SIXTIETH ANNUAL MAY CONFERENCE

Sponsors:

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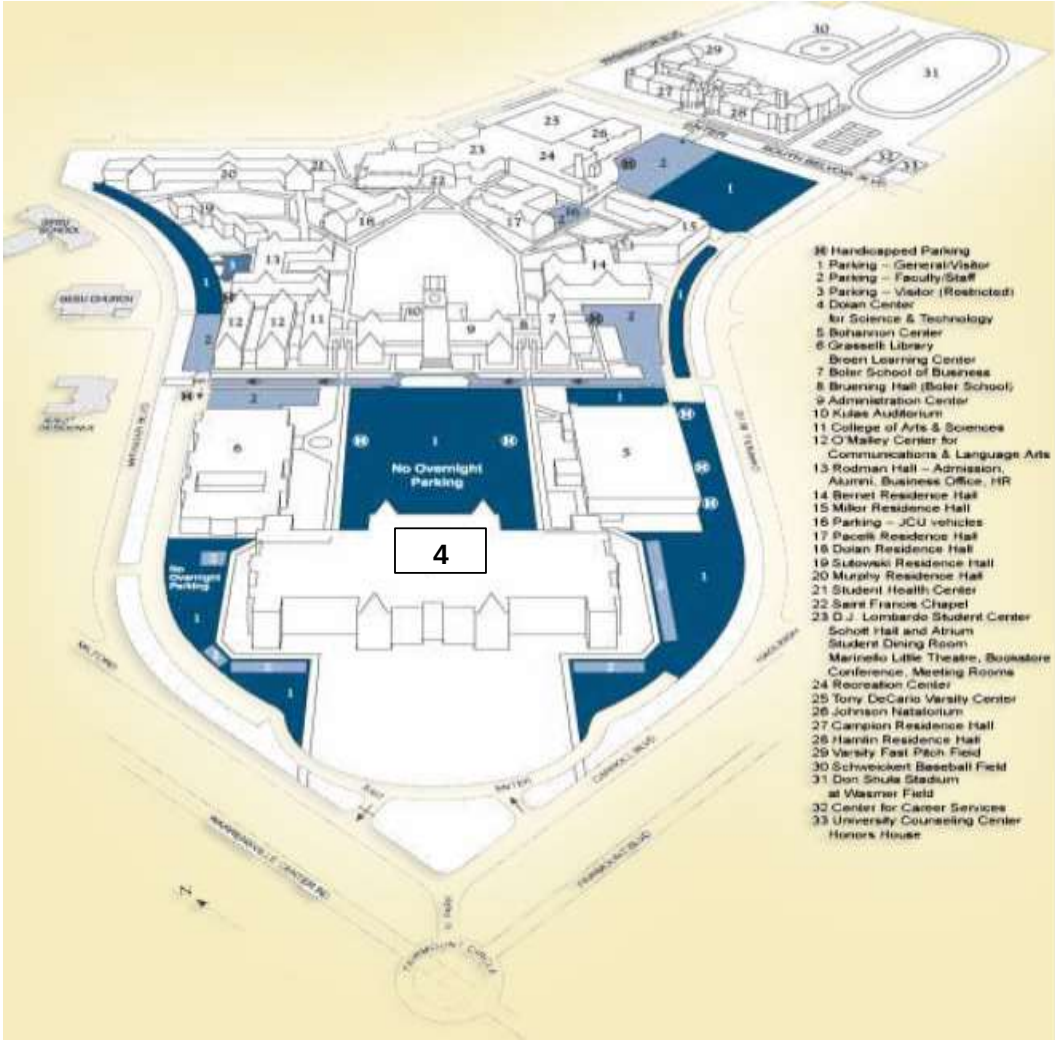
May 18, 2016
Dolan Science Center
John Carroll University
University Heights, Ohio

John Carroll University Campus Map



60th Annual
SAS/ACS/AVS/MSNO May Conference

May 18, 2016
John Carroll University
Dolan Science Center

PROGRAM

7:00 a.m. **Registration/Continental Breakfast:**
(Edward M. & Ann Muldoon Atrium)

8:00 a.m. **Opening Remarks:** (Donahue Auditorium)
Brian Perry, *LORD Corporation/SAS*
Min Gao, *Kent State University/MSNO*
Mike Setter, Department Chair, Chemistry,
John Carroll University

8:15 a.m. **Keynote Address:** (Donahue Auditorium)
Chair: Regan Silvestri, *Lorain County Community College*

"Aim High, then Aim Higher-Basic Research for the US Air Force"
Colonel Robert J. Kraus, PhD, *Chief, Science and Engineering Division, Air Force Office of Scientific Research*

9:10 a.m. **Joint Session II:** (Donahue Auditorium)
Chair: Nan Avishai, *MSNO president*

"MSNO: As Good as Gold"
Jeanette Killius, *NEOMED (President, Microscopy Society of America, 2014)*
Valerie Woodward, *Lubrizol Corporation, (National Microanalysis Society Distinguished Service Award of Council 2009)*

9:25 a.m. **Break (20 minutes):** (Edward M. & Ann Muldoon Atrium)

Presentation Session I

	Session IA **Dolan A202** Chair: Dingqiang Li	**Session IB** **Dolan A203** Chair: Zhorro Nikolov	**Session IC** **Dolan E130** Chair: Samuel Crish
9:45 a.m.	IA-1 "Application of Transmission Electron Microscopy in Crystal Structure Determination" **Chunfei Li** *Clarion University*	IB-1 "Adhesion and Friction in Wet Environment: Role of Confined Water Revealed Using Surface Sensitive Spectroscopy Techniques" **Ali Dhinojwala** *University of Akron*	IC-1 "Interaction of Amphipathic Alpha-helix Bundle Proteins with Lipid Interfaces" **Edgar Kooijman** *Kent State University*
10:15 a.m.	IA-2 "Low-Temperature Nitridation of Martensitic Stainless Steel and Reverse Austenite Transformation" **Amarali Zangiabadi** *Case Western Reserve University*	IB-2 "Phthalate Screening Using Pyrolysis GC-MS" **Mark Waksmonski** *Shimadzu Corporation*	IC-2 "Distribution of Salts and Proteins, and Structural Changes in Spider Glue Revealed by Confocal Raman Microscopy" **Gaurav Amarpuri** *University of Akron*
10:35 a.m.	IA-3 "Inside Nanofibers: Where Atoms, Molecules and Fibers are Seen" **Dinesh Lolla** *University of Akron*	IB-3 "Novel Surface Enrichment Characteristics of Polymer Surfaces Detected by Emerging Mass Spectrometry Technique" **Jacob Hill** *University of Akron*	IC-3 "Automated Method Development and Plasma Optimization on iCAP 7000 Plus Series ICP/OES" **Weimin Yang** *Thermo Fisher Scientific, Inc.*

10:55 a.m. **Break (15 minutes):** (Edward M. & Ann Muldoon Atrium)

11:10 a.m. **Yeager Award:** (Donahue Auditorium)
Chair: Rick Kus, *De Nora Tech, Inc.*

"Optimizing the Optical Properties of 'Bubble' DNA-Templated Fluorescent Silver Nanoclusters"

Ian Campbell, *Penn State Erie, The Behrend College*

11:40 a.m. **Lunch:** (O'Connell Reading Room)

12:40-2:00 p.m. Poster Session: (Second Floor Hallway)

Presentation Session II

	Session IIA **Dolan A202** Chair: Janet Gbur	**Session IIB** **Dolan A203** Chair: Ina Martin	**Session IIC** **Dolan E130** Chair: Lu Zou
2:00 p.m.	IIA-1 "Aberration-Corrected High-Resolution Transmission Electron Microscopy for Advanced Energy Materials" **Jianguo Wen** *Argonne National Labs*	IIB-1 "Plasmonic Meta-surfaces as Photomasks for Photo-patterning Molecular Orientations in Liquid Crystals" **Qi-Huo Wei** *Kent State University*	IIC-1 "Cryo-electron Microscopy and Cryo-electron Tomography of Nanoparticles" **Phoebe Stewart** *Case Western Reserve University*
2:30 p.m.	IIA-2 "Computational Fluid Dynamics (CFD) Modeling of Thermal Evaporation Synthesis of ZnO Nanostructures" **Tim Daugherty** *Youngstown State University*	IIB-2 "Thin Film Sensor Using Nanosphere-Patterned and Molecularly Imprinted Polymer Arrays for QCM Detection of Aspartame" **Sicily Tiu** *Case Western Reserve University*	IIC-2 "Architecture of the Schizosaccharomyces Pombe Ccq1-Tpz1-Poz1 Telomeric Complex" **Harry Scott** *Case Western Reserve University*
2:50 p.m.	IIA-3 "Structure-Property Studies of Fluorinated Azadipyrromethene Derivatives as n-Type Acceptors in Organic Photovoltaics" **Sandra Pejic** *Case Western Reserve University*	IIB-3 "Additive Manufacturing of a Ni-based Alloy" **Matthew Caputo** *Youngstown State University*	IIC-3 "From Boutons to Bulbs: Exploring Fluorescent and 3D Electron Microscopy to Examine Axonopathy and Synaptopathy in Mouse Models of Glaucoma" **Matthew Smith** *NEOMED*
3:10 p.m.	IIA-4 "Nanoscale Electro-Patterning and Templating with Polymers" **Prof. Rigoberto Advincula** *Case Western Reserve University*	IIB-4 "Fatigue Performance of Fused Deposition Modeling (FDM) Style 3D Printed vs. Injection Molded Ultem® 9085" **Shih-Wa Wang** *PolyOne*	IIC-4 "Recent Advances in Cryo-TEM; A New Era for Structural Biology" **Jeff Lengyel** *FEI Company*

3:40 p.m. **Break (20 minutes):** (Edward M. & Ann Muldoon Atrium)

Presentation Session III

	Session IIIA **Dolan A202** Chair: Wayne Jennings	**Session IIIB** **Dolan A203** Chair: Danqi Wang	**Session IIIC** **Dolan E130** Chair: Rick Kus
4:00 p.m.	IIIA-1 "Applications of FTIR and Raman Imaging" **Ron Rubinovitz** *Thermo Fisher Scientific, Inc.*	IIIB-1 "Designing Quantitative Experiments That Use 3D Blockface Imaging SEM in Neuroscience and Eye Research" **Dr. Grahame Kidd** *Cleveland Clinic*	IIIC-1 "Physical Chemistry in Biological Membranes: Resolving the Chemical Details of Cell Signaling" **Adam Smith** *University of Akron*
4:30 p.m.	IIIA-2 "Studying Growth Process of Facet-Controlled Platinum Group Metal Nanoparticles on Substrate with Electron Microscopy and IR Spectroscopy" **Zhenmeng Peng** *University of Akron*	IIIB-2 "Elastic Properties of Dimeric Liquid Crystals with Negative Dielectric Anisotropy" **Greta Cukrov** *Kent State University*	IIIC-2 "Ruthenium-Modified Sensitive NO Sensors: Quantifying nitric oxide in the Pathobiology of Cystic Fibrosis" **Tiyash Bose** *Cleveland State University*
4:50 p.m.	IIIA-3 "IR Spectroscopy-Breaking the Diffraction Limit!" **Jay Anderson** *Anasys Instruments*	IIIB-3 "ZEISS MultiSEM – The Fastest SEM In The World" **Kyle Crosby** *Carl Zeiss*	IIIC-3 "HIV Receptor Knockout Using the Genome-Editing CRISPR/Cas9 System" **Jennifer L. Taylor** *LCCC*

5:10 p.m. **Break (15 minutes):** (Edward M. & Ann Muldoon Atrium)

5:25 p.m. **Student Paper/Poster/MSNO Awards** (Donahue Auditorium)
(Regan Silvestri, Tom Steele, Nan Avishai)

5:35 p.m. **Joint Session III:** (Donahue Auditorium)
Chair: Amir Avishai, *Case Western Reserve University*

"The May Conference at 60 Years: A Brief History"
Brian Perry, *LORD Corp., President Cleveland SAS*

5:50-7:00 p.m. **Reception/Program:** (Edward M. & Ann Muldoon Atrium)

Recognition of Meeting Sponsors	Amir Avishai
Bell Award Presentations	Tom Steele
Raffle	Danqi Wang
Closing Comments	Brian Perry

2016 May Conference Planning Committee

General Committee	Brian Perry, LORD Corporation Amir Avishai, Case Western Reserve University Sara Freeman, Ferro Corporation Wayne Jennings, Case Western Reserve University Min Gao, Kent State University Rick Kus, De Nora Tech, Inc. Regan Silvestri, Lorain County Community College Doug Rhode, Lake County Crime Laboratory Mike Setter, John Carroll University Tom Steele, Lubrizol Corporation Hao Qu, Momentive Performance Materials Bob Williams, Lubrizol Corporation Nanthawan Avishai, Case Western Reserve University Zhorro Nikolov, The University of Akron
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E. B. Yeager Award	Rick Kus, De Nora Tech, Inc. Ann Abraham, Kent State University Doug Rohde, Lake County Crime Laboratory
Student Paper Awards	Regan Silvestri, Lorain County Community College Melanie Knowlton, LORD Corporation Rick Kus, DeNora Tech Dingquiang Li, Youngstown State University

Student Posters	Tom Steele, Lubrizol Corporation Kevin Otteni, LORD Corporation Wayne Jennings, Case Western Reserve University Nicole Klingensmith, LORD Corporation Matt Moesta, LORD Corporation Coleen McFarland, Envantage,Inc. Ina Martin, Case Western Reserve University Lu Zou, Kent State University
MSNO Student Awards	Min Gao, Kent State University Nanthawan Avishai, Case Western Reserve University Rick Kus, De Nora Tech Lu Zou, Kent State University Danqi Wang, Case Western Reserve University Ina Martin, Case Western Reserve University Zhorro Nikolov, The University of Akron Dingquiang Li, Youngstown State University
John Bell Award	Wayne Jennings, Case Western Reserve University Tom Steele, Lubrizol Corporation Brian Perry, LORD Corporation Rick Kus, De Nora Tech
Poehlman Award	Coleen McFarland, Envantage, Inc.
Abstract Booklet	Brian Perry, LORD Corporation Min Gao, Kent State University Lu Zou, Kent State University Melanie Knowlton, LORD Corporation Kevin Otteni, LORD Corporation

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TRUSTEE	**Zhorro Nikolov, The University of Akron**
TRUSTEE	**Ina Martin, Case Western Reserve University**

Ernest B. Yeager Award

In 1962, the Cleveland Section of the Society for Applied Spectroscopy established the Ernest B. Yeager Award, which now consists of a certificate and a three hundred dollar stipend. This award is made annually to an outstanding undergraduate student who is attending a college or university in Northeastern Ohio, and who has demonstrated an interest in some phase of spectroscopy. The award also carries a free one-year membership in the Society for Applied Spectroscopy.

Year	Recipient	Year	Recipient
1962	Eric A. Entemann	1989	Sheryl Tucker
1963	John H. Konnert	1990	No Award Given
1964	Sheldon J. Green	1991	Stephen C. Stone
1965	Cheryl H. Miller	1992	No Award Given
1966	Dale Wingeleth	1993	Baonian Hu
1967	Richard D. Ash, Jr.	1994	Amy L. Lusk
1968	Jon Mynderse	1995	John W. Cave
1969	Virginia E. Coates	1996	Michael Fiorentino
1970	Charles F. Cobb	1997	Jonathan Flad
1971	Gerald R. Cappo	1998	Christopher S. Callam
1972	Donald R. Diehl	1999	David T. Clark
1973	Fred A. Fortunato	2000	Adam Van Wynsberghe
1974	Douglas B. Rahrig	2001	David C. Oertel
1975	William Hart	2002	Richard L. Barger, Jr.
1976	John Havens	2003	Michelle Adams
1977	Thomas M. Leiden	2004	Tiffany Leigh Copeland
1978	Scott A. Raybuck	2005	Stacey Lynne Dean
1979	Jeff Weidenhamer	2006	Colleen M. Burkett
1980	Alexander Kondow	2007	Manasi Bhate
1981	Raymond E. Cline	2008	Nikolas Joseph Neric
1982	Marie Zaper	2009	Deacon J. Nemchick
1983	Brian L. Cousins	2010	Rachel V. Bennett
1984	Ka-Pi Hoh	2011	Daphne A. Guinn and Jennifer L. Miller
1985	Chris Scott	2012	Jean Quenneville
1986	Ann M. Mulichak	2013	Yihui Chen
1987	Rex Ramsier	2014	Jocienne Nelson
1988	Joy Gorecki	2015	Kevin Budge

2016 Ernest B. Yeager Award Recipient

Ian Campbell
Penn State Erie, The Behrend College

"Optimizing the Optical Properties of 'Bubble' DNA-Templated Fluorescent Silver Nanoclusters"

Ernest B. Yeager, the Frank Hovorka Professor Emeritus of Chemistry at Case Western Reserve University, was internationally known for his pioneering contributions to the fundamental understanding of electrochemical reactions and to the development of fuel cell and battery technology. During nearly 50 years on the Case Western Reserve faculty, he mentored 80 doctorate students and 45 post-doctorate fellows, authored 270 scientific papers and edited and co-edited 20 books. He was internationally recognized as an authority in physical acoustics and electrochemistry. His students and colleagues knew him for his uncompromising demand for excellence in research and scholarly writing.

Professor Yeager, 77, died March 8, 2002 in Cleveland, Ohio, after a long struggle with Parkinson's Disease.

John Bell Memorial Award

John Bell was a long-time member of the Society for Applied Spectroscopy (SAS). The Northeastern Ohio Science and Engineering Fair was one of John's special interests; he took great pleasure in representing our Society's local section as a judge at this event. Unfortunately, John died in November 1994. After his death, the members of the Cleveland Section of SAS voted to honor him by establishing the *John Bell Memorial Award*, for the Science Fair project which best uses or illustrates a principle of spectroscopy in an innovative manner.

Year	John Bell Award	John Bell Merit Award	Special Mention Award
1995	Mary Elizabeth Bruce		
1996	Jonathan Parkhurst		
1997	Lavanya Kondapalli		
1998	Justine Wang	Vivek Mathur	
1999	Elizabeth Long	Kara Urbanek	
2000	Elizabeth Wood	Srinivas Kondapalli	
		Frank Pucci	
2001	Catherine T. Burke		
2002	Mallory Horejis	Alia Evans	Gabe Jakubisin
		Monica Sberna	Scott Brigeman
2003	Zenon Mural	Cecilia Michel	Matthew McPheeters
		Monica Benedikt	Christina Beall
2004	Kevin Rinz	Emily C. Wirtz	Gabrielle L. Petrie
		Sarah Lynn Martin	Zack Puskar
2005	Christine Debaz	Simone Duval	
		Sara Yacyshyn	
2006	Ellen Napoli	Patrick Rinz	Brittney Williams
		Julia Juster	Derek Poindexter
2007	Anna Faist	Mary Ryan	Rebecca Rabinovich
		Jennifer Haag	Margarat Sivit
2008	Jonathan Sender	Shrey Shah	Daniel Kernan
		Johnathan Ungvarsky	Peter Suwondo
2009	Katherine Reading	Johnathan Ungvarsky	Daniel Krentz
		Morde Khaimov	
2010	Maddie Mooney	Katrina Feldkamp	Samuel Stroebel
			Leat Perez
2011	Kevin Yang	Emily Peterson	Sara Mann
			Jane Kim
2012	Jane Kim	Dongham Kim	Paige Rogozinski
		Maurice Ware	Noah Nicholas
2013	Grace Gamble	Justin Boes	
2014	Alison Jin	Claire Chalkin	Morgan Fink
		Anjali Prabhakaran	Kenna Marblestone
2015	Christine Larson	Nicholas Kernan	Lauren Zipp
			Ian Thompson

The 2016 John Bell Memorial Award Recipient

Klaudia Sirk

"The Effect of Gold Thickness on the Mechanical Properties of a Silicon Carbide Diaphragm: Determining the Shift in Fundamental Resonant Frequency"

The 2016 John Bell Memorial Merit Award Recipient

Adriana Gildone

"Lead in Lipstick?"

The 2016 John Bell Memorial Special Mention Award

Audrey Higgins

"Laser Lights through Gelatin"

Kei Kojima

"Autonomous Wearable Alert Device Based on Audio Pattern Recognition for the Hearing Impaired"

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Joint Session I

"Aim High, then Aim Higher--Basic Research for the US Air Force"

Colonel Robert J. Kraus
Chief, Science and Engineering Division Air Force Office of Scientific Research
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Arlington, VA 22203-1768

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Do you like your GPS? How often do you participate in a video teleconference? Have you ever wondered where some of today's commonplace technologies started? The Air Force Office of Scientific Research administers the basic research program for the US Air Force and provided early funding to these programs and many others. As the Science and Engineering Division Chief, Col Robert Kraus oversees the US-based program officers to administer more than 1,200 grants and $500M for research every year. AFOSR is now funding things like cold atom interferometry, hypersonic vehicles, and autonomy to discover, shape, and champion the basic science that will profoundly affect the future Air Force. AFOSR also facilitates technology transition from basic to applied research in the other technical directorates in the Air Force Research Laboratory. Besides the core research program, there are a number of other opportunities for research funding.

Joint Session II

MSNO – As Good as Gold

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50 years! The adage "the more things change, the more they stay the same" could be used to describe the MSNO arc since its founding in 1966. Microscopy and microanalysis have changed considerably in the levels of information they yield (nanometers, ppm) and the way they provide it (negatives, paper plots to completely digital formats), but the underlying mechanism remains the same – light and electron beams interacting with matter and generating detectable and measureable forms of electromagnetic radiation. The same could be said for MSNO – the breadth and depth of techniques our members practice or represent have grown exponentially, but the unifying element is the interaction of interested, dedicated scientists who enjoy working together, sharing their work and bringing along the next generation of microscopists and microanalysts. Please join two veterans of MSNO as they explore the society's morph from 1966 until now, and look into the future.

Presentation IA-1 (Invited)

Application of Transmission Electron Microscopy in Crystal Structure Determination

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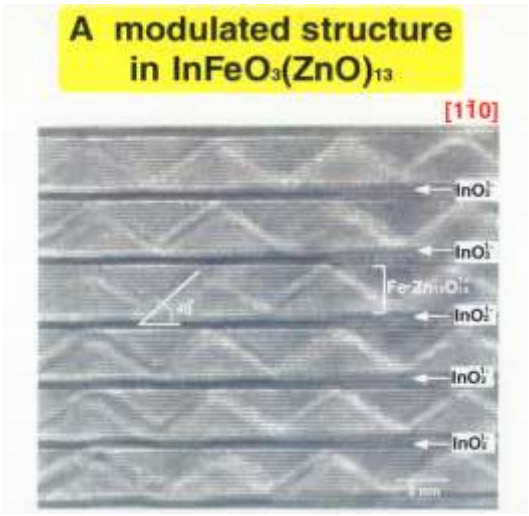
Transmission Electron Microscopy (TEM) is a powerful tool in microstructure characterization. It provides information of atomic arrangement in real and reciprocal spaces. Coupled with Energy Dispersive X-ray Spectroscopy and Electron Energy Loss Spectroscopy, it can also provide elemental and chemical information. This talk uses three examples to demonstrate such strength of TEM.

A modulated structure in the homologous compounds of $RMO_3(ZnO)_m$ (R=In, Fe, and Ga; M=In, Fe, Ga, and Al; m=integer) has been revealed by TEM. The crystal structure of these compounds have been previously studied by powder X-ray diffraction. It was suggested that the basis of the crystal structure is the dense packing of Oxygen ions. R ions occupy the octahedral sites forming RO_2^{1-} layers and the M and Zn ions occupy the tetrahedral or trigonal bipiramidal sites forming negative M/Zn-O layers. The RO_2^{1-} layers are interleaved by M/Zn-O layers. It was suggested that M and Zn distributed randomly in the M/Zn-O layer. However, TEM examination revealed the ordering of M ions, forming modulated structure, as shown by the high resolution TEM image of $InFeO_3(ZnO)_{13}$ compound. Further, the description of the modulated structure by superspace group and the dependence of the modulated structure on R and M ions will be reported.



Presentation IA-2

Low-Temperature Nitridation of Martensitic Stainless Steel and Reverse Austenite Transformation

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An isothermal martensitic martensite-to-austenite phase transformation has been observed in 15-5 PH martensitic stainless steel during nitridation at low temperatures. The transformation occurs in the near-surface region of the alloy, in which the nitrogen concentration reaches 15%, corresponding to a “colossal” super-saturation. This very high concentration of nitrogen, a strong austenite stabilizer, provides the driving force for this low-temperature phase transformation. The martensitic austenite forms as plates with an average semithickness-to-radius ratio c/r of 0.08.

Presentation IA-3

Inside Nanofibers: Where atoms, Molecules and Fibers are Seen

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Nanofibers of polyvinylidene fluoride (PVDF) were made by electrospinning and examined at high resolution with an aberration corrected transmission electron microscope. Fibers were three to ten nanometers in diameter. Rows of CF2 atomic groups, at 0.25 nm intervals, marked the bent paths of segments of the molecules. The 0.2 nm distance between the two fluorine atoms attached to the same carbon atom was clearly resolved. The fact that an electron microscope image of a segment of a PVDF molecule depended upon the particular azimuth along which the segment was viewed, showed that the molecules were often twisted, at intervals of a few nanometers, around their long axis. The fibers were self-supported over small holes, thereby eliminating confusion from the support structure. The fibers were too thin and too far apart for secondary damage to occur. Morphological and chemical changes produced by energetic electrons, ranged from no change at all, to fiber scission. These measurements provide new insights into radiation chemistry. Relative movements of segments of molecules were observed. Synergism between high-resolution electron micrographs and images created by molecular dynamic modeling was demonstrated. Such information promises to be helpful in the conception and design, for example, of molecular scale machines. Related conformational changes were observed in molecular dynamics calculations of PVDF nanofibers, where the motion of every atom was followed.

Reference: “Polyvinylidene fluoride molecules in nanofibers, imaged at atomic scale by aberration corrected electron microscopy” Nanoscale, 2016,8, 120-128.
Acknowledgements: Help from Mesfin Tsige, Suqi Liu and Zhenxin Zhong is acknowledged. Support from the Coalescence Filtration and Nanofiber Consortium, from the University of Akron and from the U. S. Department of Energy (contract DE-AC02-05CH11231) is gratefully acknowledged.

Presentation IB-1 (Invited)

Adhesion and Friction in Wet Environment: Role of Confined Water Revealed Using Surface Sensitive Spectroscopy Techniques

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Water is ubiquitous and it has a strong influence on performance of materials. The observations of corrosion of steel structures, peelings of paints, and degradation of composites are some striking examples that are influenced by exposure to humidity and water. Interestingly, nature has developed some unique approaches to protect and function under the influence of water. In my talk, I will present some unique ideas on how natural systems reveal a complex role of confined water in controlling adhesion and friction. I will present the progress we have made in understanding the structure of confined water using surface-sensitive infrared visible sum frequency generation spectroscopy. The implications of these findings in designing novel adhesives that could function in wet environments will be discussed.

Presentation IB-2

Phthalate Screening Using Pyrolysis GC-MS

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The use of phthalates in plastics has come under scrutiny in recent years in regards to consumer safety. A number of these compounds are now regulated by several governing bodies. These regulated phthalates are often analyzed by a cumbersome and tedious sample preparation prior to analysis. Pyrolysis GC-MS methods have been developed which can quickly screen these materials to determine phthalate content with minimal sample preparation. Additionally, DOTP containing materials may cause false positive results by GCMS due to co-elution and common ion fragments. An alternate separation method has been developed to eliminate the false positives associated with co-elution.

Presentation IB-3

Novel Surface Enrichment Characteristics of Polymer Surfaces Detected by Emerging Mass Spectrometry Technique

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The emerging technique of surface layer matrix-assisted laser desorption ionization time-of-flight mass spectrometry (SL-MALDI-ToF-MS) is able to validate the complete depletion from a blend film surface of a blend species differing only by the functionality at a single chain end, a difference involving less than 0.5 wt. % of the polymer chain. The results indicate that all parts of the hydroxymethyl functionalized polystyrene chain, not only its functionalized end, are virtually absent from the top molecular layer of the film. Such sensitivity to the depletion in the outermost layer due to such a subtle change in the chain is unprecedented.

Presentation IC-1 (Invited)

Interaction of Amphipathic Alpha-Helix Bundle Proteins with Lipid Interfaces

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Lipid droplets are organelles that contribute to various cellular functions which are vital for life. Aside from acting as a neutral lipid storage depot, they are also involved in building new membranes, synthesis of steroid hormones and cell signaling. Many aspects of LD structure and function are not yet well understood. One feature of LD binding proteins is the presence of amphipathic alpha-helix bundles. To shed light on the function of this structural motif we investigate the interaction of perilipin 3, a member of the PAT family of LD binding proteins, and three N-terminal truncation mutants with lipid interfaces. We find that the C-terminal amphipathic alpha-helix bundle of perilipin 3 has different insertion behavior from that of the longer truncation mutants and the full length protein. Inclusion of N-terminal sequences with the C-terminus decreases the ability of the protein construct to insert in lipid monolayers. Anionic lipids, coupled to negative spontaneous curvature, facilitates protein interaction and insertion. The C-terminus shows strong preference for lipids with more saturated fatty acids. This work sheds light on the LD binding properties and function of the different domains of perilipin proteins.

Presentation IC-2

Distribution of Salts and Proteins, and Structural Changes in Spider Glue Revealed by Confocal Raman Microscopy

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Modern orb weaving spiders use micron-sized glue droplets on their viscid silk to retain prey in webs. A combination of low molecular weight salts and proteins makes the glue viscoelastic and humidity responsive in a way not easily achieved by synthetic adhesives. We recently reported that different spider species tune glue viscosity to maximize adhesion at their foraging humidity. In this study we used optical and confocal Raman microscopy to determine the spatial chemical structure of glue droplet\cite. Optically, the glue droplet shows a heterogeneous structure, but we found that salts and proteins are present ubiquitously throughout the droplet. The distribution of adhesive proteins in the peripheral region explains the superior prey capture performance of orb webs as it enables the entire surface area of the glue droplet to act as a site for prey capture. Recent results on the primary structural changes in glue with an increase humidity and upon stretching will be discussed. Understanding the function of individual glue components and the role of the droplet's macro-structure can help in designing better synthetic adhesives for humid environments.

Presentation IC-3

Automated method development and plasma optimization on iCAP 7000 plus series ICP-OES

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The Element Finder plug-in for the Qtegra ISDS software is an intuitive user-friendly method development tool that allows for the selection of analytical wavelengths that are free from spectral interferences taking into account the analytes present in the sample and the sample matrix. By utilizing Fullframes (an image of the enter sample spectrum, within the wavelength of the instrument) of the sample, the software intelligently selects the wavelengths that are interference free for the elements you have selected. The software allows automated plasma optimization based on the elements of interest and the elements present in the sample matrix. In this way the Element Finder plug-in helps to save time and cost associated with long and cumbersome method development. Method development in less than 20 minutes!

Yeager Award Presentation

Optimizing the Optical Properties of 'Bubble' DNA-Templated Fluorescent Silver Nanoclusters

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DNA-templated silver nanoclusters (DNA-AgNCs) are small groups of silver atoms bound and protected by a DNA strand. Their strong optical absorbance and high fluorescence yield make them a promising new type of fluorophore for use as biological probes. We are optimizing the synthesis of fluorescent DNA-AgNCs to assess them as a new material for luminescent solar concentrators. DNA-AgNCs were synthesized using a new scaffold of hybridized DNA with a central interlude of unhybridized cytosine bases on each strand, resulting in AgNCs surrounded by a "bubble" of DNA. Bubble sizes ranging from 2-16 cytosine-to-cytosine pairs were tested. Maximum fluorescence intensity and stability were observed for a template with 8 cytosine-to-cytosine pairs. The synthesis was varied using silver-to-DNA bubble ratios ranging from 1:1 to 24:1. A ratio of 14:1 was found to elicit maximum fluorescence stability and intensity from AgNCs in 8 cytosine-to-cytosine pair DNA bubbles.

Poster Session
Biological Sciences Section

Katie Nowlin LCCC Dept. of Chemistry	GC-MS Analysis of Unprecedented Whiskey Flavors Created by a Novel Aging Process
Fatima A. Jaber KSU NEOMED	Osteoactivin/LC3 Interaction Regulates Autophagy in Osteoblasts
Alex Nyarko UAkron Dept. of Polymer Science	Investigating the Material Properties of the Caulobacter Crescentus Adhesive Holdfast
Kendall M. Hoover CWRU Dept. of Neurosciences	Investigating Synapse Assembly and Organization at the NMJ: Role of the Crimpy-Gbb Signaling Pathway
Lisa E. Parrish-Thompson LCCC Department of Biology	A Self-Sustainable Ecosystem Utilizing eXtreme Green Concepts: Sand vs. Soil
Samuel Bunting UAkron Dept. of Chemistry	Applications of a 3D-Printable Photospectrometer
Heba Salim CSU Dept. of Chemistry	Development of oligonucleotides films as sensing platforms for peroxynitrite detection
Octavia Whitfield LCCC Dept. of Biology	Analysis of a Novel CCR5 Mutation from an African American Family
Keira Magdos LCCC Dept. of Biology	The Effect of ccr5delta32 on the Expression of Wild-Type CCR5 and CXCR4
Jared Repas LCCC Dept. of Biology	CCR5 and CXCR4 Molecular Interactions
Jonathan P. Barko CSU Dept. of Chemistry	Chemically Modified NO Sensors with Enhanced Capability to Detect Low Levels of NO: With Application Towards Clinical Conditions Related to Decreased NO Levels
Xiaosi Li UAkron Dept. of Chemistry	Electrostatic Interactions Between Peripheral Peptides and anionic lipids in biological membranes
Neetu M. Gulati CWRU Dept. of Pharmacology	Cryo-Electron Tomography Characterization of the Shielding Properties of Serum Albumin on a Viral Nanoparticle
Dharamdeep Jain UAkron Dept. Polymer Science	Effect of Humidity on the Adhesion of Black Widow Spider's Gumfoot Silk

Physical Sciences Section

Janet L. Gbur CWRU Dept. of Materials Sci. & Eng.	Flex Bending Fatigue of Dental Archwires
Naima Hilli CWRU Department of Materials Sci. & Eng.	Degradation of LSM-Based SOFC Cathodes Under Accelerated Testing
Jerome Palaganas CWRU Dept. of Macromolecular Sci. & Eng.	Development of Self-Healing Polymer for Stereolithography 3D Printing
Napolabel Palaganas CWRU Dept. of Macromolecular Sci. & Eng.	Mechanical Properties of Poly(ethylene glycol) Reinforced by Abaca Nanocrystals and 3D Printed via Stereolithography
Suqi Liu UAkron Dept. of Polymer Sci.	Atomic Scale Electron Microscopy of Polyvinylidene Fluoride
Haitham Kalil CSU Dept. of Chemistry	Synthetic Melanin Films as Potential Interfaces for Peroxynitrite Detection
A. Bourke CWRU Department of Chem. & Biomolec. Eng.	Effects of Electrochemical Pretreatment of Carbon Electrodes on the Kinetics of Vanadium Redox Reactions
Mallory Miller CWRU Dept. Chemical Eng.	Understanding Speciation in Ionic-Liquid Electrolytes for Non-Aqueous Redox Flow Batteries
Bowen Dong CWRU Department of Materials Sci. & Eng.	Simple High Sensitivity Magnetostriction Measurement System
Andrew Pyles CWRU Dept. of Polymer Sci. & Eng.	Atomic Force Microscopy (AFM) for Optimization of Corona Treatment on PET films
Jill Manapat CWRU Dept. of Polymer Sci. & Eng.	Strengthening FDM-Printed ABS Parts Through Filament Modification and UV Post-Curing
Hua Sun CWRU Dept. of Polymer Sci. & Eng.	Tough, Low Flammability Polymer Aerogels Incorporating Inorganic Nanoparticles
Brandon C. Carreno CWRU Dept. of Earth, Env. & Planetary Sci.	Characterization of Meteorite Samples for the Determination of the Physical Properties of Asteroid Regolith
J. Healy, S. Lan CWRU Dept. of Materials Sci. & Eng.	Coercivity Model for (Co, Ni)-based Soft Nanocomposite Magnets
Lihan Rong CWRU Dept. of Macromolecular Sci. & Eng.	A Supramolecular Polyethylenimine-Cored Carbazole Dendritic Polymer with Dual Applications
Tyler Arntz UAkron Dept. Polymer Science	Multidimensional Mass Spectrometry of Polyglycerol
Brylee David B. Tiu CWRU Dept. of Macromolecular Sci. & Eng.	Electropolymerized and Colloidally-Templated Conducting Polymer-Au Co-Patterns

Xun Zhan CWRU Dept. of Materials Sci. & Eng.	Effect of Tungsten Alloying on Short-to-Medium-Range-Evolution and Crystallization Behavior of Near-Eutectic Amorphous Ni–P
Ruixia Zhang UAkron Dept. of Materials Sci. & Eng.	Effects of Laser Shock Peening on the Wear and Degradation behaviors of magnesium alloys
Peng-Fei Cao, Yun-Hui Yan CWRU Dept. Polymer Science & Eng.	Star-like Copolymer Stabilized Noble-Metal Manoparticle Powders
Asritha Nallapaneni UAkron Dept. of Polymer Engineering	Diffuse Reflection of Phase-Separated Polymer Blend Films
Piaoran Ye CWRU Dept. of Polymer Sci. & Eng.	Well-Defined Linear Polymer made by Reversible Addition-Fragmentation Chain Transfer Polymerization via Flow Chemistry
Zhencheng Ren UAkron Dept. of Mechanical Eng.	Improvement of Corrosion and Wear Resistance of AISI 4140 Steel Through Nanocrystallization-Assisted Nitriding

Presentation IIA-1 (Invited)

Aberration-Corrected High-Resolution Transmission Electron Microscopy for Advanced Energy Materials

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With the development of a spherical-aberration (Cs) corrector, aberration-corrected high-resolution transmission electron microscopy (HRTEM) is a powerful method for accurate visualization of oxygen columns. Recent development of correction of chromatic aberration (Cc) offers a new opportunity to improve imaging capability further, allowing us to achieve amplitude contrast imaging (ACI) in HRTEM. Under ACI conditions, atomic resolution channeling contrast can be realized, allowing us to obtain directly interpretable HRTEM images with discrimination between light and heavy atomic columns. With this newly developed technique combined with the first-principles calculations, we found that non-ferroelectric CaTiO3 phase can exhibit a large polarization in (CaTiO3)n/(BaTiO3)n superlatice. The stabilization of the highly polar phase is realized by a reconstruction of oxygen octahedron rotations from the pattern of nonpolar bulk CaTiO3 in-phase rotation to an out-of-phase rotation that is characteristic of a BiFeO3 phase. Another benefit of Cc correction is that it allows improve resolution without comprising image contrast. Using these newly developed techniques, some examples using aberration-corrected HRTEM for characterizing advanced energy materials such as catalyst supports, Li-ion/Li-O2 batteries will be given.

Presentation IIA-2

Computational Fluid Dynamics (CFD) Modeling of Thermal Evaporation Synthesis of ZnO Nanostructures

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ZnO nanostructures with various morphologies and sizes can be obtained using thermal evaporation by varying experimental parameters such as synthesis temperature, air or oxygen flow rate, morphology of Zn sources, position of substrate relative to Zn source, etc. The purpose of this research is to use computational fluid dynamics (CFD) coupled with an experimental investigation to understand the influence of thermal evaporation parameters on the morphology and size of ZnO nanostructures. A two-dimensional model was created using ANSYS Fluent 16.1.0 software, and mass flowrate and temperature boundary conditions were used. The modeling results were compared with the experimental ones.

Presentation IIA-3

Structure-Property Studies of Fluorinated Azadipyrromethene Derivatives as n-Type Acceptors in Organic Photovoltaics

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Zinc azadipyrromethene (ADP) chelates are good candidates as electron acceptors for organic photovoltaics (OPVs) due to their intense light absorption in the visible to near IR regions and high electron affinity. Previously, we synthesized an ADP-based electron acceptor containing phenylacetylene arms, Zn(WS3)2, which performed well in OPVs when blended with poly(3-hexylthiophene) (P3HT). In this work, we added fluorine in various positions to Zn(WS3)2 to further enhance the electron affinity and study the effect of positioning of the electron withdrawing groups. The fluorinated acceptors were tested in organic solar cells using P3HT as the electron acceptor. Depending on the position of the fluorines, the addition of fluorine either increased or decreased power conversion efficiencies (PCE) compared to the unfluorinated Zn(WS3)2 acceptor. To understand these results, we analyzed surface morphology using atomic force microscope and are calculating charge carrier mobilities. The increased efficiency for two of the fluorinated acceptors demonstrate that fluorination is a promising method to develop better acceptors for OPVs.

Presentation IIA-4 (Invited)

Nanoscale Electro-Patterning and Templating with Polymers

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Tools for micron- to nano-scale manipulation require the ability to image the object or substrate while applying the necessary thermo-mechanical tools to create an applied field effect. The uses of AFM includes imaging, sensing, and patterning. Non-lithographic methods such as writing, imprinting, embossing will allow patterns to be produced in a programmable manner on chemically or physically responsive substrate films. In our group, we have utilized conducting AFM on electropolymerizable monomers and precursor polymers to accesses nanoscale features. Possible applications include WORM memory devices and microfluidic device features. Key to this is the development of the precursor materials that react electrochemically and also respond to joule heating effects. We have also utilized nanosphere lithography (NSL) to create templated arrays with binary chemistry.

Presentation IIB-1 (Invited)

Plasmonic Meta-surfaces as Photomasks for Photo-patterning Molecular Orientations in Liquid Crystals

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Liquid crystals (LCs) are not ubiquitous in nature, but also vital to many device applications. Controlling the molecular orientation in LCs is central to both the fabrication and the operation of all LC devices. Emerging applications beyond LC displays require arranging molecular orientations in spatially non-uniform patterns, and thus a scalable manufacturing technique is in high demand. We recently developed a new photopatterning technique by using plasmonic metasurfaces as photomasks which generate both intensity and polarization patterns, and allow for photopatterning LC molecular orientations in complex and designable patterns. In this talk, I will present the design and fabrication of the metamasks, photoalignment and reconfigurations of topological defects in LCs, and their potential applications as a template for self-assembly.

Presentation IIB-2

Thin Film Sensor Using Nanosphere-Patterned and Molecularly Imprinted Polymer Arrays for QCM Detection of Aspartame

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A new detection protocol combining molecular imprinting and nanosphere lithography was developed producing a nanopatterned polyterthiophene film sensor capable of detecting aspartame. The artificial recognition sites capable of rebinding aspartame were made possible by imprinting aspartame into an electropolymerized molecularly imprinted polymer. The detection limit of the resulting sensor was ~31 μM and has a good linear response when subjected to aspartame concentrations from 12.5 μM up to 200 μM. This sensor showed a high selectivity when matched up with other peptide-based analogs including alanine-phenylalanine (Ala-Phe), alanine-glutamine (Ala-Gln), glycylglycine (Gly-Gly), and arginylglycylaspartic acid (RGD). The highly ordered nanopatterned configuration was induced and monitored in situ by electrochemical quartz crystal microbalance and atomic force microscopy; analyte imprinting and removal were characterized using X-ray photoelectron spectroscopy. Based on molecular modeling (semi-empirical AM1 quantum calculations), the key to the effective aspartame imprinting and detection of this sensor is the formation of a stable pre-polymerization complex due to the strong hydrogen bonding interactions between the terthiophene monomer and aspartame.

Presentation IIB-3

Additive Manufacturing of a Ni-based Alloy

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Nickel-based alloys are important materials for advanced structural and functional applications. Some of these alloys include Inconel, Ni-Al, and Ni-Ti and Ni-Mn-Ga shape memory alloys. Producing complex geometries of these alloys can be difficult using traditional manufacturing methods. Alternatively, additive manufacturing was used in the present work to produce parts from Ni-Mn-Ga ferromagnetic shape memory alloy powders. Ni-Mn-Ga powders with two different morphology were used in manufacturing parts using powder-bed binder-jet 3D printing method. The parts were successfully printed and sintered, but they exhibit weak mechanical properties. In order to correlate the macroscopic behavior with the printing conditions, after each manufacturing step the parts were investigated and characterized using electron microscopy, X-ray diffraction, and thermal analysis analytical techniques.

Presentation IIB-4 (Invited)

Fatigue Performance of Fused Deposition Modeling (FDM) Style 3D Printed vs. Injection Molded Ultem® 9085

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Advancements in fused deposition modeling (FDM) and other additive manufacturing/3D printing techniques have provided great opportunities for production of specialized, functional, lightweight parts for advanced automotive and aerospace applications. However, compared to traditional injection molding, the FDM process inherently introduces a much larger number of material interfaces resembling weld lines. It is very important to thoroughly understand how the tensile and fatigue properties can be affected in order to design reliable parts. In this study, the tensile and fatigue properties of polyetherimide/polycarbonate (Ultem® 9085) tensile bars fabricated by both injection molding and FDM were investigated. The single and double gate injection molded bars were used as controls and the FDM bars were printed with various orientations and toolpaths. It was found that the FDM bars show at least 18% lower tensile modulus and the fatigue endurance limit was also significantly reduced. A different fatigue behavior from classic fatigue theory was also found in the FDM samples.

Presentation IIC-1 (Invited)

Cryo-electron Microscopy and Cryo-electron Tomography of Nanoparticles

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Cryo-transmission electron microscopy (cryo-EM) and cryo-electron tomography (cryo-ET) offer powerful ways to visualize nanoparticles. They involve imaging samples in a frozen-hydrated state, allowing visualization of biological particles or nanoparticles essentially as they exist in solution. Three-dimensional structures can be generated by single particle reconstruction for regular particles or by cryo-ET for irregular or one-of-a-kind particles. For cryo-ET a tilt-series of 2D projection images is collected and processed to generate a 3D tomogram. CryoEM and cryoET data will be presented for polymer-based and protein-based nanoparticles. Polymer-based nanoparticles have the advantage that they can be formed from a diverse array of polymers and can be fabricated in a variety of forms such as spherical, branched or core-shell. Mixed polymer brush-grafted particles represent a novel class of environmentally responsive hybrid nanoparticles, which are beginning to be evaluated for molecular cargo delivery applications. Engineered plant virus nanoparticles have the advantages that they can be genetically engineered and chemically modified with drugs and they can be efficiently produced in plants. Engineered tobacco mosaic virus nanoparticles are showing promise in delivering high payloads of therapeutic molecules to tumor sites while reducing off-target effects.

Presentation IIC-2

Architecture of the Schizosaccharomyces Pombe Ccq1-Tpz1-Poz1 Telomeric Complex

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The shelterin complex is a macromolecular assembly of proteins that shields telomeric DNA from catastrophic events that include chromosome end-to-end fusions and induction of the DNA damage response (DDR). All linear chromosomes are protected at the ends by multi-protein complexes called shelterin. In addition to protecting the ends of chromosomes, shelterin components modulate the recruitment of telomerase to telomeric DNA. Telomerase is a reverse transcriptase, which acts to elongate telomeres in proliferating cells (embryogenesis, germline, stem cells, and cancer). This study utilizes Schizosaccharomyces pombe as a model organism for structural investigation of its shelterin complex which exhibits structural homology to its human counterpart. In S. pombe, the three proteins Ccq1, Tpz1, and Poz1 (CTP complex) comprise a sub-component of the full shelterin complex. The CTP complex regulates important events that lead to the recruitment of telomerase. An understanding of the architecture of the CTP complex would provide important insight into the molecular mechanism of a telomerase-extendable and a telomerase non-extendable state. To do so, we have used electron microscopy (EM) to elucidate a three-dimensional structure of the intact CTP complex. Biochemical data combined with single particle reconstruction was used to demonstrate that the CTP complex is a dimer of trimers.

Presentation IIC-3

From Boutons to Bulbs: Exploring Fluorescent and 3D-Electron Microscopy to Examine Axonopathy and Synaptopathy in Mouse Models of Glaucoma

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Significant predegenerative manifestations occur within retinal ganglion cell axons and terminals in the brain early in glaucoma. This presents exciting new targets for intervention. However, in order to effectively observe these complex changes more refined imaging modalities and protocols need to be employed. We have combined multiple imaging techniques, including neuronal tract tracing, immunofluorescence, 2-D and 3-D electron microscopy to observe synaptic and axonal changes occurring in two mouse models of glaucoma. In doing so, we have found extensive morphological variation of RGC boutons and presynaptic active zones after axonal transport loss, but before degeneration in the major retinal target in the brainstem. These changes likely represent complex mechanisms of both compensatory and dysfunctional processes. Finally, we have obtained evidence for the presence of the formation of non-traditional synapses made by RGC axons onto unidentified glial cells. These results and the imaging techniques used to acquire them offer exciting additions toward better understanding the neurodegenerative process underlying glaucoma which will allow us to develop new therapies for this debilitating disease.

Presentation IIC-4 (Invited)

Recent Advances in Cryo-TEM; A New Era for Structural Biology

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Cryo-transmission electron microscopy (Cryo- TEM) and particularly single particle analysis is rapidly becoming the premier method for determining the three dimensional structure of protein complexes, and viruses. In the last several years there have been dramatic technological improvements in Cryo-TEM, such as advancements in automation and use of improved detectors, contrast enhancement through the use of phase plates, as well as improved image processing techniques. While Cryo-TEM was once thought of as a low resolution structural technique, the method is currently capable of generating nearly atomic resolution structures on a routine basis. As such cryo-TEM is now being applied to the study of biomedically critical proteins specimens that are intractable to other structural techniques. Moreover, Cryo-TEM is able to study multiple conformational and occupational states within a single population or field of view. It is not inconceivable that Cryo-TEM could become as routine as X-ray crystallography for protein structure determination. At the end of 2015 Cryo-TEM was recognized at the Nature Method of the year.

Presentation IIIA-1 (Invited)

Applications of FTIR and Raman Imaging

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FT-IR and Raman vibrational spectroscopy both offer many benefits to material characterization, however their utility is further increased when applied to the mapping or imaging of surfaces at the micron level in order to obtain valuable information related to the changes and distribution of materials in a sample. Such applications can range from biological to pharmaceutical to advanced material characterization. This presentation will discuss how the characteristics of each spectroscopy impacts the sampling techniques and performance parameters associated with each method. Recent improvements in speed and performance allowing larger maps to be collected in less time will also be discussed. Different automated approaches to extracting information from the thousands of spectra that are typically collected for imaging applications ranging from simple univariate peak height measurements to multivariate curve resolution will be reviewed. Examples will be presented from a variety of application fields highlighting the respective advantages of IR and Raman imaging.

Presentation IIIA-2 (Invited)

Studying Growth Process of Facet-Controlled Platinum Group Metal Nanoparticles on Substrate with Electron Microscopy and IR Spectroscopy

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The finding that the physiochemical property of platinum group metal (PGM) nanoparticles can be altered significantly by the nature of facets exposed stimulated the exploration of new methods for making facet-controlled PGM nanoparticles. Our lab has recently developed a scalable and generic wet impregnation method for producing substrate-supported PGM metal and alloy nanoparticles with controlled particle morphology. Transmission electron microscopy (TEM) and high-resolution TEM (HRTEM) were used to characterize the faceted PGM particles at their different growth stage. In-situ Fourier transform infrared spectroscopy (FTIR) experiments were conducted for investigating the reduction of PGM precursors and the interaction between reacting species and growing PGM particles. The combined information was used for interpretation of the mechanisms of PGM nanoparticles growth on substrate and of their facet formation.

Presentation IIIA-3

IR Spectroscopy-Breaking the Diffraction Limit!

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This talk will focus on techniques and instrumentation for measuring chemical and optical properties of materials with nanometer scale spatial resolution. Conventional infrared spectroscopy is one of the most widely used tools for chemical analysis, but optical diffraction limits its spatial resolution to the scale of many microns. Atomic force microscopy (AFM) enjoys excellent spatial resolution, but has historically lacked the ability to perform robust chemical analysis. This presentation will discuss two techniques (1) AFM-based infrared spectroscopy and (2) scattering scanning near field optical microscopy (s-SNOM). Both of these techniques overcome the diffraction limit, providing the ability to measure and map chemical and optical properties with nanometer scale spatial resolution. As complementary techniques, AFM-IR and s-SNOM together provide an unrivaled capability to perform nanoscale chemical analysis on a diverse range of organic, inorganic, photonic and electronic materials. This talk will show AFM and s-SNOM applications on samples from fields including polymers, life sciences, semiconductors, graphene and nanoantennas.

Presentation IIIB-1 (Invited)

Designing Quantitative Experiments That Use 3D Blockface Imaging SEM in Neuroscience and Eye Research

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Over the past 5 years, blockface imaging SEM approaches have grown from a curiosity to a staple technique for many labs. Remarkably, many of these labs have no EM facilities or prior EM experience, outsourcing the imaging to cores or other facilities. The wholly digital nature of image assessment and analysis makes 3DEM adoption available to any lab with a suitable computer, and several serial imaging SEM applications are routinely used in the neurosciences and eye research to quantify mitochondria, synapses and myelin. While such studies plumb resolution limits of blockface SEM, at the other extreme, great versatility in field size, magnification range, and ROI acquisition programing make new classes of hybrid LM/EM analysis possible. From studies of nervous systems and the eye, several principles of experiment design emerge. First, have a clear question in mind and tailor the dataset to answer that as quickly as possible. Second, have a clear idea of which features will be quantified and what measurements will be helpful, including controls, in advance. Third, use cell markers, either endogenous, through reporters such as Placental Alkaline Phosphatase, or correlative electron/confocal microscopy, to identify key cells or other features. Serial blockface SEM experiments can be time consuming and computationally cumbersome, but continue to open new avenues for discovery in a variety of fields.

Presentation IIIB-2

Elastic Properties of Dimeric Liquid Crystals with Negative Dielectric Anisotropy

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We report on the temperature dependence of the splay (K11), twist ((K22), and bend (K33) elastic constants of the uniaxial nematic (N) phase formed by dimeric liquid crystal materials with negative dielectric anisotropy. The materials under study form the nematic twist-bend (N_{tb}) phase when cooled down from the uniaxial nematic (N) phase. In the N phase, the bend constant decreases dramatically as the temperature is lowered towards the N - N_{tb} phase transition. Both K11 and K22 increase as the temperature is lowered; K11 remains about 2-3 times higher than K22 near the transition to the N_{tb} phase. The measured elastic properties are consistent with the tendency of the dimeric molecules to adopt bent configurations that eventually give rise to the N_{tb} phase.

Presentation IIIB-3

ZEISS MultiSEM – The Fastest SEM in the World

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Many applications of contemporary research require simultaneous high resolution and high throughput imaging in order to investigate the nanoscale properties of a material in their true context to the macroscale component. In particular, the electron microscopy community has a need to increase data acquisition speed without sacrificing the ability to resolve features of interest in the <10 nm regime. Sampling with such precision over large areas has traditionally been hindered by long experimental times due to limitations of commercially available instrumentation. Herein, the groundbreaking speed of the ZEISS MultiSEM family will be described using examples from both life science and materials science.

Presentation IIIC-1 (Invited)

Physical Chemistry in Biological Membranes: Resolving the Chemical Details of Cell Signaling

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The chemical interactions that drive biological function operate in a complex environment. This is especially true of the plasma membrane, where cells present an array of chemical receptors that transmit environmental cues inside the cell. The spatial and temporal arrangement of these receptors from the nanometer to micrometer length scale is critical to function, but the chemical forces driving this organization are not well understood. Membrane protein dimerization, for example, is a key regulator of many receptor pathways, but its role in others is still controversial or completely unknown. Assembly of receptor complexes upon ligand stimulation is central to many signaling pathways, but the activation mechanisms are still poorly understood. Finally, lipid-protein interactions play many structural and regulatory roles in receptor activation, but they are difficult to study in functioning membranes. I will describe two recent projects in my group. In one project we investigate membrane protein interactions in live cells using PIE-FCCS and related methods. These efforts have led to several key insights into the organization and activation mechanism of receptors like plexins, growth factor receptors, and visual photoreceptors. The second project is to resolve the details of lipid-protein coupling in model membranes to build a more complete picture of the chemical landscape that governs cell communication.

Presentation IIIC-2

Ruthenium-Modified Sensitive NO Sensors: Quantifying Nitric Oxide in the Pathobiology of Cystic Fibrosis

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This is a preliminary work towards preparing a device capable to measure nitric oxide levels in a cystic fibrosis cell line model. It has been found that exhaled NO levels remain unchanged or reduced in cystic fibrosis patients unlike other inflammatory lung diseases like asthma where it increases. However, it is not clear whether the lower NO levels in cystic fibrosis correlate with lowered production of this metabolite in the bronchial epithelium. We will present preliminary results of our ruthenium oxide modified combined electrodes, and how they can be applied to the study of cystic fibrosis at the cellular level.

In this work, we explore the performance of combined reference/working electrodes modified with ruthenium oxide and Poly(3,4-ethylenedioxythiophene) (PEDOT) in the detection of nitric oxide with the goal to measure nitric oxide at the level of single or collective cultured cells. The synergistic effect of the electrocatalytic activity of ruthenium oxide and the enhanced surface area for catalytic activity provided by the polymer greatly enhanced the analytical performance of our sensors in terms of sensitivity, selectivity, and stability. With the incorporation of a layer by layer method of electrodeposition, we attained a sensitivity of ~ 17 pA/nM towards NO and a detection limit in the vicinity of 500 pM. In order to improve the selectivity of our sensors, we coated the surface with ionic liquid composite and lowered the applied potential. We attained ~86% and ~81% decrease in response to nitrite and ascorbic acid respectively after nafion coating.

Presentation IIIC-3

HIV Receptor Knockout Using the Genome-Editing CRISPR/Cas9 System

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A 32 base pair deletion mutation, delta 32, confers resistance to Yersenia pestis and HIV infection. It has been hypothesized that the amino-terminus of the CCR5 delta 32 protein is capable of exerting a negative regulatory effect on wild-type CCR5 as well as CXCR4, an additional secondary co-receptor (Agrawal, L., Lu, X., et al J Virol, Mar. 2004). This study was designed to determine the effect of the complete removal of the ccr5 gene in human cells. Gene editing was performed using the CRISPR/Cas9 system to eliminate the expression of the CCR5 protein by removing a section of the sequence from both copies of the ccr5 gene. The human T-cell line H9 was co-transfected with plasmids containing guide RNA sequences that have homology to the amino-terminus of the ccr5 gene along with a plasmid containing the CRISPR/Cas9 gene. Puromycin toxicity was determined by serial diluting puromycin into culture medium and counting cells. Stable transformants were obtained by puromycin selection. Transformed cells were biologically cloned by dilution and some were identified as potential ccr5 knockouts by PCR using ccr5 primers. The successful ablation of CCR5 will be confirmed and used to test expression of both CCR5 and CXCR4.

Joint Session III

The May Conference at 60 Years: A Brief History

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The May Conference began as a local meeting of the Cleveland Section of the Society for Applied Spectroscopy and the Analytical Topics group of the Cleveland ACS in 1956 that had a single session of invited talks.

Several Awards have been added to the program through the years. The Ernest B. Yeager award was initiated in 1962 that recognizes an undergraduate research in Northeast Ohio that utilizes some form of spectroscopy. The John Bell Memorial Award was started in 1994 to recognize the Science Fair project (grades 7-12), which best utilizes an area of spectroscopy in an innovative manner. Awards for best student oral presentation were added in 2006 and best student posters were started in 2013. MSNO added best paper awards in 2015.

The conference now has The Microscopy Society of Northeast Ohio, and the American Vacuum Society, Ohio Chapter as co-sponsors and it has grown to contain three parallel sessions, a poster session and vendor displays.

The talk will go through a timeline that briefly discusses the growth of the conference to include the state of science and spectroscopy in 1956, the addition of the various awards (Yeager, Bell, MSNO), and some facts from earlier conferences

Poster Number One

GC-MS Analysis of Unprecedented Whiskey Flavors Created by a Novel Aging Process

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Gas Chromatography-Mass Spectroscopy (GC-MS) can be readily utilized to generate an analytical profile of flavor compounds in whiskey. This method has successfully been applied to bourbon whiskies produced by a novel accelerated aging process which employs pressure, as opposed to conventional time, to mature the whiskey. New experimental flavors of whiskey have been generated which are completely original, having been made possible only by this innovative technology of accelerated pressure aging. These unprecedented bourbon whiskey flavors include cherry, apple, hickory, maple and honey locust. The distinct flavor compounds in these uniquely flavored bourbon whiskies have been identified and profiled using routine straight injection GC-MS. As such, it has been observed that cherry bourbon has more ethyl octanoate, a compound known to impart a sweet fruity flavor, than traditional oak flavored bourbon. Furthermore, it has also been observed that cherry bourbon has less phenethyl alcohol, a compound known to impart a floral and bready flavor, than traditional oak bourbon.

Poster Number Two

Osteoactivin/LC3 Interaction Regulates Autophagy in Osteoblasts

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Autophagy plays an important role in bone homeostasis where it regulates both osteoblast and osteoclast differentiation and function. Glycoprotein nmb (Gpnmb), also called osteoactivin (OA) (Gpnmb/OA) is a novel protein discovered in our lab that positively regulates osteoblast and negatively regulates osteoclast differentiation and function, respectively. Recent evidence showed Gpnmb/OA binds to microtubule-associated protein light chain 3 (LC-3II), a maker indicative of autophagic activity and stimulates the recruitment and formation of autophagosomes. In this study, we investigated whether Gpnmb/OA regulates osteoblast differentiation and function by mediating the autophagy pathway. First, we examined the expression of Gpnmb/OA in osteoblast following induction of autophagy. MC3T3-E1 osteoblast-like cells were treated with Trehalose (TH), a mTOR-independent autophagy enhancer. TH treatment induces autophagy associated with increased expression of Atg5, ATG 7, and Beclin and Gpnmb/OA is dose- and time-dependent manner. Second, we assessed the effect of TH treatment of autophagosome formation. Transmission electron microscopy (TEM) analysis showed that TH treatment causes induction of autophagosome formation associated with the formation of double membrane of autophagic vesicles compared to untreated control cells. Next, we determined whether Gpnmb/OA binds LC3II in osteoblasts, MC3T3-E1 cells were transfected with either GFP-LC3II or control empty vector (GFP-EV) followed by TH treatment. Immunoflorescent analysis revealed that osteoblasts display a punctate distribution of LC3II that co-localized with Gpmnb/OA suggesting a role of Gpnmb/OA in autophagy in bone cells. Finally, we examined the ability of osteoblast-derived form Gpnmb/OA mutant mice to induce autophagy. Gpnmb/OA mutant osteoblasts showed significant reduction of autophagy associated with LC3II expression and autophagocytic markers. Based on these finding, our data suggest that Gpnmb/OA is a major regulator of autophagy induction to maintain bone cells survival and homeostasis.

Poster Number Three

Investigating the Material Properties of the Caulobacter Crescentus Adhesive Holdfast

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The ability to adhere materials underwater is greatly impeded by the presence of a boundary layer of water between the two adherends, with synthetic adhesives failing due to poor interfacial adhesion. Nature possesses various solutions to this problem, as seen in studied mussels, sandcastle worm and barnacles; however, less complex unicellular organisms such as bacteria are also faced with this problem. One of the primary colonizers of submerged surfaces is the bacteria Caulobacter crescentus, which adheres underwater by means of a secreted adhesive holdfast that possesses the highest measured adhesive strength for any microorganism. Little is known about the material properties of this adhesive. We use a combination of spectroscopic and microscopic techniques to elucidate the chemical components of the holdfast, its structural features as well as its interaction with different surface characteristics. An understanding of these properties will provide design ideas for the fabrication of bio-inspired underwater adhesives with potential applications in areas such as engineering, medicine and biomimetics.

Poster Number Four

Investigating Synapse Assembly and Organization at the NMJ: Role of the Crimpy-Gbb Signaling Pathway

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The BMP pathway directs NMJ growth and neurotransmitter release at the neuromuscular junction (NMJ). Importantly, distinct pools of the BMP ligand Glass bottom boat (Gbb) control NMJ structure and function. While presynaptic Gbb promotes neurotransmission, postsynaptic Gbb promotes overall NMJ expansion during development, arguing for at least partially separable molecular cascades. However, the molecular mechanisms enabling discrimination between pre- and postsynaptic pools of Gbb were undefined. Our lab discovered the neuronal transmembrane protein Crimpy traffics neuronal Gbb to presynaptic terminals. We found that Crimpy delivers neuronal Gbb to dense core vesicles (DCVs) for activity-dependent release. Upon DCV exocytosis, both a Crimpy C-terminal fragment and Gbb are released from presynaptic terminals, defining an activity dependent presynaptic signal.

In our current studies, we are defining the function of the activity-dependent Gbb signal in synapse morphology and function. Using high-resolution STED microscopy, we find that neuron-specific Gbb loss-of-function (LOF) mutants display severe active zone (AZ) morphological defects. In mutants specifically lacking the presynaptic signal, the typical ring-shaped structure of presynaptic release sites is absent, and AZs have a larger, more disorganized appearance. In addition, the orderly apposition of presynaptic release sites and postsynaptic receptor fields is disrupted. Presently, we are conducting ultrastructural analyses of the mutants lacking presynaptic Gbb via electron microscopy. Together, these studies indicate that an activity-dependent autocrine BMP signal directs synapse structure and function at the NMJ.

Poster Number Five

A Self-Sustainable Ecosystem Utilizing eXtreme Green Concepts: Sand vs. Soil

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The three most important global resources are water, food, and energy. We investigated using an eXtreme Green solution that can potentially optimize the world's water and food resources. eXtreme Green is a concept originally developed at NASA's GreenLab Research Facility where renewable, alternative, and sustainable techniques were researched and implemented. Using the results of our successful, 8-week feasibility study (completed in the Fall of 2015), in which we used a portable, self-sustaining renewable ecosystem where we evaluated three plant species (Lima camelina, Salicornia virginica, and Salicornia subterminalis), and utilized Poecilia species fish (Mollies) as a natural fertilizer to provide essential nutrients for the plants, we conducted a new 12-week study comparing two separate portable ecosystems, sand versus soil. Our goal is to develop reliable, portable, self-sustainable, renewable ecosystems that can be implemented worldwide. We present the results of our 12-week study, and our recommendations for adapting our ecosystem to future eXtreme Green Concepts.

Poster Number Six

Applications of a 3D-Printable Photospectrometer

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Spectroscopy is a powerful and broadly applicable technology. However, traditionally, high costs and sophistication have relegated the equipment to industry and higher education. Limiting barriers to next generation technology early in the education cycle is essential to preparing the next generation of scientists and science-educators. Here, an inexpensive, 3D-printable photospectrometer is presented. This device, called the SpecPhone, uses an iPhone as the camera, along with several other inexpensive additions to make a fully functioning spectrophotometer. The simplicity of the components makes this device and the technology of spectrophotometry accessible to previously excluded situations and educational environments. Application of the SpecPhone with a simple, educational concentration assay as well as a protocol for protein detection are presented. Results from a protein limit of detection test are discussed, bringing the potential for development of biomedical assays. Future directions for this newly developed device are discussed as well, which can include further application of the SpecPhone in education and possibly healthcare. In sum, the ease of access of the SpecPhone gives it the unique potential to be introduced at education levels that were previously financially-restricted.

Poster Number Seven

Development of Oligonucleotides Films as Sensing Platforms for Peroxynitrite Detection

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Peroxynitrite (ONOO−) is a strong oxidizing and nitrating agent, and its formation has been correlated with many pathological conditions. It is generated in-vivo through the diffusion-controlled reaction between nitric oxide and superoxide. ONOO− has been linked to nitration of protein and DNA as well as to DNA strand breaks. Accumulation of mutations and/or other kinds of DNA damage represent a carcinogenic risk. The accurate measurement of ONOO− concentration has been a challenge since this analyte is very unstable and reacts with many cellular targets.

In this work, we develop DNA films as a sensitive sensing platforms to detect and quantify ONOO− DNA damage. We apply electrochemical grafting method for DNA immobilization. Grafting is made by generation of carboxylic acid groups on the graphite carbon electrode surface via electrochemical reduction of trans-4cinnamic acid diazonium tetrafluoroborate, followed by coupling of pre-activated carboxylic groups with amino terminated oligonucleotide. On this grafted oligonucleotides platforms, we assess the effect of defined exogenous levels ONOO− metabolite on the electrochemical response of DNA interface. We focused on detecting the differential response of complementary strands versus DNA helices with a single base mismatch. The DNA platforms responses are compared and contrasted as sensing tools for ONOO− in the biological setting.

Poster Number Eight

Analysis of a Novel CCR5 Mutation from an African American Family

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The CCR5 and CXCR4 receptors facilitate inflammatory responses. Additionally, both receptors act as secondary receptors for HIV infection. A novel mutation in the ccr5 gene, which codes for the CCR5 receptor, was found in a child of an African American family. Before the birth of the first child, the mother of this family contracted HIV and unknowingly exposed her five children to HIV through natural childbirth. Out of the five children, only the second born did not acquire the infection. After testing this individual, we discovered a point mutation in the cytoplasmic domain of the ccr5 gene. This mutation is referred to as TG5 changes the lysine codon into an arginine codon. This mutation will be cloned into the pLNCX2-TG5 clones will be used to transfect the packaging cell line PT67. The PT67 cell line then will be assembled viral particles containing the TG5 gene. These retroviral particles will be isolated and introduced into H9 cells. We plan to test the expression of the TG5 gene in H9 and primary cells. We will assess its effect on HIV infectability. In addition, we will examine the whether TG5 can down-modulate the expression of wild-type CCR5 and or CXCR4 receptors.

Poster Number Nine

The Effect of ccr5delta32 on the Expression of Wild-Type CCR5 and CXCR4

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Human Immunodeficiency Virus (HIV) must use CD4 and one of two secondary receptors, CCR5 or CXCR4 to enter human cells. Some individuals exposed to HIV, but uninfected, were shown to be heterozygous for a deletion of 32 base pairs (delta32) in CCR5. Timothy Ray Brown was functionally cured of HIV by a bone marrow transplant from a homozygous ccr5delta32 donor. It's hypothesized that this mutation disrupts transport of CCR5 to the surface of the cell, preventing HIV infectivity. It's been hypothesized that the truncated CCR5delta32 protein (208 amino acids) may be able to exert a negative regulatory effect on wild-type CCR5 and CXCR4. Fifty-eight individuals were screened for ccr5delta32 allele by PCR. Five CCR5 heterozygous individuals, and no homozygous individuals were identified. A heterozygous sample, called AF2, was used as a source to subclone both wild-type and ccr5delta32 alleles. A PCR was performed on that DNA sample and then purified to remove excess primers. The purified sample was ligated into a linear pCR 4-TOPO cloning vector. The sample was digested out of the TOPO vector and will be ligated into a eukaryotic expression vector known as pLNCX2. Both Wild-Type and delta32 alleles will be used in transient and stable transfections.

Poster Number Ten

CCR5 and CXCR4 Molecular Interactions

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Human Immunodeficiency Virus (HIV) requires two receptors to enter T-Cells: primary-receptor (CD4), and one of two co-receptors (CCR5/CXCR4). Agrawal et al. performed experiments which suggest CCR5delta32 may affect CXCR4 expression in T-Cells. Our study aims to determine what effects various CCR5 mutations will have on CXCR4.

The cxcr4 gene sequence was extracted from a human T-Cell line, H9. Cells were amplified through PCR for cxcr4. The cxcr4 gene was inserted into pCR®4-TOPO®-vector (TOPO-vector) that's resistant to ampicillin and kanamycin. TOPO-CXCR4 was digested using HindIII and NotI enzymes. The separated TOPO-vector was digested with BglI to inactivate ampicillin resistance. Concurrently, pLNCX2-vector (confers ampicillin resistance) was digested with these enzymes. The digested pLNCX2-vector and CXCR4-fragment were ligated, transformed into E. coli, and grown on ampicillin plates. Cultures were tested for kanamycin resistance (TOPO-vector is kanamycin resistant; pLNCX2-vector isn't). Cultures that were only resistant to ampicillin were continued.

Our goals are to transfect pLNCX2-CXCR4 clones into the retroviral packaging cell line PT67. PT67 will produce retroviral-particles that infect CEMX174 and U937 cells. We will determine whether additional copies of cxcr4 genes change receptor density for CXCR4/CCR5 proteins on transfected cells. Cells will also be sent to labs capable of determining HIV-infectivity.

Poster Number Eleven

Chemically Modified NO Sensors with Enhanced Capability to Detect Low Levels of NO: With Application Towards Clinical Conditions Related to Decreased NO Levels

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Carbon Fiber Microelectrodes (CFME), when modified electrochemically, can be used to detect low levels of Nitric Oxide (NO) concentration. The CFMEs used in this study were prepared using carbon fibers with a 7 micron diameter tip. The exposed surface of the fiber tip was electrochemically modified with ruthenium oxide and Poly(3,4-ethylenedioxythiophene) (PEDOT). By chemically modifying these electrodes, the sensitivity and selectivity of the CFMEs to NO improves, resulting in improved signal to noise ratio when compared to unmodified surface. The CFMEs are treated to these modifications using layer-by-layer electrodeposition. The synergistic effect of the electrocatalytic activity of ruthenium oxide and the enhanced surface area for catalytic activity provided by the polymer greatly enhanced the analytical performance of our sensors in terms of sensitivity, selectivity and stability. Another method of chemical modification with Graphene oxide (GO) is currently being explored, with hopes of discovering a modification sequence that allows for even greater selectivity and a higher signal to noise ratio. Graphene oxide will be applied via electrodeposition and combinations of GO with PEDOT and Ruthenium oxide will be tested to obtain optimal results. The objective of this project is to prepare CFMEs that are able to consistently detect low levels of NO with negligible interference from other analytes. Future work will be preparing these sensors to measure NO levels with the goal to measure nitric oxide at the level of single or collective cultured cells.

Poster Number Twelve

Electrostatic Interactions Between Peripheral Peptides and Anionic Lipids in Biological Membranes

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Peripheral membrane proteins contain basic domains that can form the nonspecific electrostatic interactions with anionic lipids in the plasma membrane. Studies of the protein or peptide lipid interactions can help in understanding various biological processes, such as signal transduction, membrane trafficking and cell motility. Previous studies has shown that electrostatic interactions can affect the PIP_2 distribution on the plasma membrane. However, the dynamics of lipid-peptide complex are unclear. Here, we used pulsed interleaved excitation fluorescence cross-correlation spectroscopy (PIE-FCCS) to investigate the binding of histidine-tagged peptides to phosphatidylinositol phosphate (PIP) lipids on asymmetric supported lipid bilayers (aSLBs). PIE-FCCS is a powerful method used to measure the dynamics of interactions and quantify the degree of binding between species with different fluorescent labels. Our results show that histidine-tagged peptides co-diffuse with anionic lipids in the model membrane system. By comparing the cross correlation of the lipid-peptide complex under different buffer conditions, we show that electrostatic interactions are stronger with low ionic strength buffer. The mobility of anionic lipid is significantly decreased by electrostatic interactions, indicating that a stable peptide-lipid complex is formed.

Poster Number Thirteen

Cryo-Electron Tomography Characterization of the Shielding Properties of Serum Albumin on a Viral Nanoparticle

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Engineered nanoparticles can deliver high payloads of therapeutic molecules to a tumor sites while reducing off-target effects. However, in order for drug delivery platforms to reach the target site, these platforms must evade elimination by the immune system. To shield nanoparticles from recognition and clearance by the immune system, drug delivery platforms are coated with shielding polymers, such as polyethylene glycol (PEG). PEG acts by reducing serum protein adsorption on the nanoparticle surface, thereby reducing immune activation. However, PEG has disadvantages, including a recent increase in anti-PEG antibodies in humans. Therefore, alternative approaches are needed. Our lab had developed a novel platform for stealth coating using serum albumin (SA). In this study, we examine the structural characteristics of SA on a tobacco mosaic virus (TMV) nanoparticle platform through cryo-electron tomography. We also investigate the antibody recognition of SA-coated TMV compared to PEG-coated and bare nanoparticles. Preliminary results show that SA provides better shielding from antibody recognition than PEG, thereby opening up a promising new avenue of nanoparticle stealth coatings.

Poster Number Fourteen

Effect of Humidity on the Adhesion of Black Widow Spider's Gumfoot Silk

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Humidity plays an important part in the performance of biomaterials such as pollen, gecko toe, wheat awns, bird feathers and dragline silk. Capture silk produced by web building spiders form an interesting class of humidity responsive biological glues. The adhesive properties of the widely studied 'viscid silk' produced by orbweb-weaving spiders is highly humidity sensitive. On the other hand, relatively less is known about the dependence of composition and humidity response towards adhesion for 'gumfoot' silk produced by cobweb-weaving spiders. In the present study, we investigate the gumfoot silk produced by Black Widows, using adhesion mechanics, microscopy and spectroscopic methods. The results show the presence of hygroscopic salts, glycoproteins and previously known spider coating peptides and their importance in the humidity response and adhesion of the sticky silk. The current study elucidates the role of constituents in the adhesion mechanism of capture silks and offers insights towards new ways to fabricate bio-inspired adhesives.

Poster Number Fifteen

Flex Bending Fatigue of Dental Archwires

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Dental archwires are used to treat patients with malocculusion by producing forces on the teeth to generate realignment. Shape memory alloy (SMA) development has contributed to orthodontic treatment by providing excellent strain recovery and lower stiffness than traditional stainless steel wires while maintaining good formability. Furthermore, nickel-free materials such as beta titanium alloys, with properties between stainless steels and SMA provides treatment flexibility for the clinicians and an alternative for patients with nickel sensitivity. Bending stiffness of these materials in archwires has been well documented; however, little information exists on fatigue behavior. Nitinol, stainless steel and beta titanium archwires were evaluated in tension and flex bending fatigue. Cyclic strain was calculated for various mandrel sizes. Scanning electron microscopy was used to identify characteristic features associated with the failure mode and note trends in low cycle fatigue (LCF) and high cycle fatigue (HCF) regimes. Tension data was clearly delineated among the materials providing archwire options that are strong and stiff when small amounts of tooth movement are needed to elastic when larger malocclusions exist. The Nitinol wires exhibited the greatest fatigue life across the LCF and HCF regimes. Future work should investigate correlations between the fatigue data and in vivo use.

Poster Number Sixteen

Degradation of LSM-Based SOFC Cathodes Under Accelerated Testing

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After long-term testing (up to 16 kh) under practical operating conditions, SOFC cathodes based on lanthanum strontium manganite (LSM, $(La_{1-x}Sr_x)_{1-y}MnO_{3\pm\delta}$) exhibit microstructural changes that may be related to loss of cell performance: Changes in phase fraction and their distribution across the cathode, particularly densification/loss of porosity near the cathode-electrolyte interface; Changes in (total and active) triple-phase boundary (TPB) density; Formation of free manganese oxides (MnOx); and Interfacial chemistry, particularly LSM/YSZ at the cathode/electrolyte interface and in the composite cathode.

This research program implements an accelerated testing protocol to gather performance data in time frames of e.g. 500 h that are relevant to much longer-term normal cell operation (≥ 5 kh). We present performance data from button cells with a different cathode composition under accelerated conditions until 500 h. We also present microstructural studies (TEM, EDXS, FIB-SEM, and 3-D reconstruction) on tested cells and an untested, as-reduced cell. We compare these findings to results from prior tests carried out at LG Fuel Cell Systems to see whether similar microstructural and performance differences are seen in these button cells.

Poster Number Seventeen

Development of Self-Healing Polymer for Stereolithography 3D Printing

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The study explores the viability of producing a self-healing polymer resin which can be used in 3D printing via stereolithography process. Currently, self-healing polymer (SHP) is considered as one of the key research areas in the field of study on polymers. However, most of the earlier studies on self-healing polymer have been using the traditional method or 2D manufacturing process. Furthermore, comparative analyses would be done to evaluate the thermo-mechanical properties of neat self-healing polymer vis-a-vis the 3D printed specimen of the SHP polymer. The 3D-printed self-healing polymer shall be subjected to NMR, FTIR, DSC, TGA and UTM. The study will synthesize boronic-ester-based material in the production of the self-healing polymer. Moreover, careful consideration and selection of the photoinitiator is critical as this will be used in the photopolymerization of the boronic-ester network for the formation of the self-healing polymer. Self-healing efficiency test shall be conducted to both the neat and 3D-printed polymer and comparison will be done to these specimens as part of the study. The success of the study will pave way for the advancement in the application of the self-healing polymer.

Poster Number Eighteen

Mechanical Properties of Poly(ethylene glycol) Reinforced by Abaca Nanocrystals and 3D Printed via Stereolithography

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The operational framework for printing three-dimensional nanocomposite hydrogel consisting of poly(ethylene glycol) and nanocellulose (specifically abaca nanocrystals) via stereolithography apparatus is presented. Poly(ethylene glycol) has been extensively studied due to its hydrophilicity and biocompatibility. However, this material lacks attractive mechanical properties that are required by many applications. Nanocrystals, known to be hydrophilic and biocompatible as well, exhibit inherent stiffness with a density of around 1.6 g/cm3 thus promoting their potential to provide high-performance reinforcement in polymeric composites. The combination appears to be promising because the strength of abaca nanocrystals can easily be incorporated into the polymeric matrix by suspending them in the cross-linked network. This mechanical reinforcement stems from the strong hydrogen bonds within and between the cellulose chains. It is expected that the current system will allow significant improvement in the mechanical properties of the conventional polyethylene glycol, which may be attributed to the uniquely efficient energy dissipation through the reversible interactions between the nanocrystals and the covalent cross-links of polyethylene glycol. One of the important considerations to attain optimum results, the dispersion of the nanocrystals is regarded to be homogeneous at concentrations below 1.5% v/v. Over this level, the nanoparticles tend to aggregate locally. Once achieved at optimum volume loading of nanocrystals, a good balance between elasticity and toughness likewise between fracture stress and fracture strain will strengthen the conventional polyethylene glycol hydrogel at least threefold. The experimental values of the modulus are believed to exceed the predicted moduli of Guth-Gold model simply to indicate assurance of notable enhancement. Successful printing of three-dimensional figures will provide manufacturers a good test bed for failure analysis and testing the limits of product prototypes using hydrogel material.

Poster Number Nineteen

Atomic Scale Electron Microscopy of Polyvinylidene Fluoride

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Obtaining the positions of atoms in the molecules is a direct and fundamental way to determine the molecular structures and explain the properties of the molecules. It can be achieved with the help of super-resolution electron microscope. In our study, the morphology and structure of electrospun polyvinylidene fluoride (PVDF) nanofibers were characterized by aberration corrected transmission electron microscope. Fluorine atoms were observed. Twist and bend of the PVDF molecules observed in the electron micrographs were demonstrated by molecular dynamic modeling results. Relative movements of segments of PVDF molecules were also observed. The atomic scale study of PVDF molecules in nanofibers sheds light on the promising future of electron microscope in the structural and dynamical study of polymer and other molecules.

Poster Number Twenty

Synthetic Melanin Films as Potential Interfaces for Peroxynitrite Detection

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Peroxynitrite (PON) is a very reactive oxygen-nitrogen species. It facilitates both oxidation and nitration reactions. PON emerged as a major cytotoxic agent, implicated in a host of pathophysiological conditions. Peroxynitrite is the primary product of the reaction of superoxide anion-radical and nitric oxide radical. PON is relatively a new member of the nitroxidative array of reactive metabolites. Early clinical reports have emphasized the deleterious physiological reactivity of PON with many cellular targets including DNA, proteins, and lipids at cell/tissue levels.

Melanin is a natural pigment that has many physiologic functions including neutralizing highly reactive oxidative species. Tyrosine and its derivative 5,6-dihydroxyindole (DHI) are some precursors of eumelanin, a black form of melanin that is also photo-stable.

In this work we examine the chemical interaction between synthesized peroxynitrite and polymerized films of DHI as a model of synthetic melanin. First we studied the electrochemical characteristics of polymerized 5,6-dihydroxyindole on graphite electrodes, and then monitored the changes after adding aliquots of peroxynitrite. This part of the work reports mainly on chemical changes within the electro-polymerized films of melanin on the electrode. Ultraviolet-visible spectroscopy showed a dramatic difference between the decomposition rates of peroxynitrite alone and in the presence of DHI films.

Poster Number Twenty-One

Effects of Electrochemical Pretreatment of Carbon Electrodes on the Kinetics of Vanadium Redox Reactions

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There is considerable interest in flow batteries for as energy storage devices in conjunction with renewable energy sources. Vanadium flow batteries (VFBs) are particularly attractive and the kinetics of these redox reactions at carbon electrodes is of great interest. However, there are conflicting reports in the literature on which half-cell has slower kinetics.(1,2) Thus, this area of research requires further investigation.

Pretreatment of electrodes by polarization at either positive or negative potentials has a very significant effect on the kinetic rates of both the V(II)/V(III) or V(IV)/V(V) redox reactions. We have found (1,2) that pretreatment of various carbon electrodes at positive potentials leads to inhibition of the rates of the V(IV)/V(V)reactions but enhancement of the rates of the V(II)/V(III) reactions. Conversely, pretreatment at negative potentials leads to enhancement of the V(IV)/V(V) reactions but inhibition of the V(II)/V(III) reactions.

We will present results on the effect of electrochemical pretreatment of single carbon fibers extracted from carbon felt. The kinetic rates for both the V(II)/V(III)and V(IV)/V(V) couples on these electrodes were measured and compared using linear sweep voltammetry, electrochemical impedance spectroscopy, and current measurements at constant potential. The surface of the carbon fibers after electrochemical treatments was investigated using x-ray photoelectron spectroscopy and scanning electron microscopy. These results are directly applicable to the performance of VFBs which are typically operated using carbon felt electrodes.

Poster Number Twenty-Two

Understanding Speciation in Ionic-Liquid Electrolytes for Non-Aqueous Redox Flow Batteries

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Conventional aqueous redox flow batteries (RFB) are limited by low energy and power densities; thus, recent focus has been on development of non-aqueous electrolytes. Although organic solvents allow for increased voltage windows, they possess a several drawbacks, including sensitivity to moisture, low solubility of active species, and high flammabilities and toxicities. Ionic liquids (IL) offer a “greener” alternative to volatile organic electrolytes as they are non-toxic and nonflammable [1,2].

Iron chloride based IL electrolytes containing up to 6.3 M iron have been synthesized. It was found that electrolyte conductivity and viscosity, as well as the nature of the electroplated iron, are greatly influenced by electrolyte composition. An electrolyte containing iron chloride, choline chloride, and ethylene glycol in a 1:1:4 molar ratio was attractive due to its high plating efficiencies, fast kinetics, and acceptable conductivity [3]. Electrochemical reactivity of the solute ions as well as the physical properties of the electrolyte are controlled by speciation of the metals in solution. To understand what ions are responsible for the observed properties in these iron IL electrolytes, chemical speciation was investigated using x-ray absorption spectroscopy (XAS) as well as x-ray Photoelectron spectroscopy (XPS).

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Poster Number Twenty-Three

Simple, High Sensitivity Magnetostriction Measurement System

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Magnetostriction is the dimension change of magnetic materials induced by the change in magnetization due to an applied field. Materials with large magnetostriction are used in highly sensitive naval sonar. However, in many magnetic applications (specifically the core for transformers and inductors) magnetostriction transfers the magnetic energy into mechanical energy, which is one of the mechanisms for loss. For these reasons, accurate measurement of magnetostriction is of great importance. We established a strain gage based magnetostriction measurement system for small foil or thin-film samples. Nb-Fe-B permanent magnets mounted on a rotating stage are used to provide uniform magnetic field up to about 2400 Oe to magnetize sample. An electric signal from the strain gage as a result of magnetostriction is filtered and amplified to ensure a good signal-to-noise before measurement using an oscilloscope. To further improve the signal-to-noise ratio the waveform data is acquired in average mode, which means that each of the data points is derived from averaging of 128 sample points collected during the experiment. Pairs of experiments with opposite direction of the voltage across the strain gage are conducted to remove voltage induced by the rotating magnetic field. Further data processing for the two separate data sets from a specific sample is done using Mathematica program. Validation measurements using Ni foil standards acquired – 34.58 ppm magnetostriction , which is in a good agreement with the -34 ppm reported from literatures. The whole data acquisition and processing takes only minutes, and our system provides an easy and accurate method for magnetostriction measurements of small thin samples.

Poster Number Twenty-Four

Atomic Force Microscopy (AFM) for Optimization of Corona Treatment on PET films

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Corona treatment has been used by a number of industry to increase the surface energy of films, foils, paper, cloth, and polymer to improve its wettability. Increasing the surface energy improves the adhesion of water based inks, glues, coatings, and adhesives. As a general rule, a material will be wetted if its surface energy is higher than the surface energy of the liquid. Incompatibility between surface energies can cause several problems such as poor adhesion, inability to print on it, and poor wetting.The AFM could be a very important tool for industries that utilize corona treatment in investigating the effect of the process in the surface morphology. The AFM coupled with a goniometer can provide the dependence of the wetting property and the surface roughness. It can be used as a decision making tool on how long the polymer film should be treated without significant damage on its surface.

Poster Number Twenty-Five

Strengthening FDM-Printed ABS Parts Through Filament Modification and UV Post-Curing

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The anisotropic nature of Fused Deposition Modeling (FDM) printed parts has limited its use to rapid prototyping. This study aims to explore a way to improve FDM's weak mechanical properties along the build axis through acrylonitrile butadiene styrene (ABS) filament modification and UV post-curing. If successful, this study will increase the range of applications where FDM-printed ABS parts can be used. In the long run, this will aid in converting the process from rapid prototyping to rapid manufacturing.

The project involves applying a thin coating of photoactive polymer on commercially available ABS filaments. It is expected that interlayer crosslinking will enhance the mechanical property of FDM-printed products using the modified filaments. Characterization techniques include NMR spectroscopy to verify quality of synthesized compounds, thermal analyses using TGA and DSC to determine the proper processing temperature of modified filaments, tensile testing for mechanical property determination, and SEM for surface morphology and fracture analyses.

Poster Number Twenty-Six

Tough, Low Flammability Polymer Aerogels Incorporating Inorganic Nanoparticles

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Polymer aerogels with high surface areas and low densities have numerous applications, including insulation, low dielectric substrates and catalyst supports. Organic polymers can suffer from high flammability, which limits their use. A hybrid of polymeric aerogel and inorganic nanoparticles was produced by ice-templating of a polymer solution, followed by a sol-gel process which infiltrated the structure with silica. Compared to the pristine polymer aerogel, the composite aerogel exhibited excellent fire resistance and superior mechanical properties. By controlling the sol-gel process conditions, different morphologies could be achieved, further modifying flammability properties of the composite.

Poster Number Twenty-Seven

Characterization of Meteorite Samples for the Determination of the Physical Properties of Asteroid Regolith

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Cohesion and adhesion, which describe how strongly particles will cling to like, or unlike materials, are still poorly understood in asteroid regolith. A greater knowledge of these forces would not only better inform us of the story of asteroid formation, but also aid engineers seeking to design spacecraft that are immune to potentially damaging regolith. A significant obstacle in solving this problem is the scarcity of asteroidal material on Earth. However, there are still ways to study these materials. Meteorites, relatively unaltered chunks of space debris that have passed through Earth's atmosphere can be used as an analogue for asteroids. Using a torsion balance in an ultrahigh vacuum chamber at NASA's Glenn Research Center, it is possible to quantify the strength of cohesion and adhesion of meteorite samples. In order to accomplish this, a full characterization of the mineralogy of the samples was made. First, the meteorites were imaged using a variety of microscopy techniques (Optical, PLM, and SEM). Next, a variety of characterization techniques were attempted (EDS, and Elemental Mapping) to determine the relative abundances of minerals in the different meteorites. As the focus of this project was the CM2 carbonaceous chondrite, this specimen received the greatest emphasis. From this, it was found that the primary mineral phases were olivines, pyroxenes, and altered phyllosilicates. In addition to these, minor amounts of sulfates, carbonates, oxides, iron-nickel metals and sulfides were found to be present. With this information, the broader cohesion and adhesion quantification project can proceed with an understanding of the diversity of material properties likely to be encountered.

Poster Number Twenty-Eight

Coercivity Model for (Co, Ni)-based Soft Nanocomposite Magnets

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(Co, Ni)-based nanocrystalline alloys (Co1-xNix)88Zr7B4Cu1 have shown promise for energy-related applications such as inductors, high and low frequency transformers, AC machines, motors, generators and magnetic amplifiers[1] due to their coercivity values (less than 50 A/m). Coercivity variation with composition in (Co, Ni)-based nanocomposites (x = 0, 0.25, 0.5, 0.75, 1)[2] indicates a plateau when $0.50 \leq x \leq 0.75$. This phenomenon could be explained by our proposed model considering composition dependence of magnetostriction and magnetocrystalline anisotropy in these alloys. (Co1-xNix)88Zr7B4Cu1 with $x \approx 0.684$ could have a coercivity less than 10 A/m while maintaining high saturation magnetization, as predicted by our model. (Co, Ni)-based nanocomposites with this composition are prepared by melt spinning followed by isothermal annealing, following the same procedure previously used[2]. Room temperature magnetic hysteresis and temperature dependent magnetization have been studied. Coercivity data from this work will be used to validate our proposed coercivity model.

Poster Number Twenty-Nine

A Supramolecular Polyethylenimine-Cored Carbazole Dendritic Polymer with Dual Applications

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Three generations of supramolecular core-shell polymers are fabricated through simply mixing two components. The core structure is hyperbranched polyethylenimine (PEI), while the shell structure is carboxylic acid-terminated carbazole-containing dendrons. Three generations (G0, G1, G2) stands for different number of outside carbazole groups. G0, G1 and G2 contains one, two, four carbazole groups, respectively. The formation of the core-shell polymers is due to ionic interaction between PEI and dendrons. Dynamic light scattering (DLS) and water contact angle (WCA) test have been performed to verify the formation. At the same time, Fourier transform infrared (FTIR) spectra and nuclear magnetic resonance (NMR) spectra are performed to verify the ionic bonding. The core-shell polymers have two notable applications. One is to encapsulate anionic guest molecules (nanocarrier) and the other is reduce metal ions and form metal nanoparticles without any additional reduce agent (nanoreactor). The encapsulate capacity is monitored through ultraviolet-visible (UV-vis) spectra and the metal reducing property is monitored through scanning electron microscope (SEM). The material broad the approach to optoelectronic devices and intelligent materials.

Poster Number Thirty

Multidimensional Mass Spectrometry of Polyglycerol

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Polyglycerol is an industrial polymer that is widely used as an intermediate for the production of emulsifiers. It has been available since the early 1900's, however little research has been done on the structure. Industrial grade polyglycerol was obtained from Lubrizol and analyzed by matrix assisted laser desorption/ionization and electrospray mass spectrometry. Upon analysis, three distributions were present, two of which display degrees of water loss. Ion mobility spectrometry was coupled with mass spectrometry to separate the polyglycerol by charge and structure. From the ion mobility data, collisional cross sections were calculated. Ongoing theoretical modeling aims at determining the product architecture and likely points for branching. Overall this study will contribute information that can be used to improve the manufacturing of polyglycerol and polyglycerol derivatives.

Poster Number Thirty-One

Electropolymerized and Colloidally-Templated Conducting Polymer-Au Co-Patterns

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Nanoscale manufacturing of sensors, thin film coatings, electronic, organophotovoltaic, and plasmonic devices can significantly benefit from developing new multi-component interfaces and hierarchical architectures. In this study, a novel co-patterned surface of a conducting polycarbazole and gold was fabricated using colloidal sphere-assisted electrochemical deposition. The dual nanopatterning is based on the hexagonally close-packed assembly of sacrificial microsphere template whose interstitial spaces remain electrochemically accessible for further deposition. Following the electropolymerization of the polycarbazole, the colloidal template can be etched thus unveiling an inverse opaline pattern. The periodic holes can then accept subsequent build-up of another material such as gold via electrochemical reduction. The successful formation of the dual nanopatterned surface is completely characterize using atomic force microscopy (AFM), electrochemical quartz crystal microbalance (EC-QCM), X-ray photoelectron spectroscopy (XPS), and surface plasmon resonance (SPR). Moreover, UV-vis absorption spectra of the surface exhibited overlapping peaks of the localized SPR behavior of gold and the polycarbazole polarons. Finally, the polymer can be selectively removed thus revealing a patterned array of gold microparticles for biosensing applications.

Poster Number Thirty-Two

Effect of Tungsten Alloying on Short-to-Medium-Range-Order Evolution and Crystallization Behavior of Near-Eutectic Amorphous Ni–P

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Alloying a small amount of tungsten can significantly retard the crystallization of near-eutectic amorphous Ni–P. To understand this phenomenon, Ni80P20 and Ni76W4P20 amorphous alloys were fabricated by electroless plating as 10 um thick continuous layers. Subsequently, the alloys were tempered to two different stages: (i) the incubation stage (still completely amorphous) and (ii) a partially crystalline stage (amorphous and crystalline phases). To understand the strong effect of tungsten alloying on the crystallization behavior, we investigate the optimistic structure of as-plated and tempered Ni–W–P and compare it with that of as-plated and correspondingly tempered amorphous Ni–P. The study focuses on SRO (short range order) and MRO (medium range order). Specifically for SRO, characterized by typical nearest neighbors, was studied by XPS (X-ray photoelectron spectroscopy). MRO, which includes neighbor atoms up to about 2 nm distance, was studied by FEM (fluctuation electron microscopy). In addition, the crystalline phases and microstructure of both alloys were studied by XRD (X-ray diffractometry) and TEM (transmission electron microscopy), respectively. By combining these complimentary techniques, atomistic structure models as well as the structure evolution mechanisms are proposed for Ni–P and Ni–W–P amorphous alloys. Specifically, conclusions on the role of tungsten in retarding crystallization can be drawn from the resulting structure models and structure evolution mechanisms. This may be useful for identifying even more effective alloying elements for retarding Ni–P crystallization to higher temperature.

Poster Number Thirty-Three

Effects of Laser Shock Peening on the Wear and Degradation Behaviors of Magnesium Alloys

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In this study, we investigated the mechanical properties of AZ31B Mg alloy before and after laser shock peening (LSP). The hardness of the AZ31B Mg alloy increased from 57 HV to 69 HV after LSP. The yield strength increased from 128 MPa to 152 MPa. Wear resistance was significantly improved after LSP. Immersion testing showed that LSP did not significantly increase the element release and weight loss in simulated body fluid. We have demonstrated that LSP is an effective way to improve the mechanical properties of the AZ31B Mg alloy.

Poster Number Thirty-Four

Star-like Copolymer Stabilized Noble-Metal Nanoparticle Powders

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The amphiphilic star-like copolymer polyethylenimine-block-poly(ε-caprolactone) (PEI-b-PCL) was utilized to transfer the pre-synthesized citrate-capped noble metal nanoparticles (NMNPs) from an aqueous layer to an organic layer without any additional reagents. Dynamic light scattering (DLS) and transmission electron microscopy (TEM) were utilized to study the assembly of the polymers coated on the surface of the citrate-capped NMNPs. After removing the organic solvent, the polymer-coated NMNPs in powder form (PCP-NMNPs) were obtained. The excellent solubility of the PEI-b-PCL allows the PCP-NMNPs to be easily dispersed in most of the organic solvents without any significant aggregation. Moreover, the good thermal stability and long-term stability make PCP-NMNPs an excellent NMNP-containing hybrid system for different specific applications, such as surface coating, catalysis and thermoplastic processing of nanocomposite materials.

Poster Number Thirty-Five

Diffuse Reflection of Phase-Separated Polymer Blend Films

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Diffuse reflection phenomenon is observed in firefly organism and is employed in light emitting diodes (LEDs), solar cells in order to enhance light extraction efficiency. Diffuse reflection is observed as a result of scattering of light from micro/nano structures that exhibit surface roughness. This study aims at understanding the diffuse reflection of spinodal phase separated PS/PMMA blend films. Colors of films vary from ultraviolet to blue. Diffuse reflection of UV-visible light from selectively leeched phase separated blends are studied in terms of varying domain spacing (200 nm to 1 μm) and surface roughness (0 nm to 40 nm) of film. We control these parameters by tuning annealing time and temperature. Angle-resolved spectroscopy studies suggested that the phase-separated films are more diffuse when compared to well-mixed films. This study offers solutions to several color-based application in paints, coatings, electronics industry.

Poster Number Thirty-Six

Well-Defined Linear Polymer made by Reversible Addition-Fragmentation Chain Transfer Polymerization via Flow Chemistry

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The use of flow reactor for RAFT polymerization allows for optimization of reaction conditions (such as temperature, and reaction time) to synthesize linear polymers under high pressure. Poly(ethylene glycol) methyl ether methacrylate was chosen to be as the monomer which was dissolved in environmental friendly solvent (ethanol solution). Different temperature, flow rate, and the ratio of reactant were chosen during the polymerization. GPC, NMR and FTIR were utilized to characterize the polymer chains. Under some certain conditions, very low polydispersity with relatively high molecular weight can be reached. This method provides a possibility to produce well-defined polymers on a large scale with relatively high efficiency.

Poster Number Thirty-Seven

Improvement of Corrosion and Wear Resistance of AISI 4140 Steel through Nanocrystallization-Assisted Nitriding

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In this study, an innovative process called nanocrystallization-assisted nitriding was used to process 4140 steels. First, a nanocrystalline surface layer was induced in 4140 steel by ultrasonic nanocrystal surface modification (UNSM). The abundant nanoscale grain boundaries provide micro-channels for efficient nitrogen diffusion during nitriding at relatively low temperature (400 °C) and short duration (4 hours). The samples were characterized by X-ray diffraction, scanning electron microscopy and energy dispersive spectroscopy. The hardness and corrosion resistance were examined and compared for samples after different processing conditions. It has been demonstrated that the sample processed by nanocrystallization-assisted nitriding has much higher hardness and corrosion resistance compared with the samples processed by nitriding only.