when the electric field of incident light is parallel to the nanorod long axis. During electrospinning of a GNR and polymer solution, GNRs with an aspect ratio of 3 align parallel to the fiber axis. Aligning the polymer fibers therefore provides macroscale alignment of the GNRs, resulting in a macroscale optical anisotropy in oriented polymer fiber mats. We have demonstrated polarization-controlled photothermal heating and melting of polymer fibers lying along a chosen direction, while leaving the remaining material largely unheated and unaffected. Fluorescence-based temperature sensing was employed to measure the temperature of the polymer fibers during photothermal heating. These studies required large amounts of GNRs, for which we developed an efficient large-scale synthesis with control over the GNR size and aspect ratio.

10:30 AM

(ICE-117-2014) One-Dimensional Au/TiO2 Composite Nanofibers Synthesis by Electrospinning and Applications

X. YANG*, V. Salles, M. Maillard, A. Brioude, University of Claude Bernard Lyon 1, France

One-dimensional (1D) Au/TiO2 composite nanofibers are promising new materials for photocatalysis applications. In this study, an electrospinning technique coupled with sol-gel chemistry is applied to produce 1D Au/TiO2 composite nanofibers. Au ions are introduced in two ways: direct-dispersion in electrospinning solution, or secondary-deposition on TiO2 nanofibers or Titanium/polymer composite nanofibers. Various treatments were used to form Au nanoparticles by in situ reduction. Polymer components were removed to form Au/TiO2 composite nanofibers with the subsequent treatments. Au nanoparticles were embedded uniformly on the surface or inside the TiO2 nanofibers. Structures, morphologies of nanofibers and photocatalysis activity can be readily tuned as a function of electrospinning process parameters, metal nanoparticles content and morphology. Surface coating and interface between Au/TiO2 were investigated. The growth mechanism, relation of structural, electrochemical and photocatalytic properties are discussed in detail.

10:50 AM

(ICE-119-2014) On the enhancement of light harvesting with hierarchical structures using electrosprayed photoactive materials

K. K. Khanum*, P. C. Ramamurthy, Indian Institute of Science, India

This study examines the enhancement in the light harvesting of photoactive materials by fabricating hierarchical structures. Past studies have demonstrated various techniques employed to fabricate hierarchical structures. In this study, electrospraying has been explored for photoactive materials using various solvents and by optimizing process parameters like applied voltage, flow rate, collector type to obtain range of hierarchical structures. The analysis of the evolved morphological structure showed a transformation from 'spheres' to 'floral' patterns with change in size and increase in surface area. Thermal studies showed its thermal stability up to 250°C. Optical properties due to structured architecture showed enhancement in the internal reflection and in turn leading to higher light absorption. Opto-electrical characteristics of these devices showed higher order of response in comparison to standard film devices. Hence a step towards better light management is possible by tuning the morphological structures of photoactive materials with optimized process parameters.

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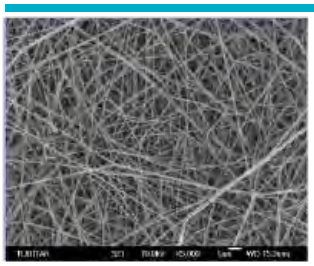

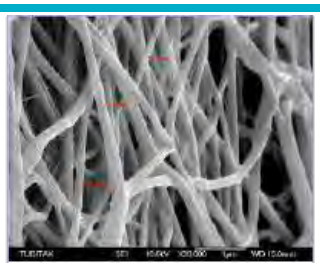

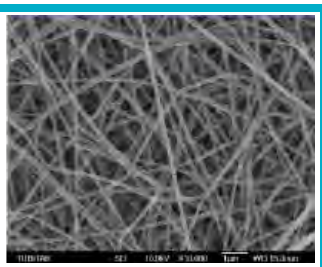

NE100 is a 40 kV basic electrospinning device model that allows you to do top-down, bottom to up, horizontal electrospinning and nanofiber production on stainless steel plate collector with single nozzle in its electrically insulated chassis with 30-230mm manual spinning distance adjustment slide and basic automation options as LED illumination, solvent exhaust fan, HV adjustment&indicator, micropump control, "SAFE DOOR" and emergency safety buttons.

NE200 is the 40 kV model that allows you to do bottom to up electrospinning and nanofiber production on 7 different changeable plate collectors (Round plate D130mm, parallel rods, two opposite rods, four cross rods, circular perforated, square perforated, opposite sharp edges collectors) with single nozzle in its electrically insulated chassis with 30-230mm automatic spinning distance control&indicator (in mm.) and automation options as LED illumination, solvent exhaust fan, HV adjustment&indicator, micropump control, "SAFE DOOR" and emergency safety buttons.

NE300 is the 40 kV model that allows you to do bottom to up electrospinning and nanofiber production on a plate collector and a D100mm X L220mm dimensioned max. 500 rpm rotating drum with multi-nozzles up to 9 in its electrically insulated chassis with 30-230 mm automatic spinning distance control&indicator (in mm.) and automation options as LED illumination, solvent exhaust fan, HV adjustment&indicator, horizontal homogeneity movement, cylinder rotation control&rpm indicator, digital temperature indicator, micropump control, "SAFE DOOR" and emergency safety buttons.

NS24 is the 40 kV model that allows you to do bottom to up electrospinning and nanofiber production on a plate collector and a D120mm X L280mm dimensioned max. 2000 rpm rotating drum with multi-nozzles up to 12 in its electrically insulated chassis with 30-230 mm automatic spinning distance control&indicator (in mm.) and automation options as LED illumination, solvent exhaust fan, HV adjustment&indicator, horizontal homogeneity movement speed and stroke control&speed indicator, cylinder rotation control&rpm indicator, digital temperature indicator, digital RH% indicator, micropump control, "SAFE DOOR" and emergency safety buttons.

DOUBLESPINNER is the 2X40 kV model that allows you to do horizontal electrospinning with two nozzles/nozzle sets from opposite sides of a D100mm X L100mm dimensioned max. 2000 rpm rotating drum, shaft and disk with multi-nozzles up to 3+3 in its electrically insulated chassis with 30-230mm automatic spinning distance from both sides. The machine lets you to use 2 different polymer solutions with standard nozzles and also 4 different polymers with 2 co-axial nozzles from both sides with %RH control inside the chamber. The automation specs are spinning distance control&indicator (in mm.) and automation options as LED illumination, solvent exhaust fan, 2XHV adjustment&indicator, horizontal homogenity movement speed control&indicator, cylinder rotation control&rpm indicator, digital temperature indicator, digital RH% control&indicator, micropump control, "SAFE DOOR" and emergency safety buttons.

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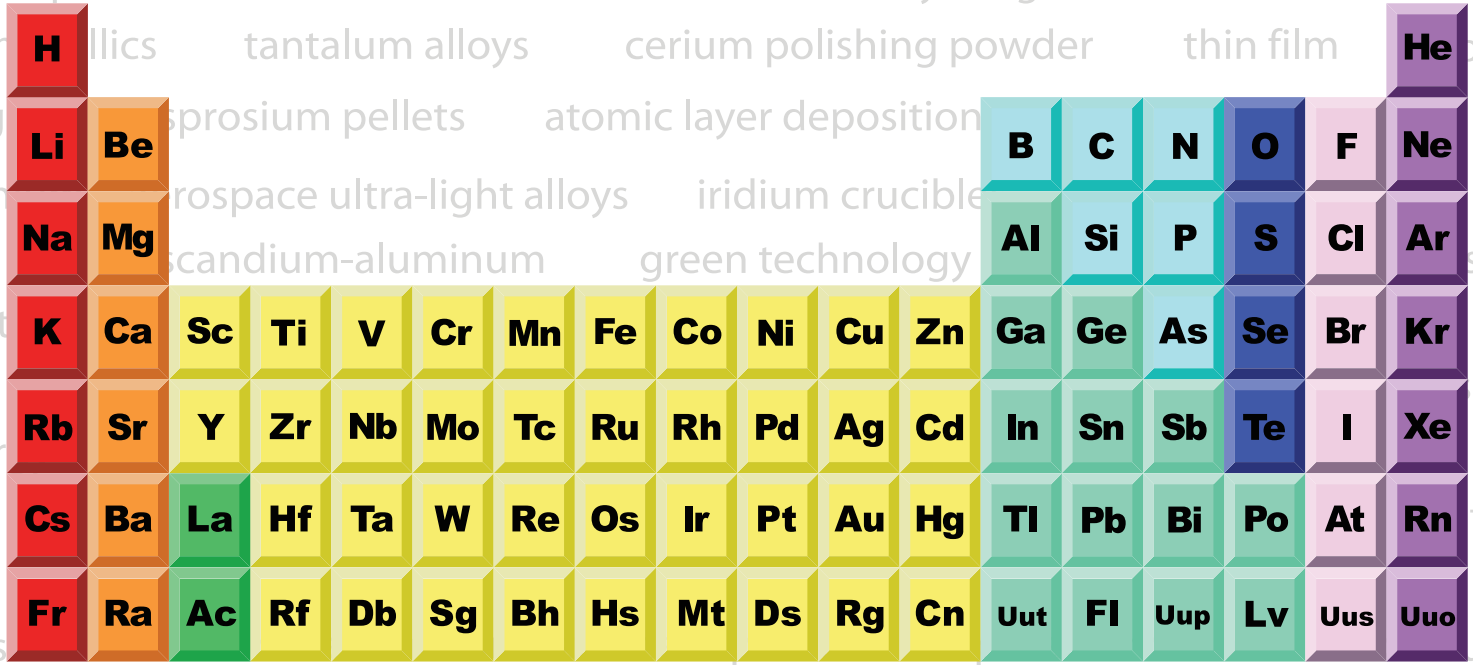

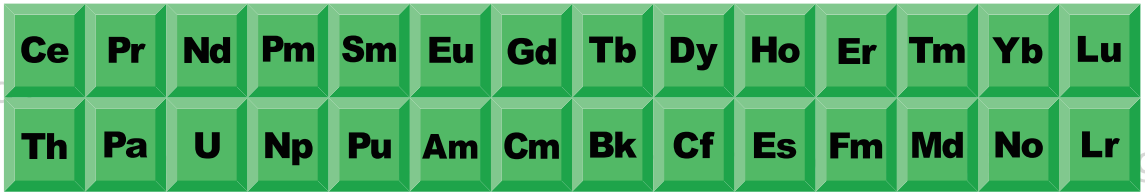

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