Tuesday, September 9

SAMPE Keynote Presentation
8:00 AM- 9:00 AM Ballroom C&D
"Multifunctional Materials For Adaptive & Autonomic Systems: An Overview"
By: Dr. B. L. ("Les") Lee, Air Force Office of Scientific Research, Arlington, VA

The efforts to develop a newer generation of structures with more advanced performance and higher system efficiency have been guided by two criteria: (a) the achievement of maximum load-carrying capability per unit weight or volume and (b) the incorporation of specific functional properties dictated by the system requirements with minimum weight penalty. Traditionally, these two issues are addressed separately, resulting in a passive structure of optimum load-carrying capability with compartmentalized functionality often in the form of attached components. However, this approach is in stark contrast to biological systems, in which jointed frameworks and complex materials impart active functionality at multiple length scales within the materials. Our new challenge has been to learn from and mimic nature's design by developing "multifunctional" load-bearing structures with integrated functional properties, such as remediation of cracks, thermal management, vibration mitigation, detection of external threats, protection against electromagnetic radiation, built-in communication channel, self-supply of power, etc. The realization of analogous synthetic structures, which can accommodate the above-cited functions, depends on the combination of new "multifunctional" materials that inherently possess the capacity to meet the requirements for specific functionality as well as mechanical load carrying capability. It is hoped that individual material elements are simultaneously participating in distinct, beneficial physical processes thereby delivering truly dramatic improvements in system-level efficiency instead of incremental improvements encountered in mono-functional materials. Among various visionary contexts for developing multifunctional materials, the most revolutionary concepts are: (a) "autonomic" structures which sense, diagnose and respond for adjustment with minimal human intervention, and (b) "adaptive" structures allowing reconfiguration or readjustment of functionality, shape and mechanical properties on demand. This presentation is intended to review the current state of scientific research and future challenges on the subject of adaptive and autonomic structures. Over the past decade, the funding support provided by the U.S. Government, esp. the Department of Defense, has allowed focusing extensive research and development efforts to the subjects of interest. For example, the multidisciplinary efforts through special research initiatives have made fundamental contributions to the concepts of "morphing materials," "self-healing materials," "self-cooling systems," "self-sensing structures," and "self-powered systems." The creation of such multifunctional design and novel materials that deliver active properties was aided by new computational tools that enable design, analysis, and optimization of the collective and hierarchical dynamic characters.

Nanocomposites: Processing IA Room: Sultana-Mississippi
Session Chair: Holly Stretz, Tennessee Technological University, Cookeville, TN
9:15 AM Reinforced Films Made by Crosslink Reaction Between Water-Soluble Sulfonated Carbon Nanotubes and Sulfonated Polystyrene (ITAR)

Y. Dai, H. Haiping, South Dakota School of Mines and Technology, Rapid City, SD; J.S. Welsh, Air Force Research Laboratory, Kirtland AFB, NM

9:40 AM Multi-Functionalization of Epoxy Resin by Addition of Reactive Graphitic Nanofibers (r-GNFS)

S. Jana, W.-H. Zhong, School Mechanical and Materials Engineering, Washington State University, WA

10:05 AM Cure Behavior Of Epoxy/MWCNT Nanocomposites: The Effect of Nanotube Surface Modification

M. Abdalla, D. Dean, University of Alabama at Birmingham, Birmingham, AL; P. Robinson, Tuskegee University, Tuskegee, AL; E. Nyairo, Alabama State University, Montgomery, AL

Design for Multifunctionality: Capability vs. Application IA Room: L12

Session Chair: Gail Jefferson, NASA Langley Research Center, Hampton, VA

9:15 AM Crosslinked Templated Mesoporous Silica Aerogels as Multifunctional Materials

H. Lu, H. Luo, G. Churu, Oklahoma State University, OK; S. Mulik, C. Sotiriou-Leventis and Nicholas Leventis, Missouri University of Science and Technology, MO

9:40 AM Carbon Nanotube Networks: In Situ Sensing of Damage Evolution in Fiber Composites

E.T. Thostenson, Tsu-Wei Chou, University of Delaware, Newark, DE; Limin Gao, Beijing University of Aeronautics and Astronautics, Beijing, China

10:05 AM Strain and Temperature Sensing Properties of Multiwalled Carbon Nanotube Yarn Composites

S.K. Kahng, T.S. Gates, NASA Langley Research Center, Hampton, VA; G.D. Jefferson, National Institute of Aerospace, Hampton, VA

Aerospace Structures and Applications 1A Room: L3

Session Chair: George Khawand, General Dynamics ATP, Burlington, VT

9:15 AM Proton Exposure Tolerance of Rohacell 31 HF Foam (ITAR)

P. Hogue, B. Brawley, Johns Hopkins University Applied Physics Laboratory, Laurel, MD; D. Hubert, Point Magu, CA; A. Daugherty, B. Marinelli, Naval Air Weapons Center, China Lake, CA; D. Price, Raytheon Space and Airborne Systems, El Segundo, CA

9:40 AM Safe-Life Coupon Testing of Aluminum Lined Pressure Vessels with Strain Ranges Exceeding Elastic Limits (ITAR)

M.B. Elliott, A.S. Hieronymus, General Dynamics Armament and Technical Products, Lincoln, NE

10:05 AM Design and Manufacturing of Quasi-Three-Dimensional Woven Composites

D. Liu, K. Rosario, Michigan State University, East Lansing, MI; B.B. Raju, U.S. Army RDECOM/TARDEC, Warren, MI

Infrastructure Applications 1A Room: L10

Session Chair: Hwai-Chung Wu, Wayne State University, Detroit, MI

9:15 AM Status of Using Fiber-Reinforced Polymer Composites in U.S. Bridges

Louis N. Triandafilou, P.E., Federal Highway Administration, Resource Center Structures Technical Service Team, Baltimore, MD

10:05 AM Comparison of Composite Slab Deflections Under Blast Loads Using A Proposed Simple Practical Analytical Model and A Procedure Involving RISA-3D

M. A. Faruqi, J. Sai, P. Shah, Texas A & M University- Kingsville, Kingsville, TX; H. Estrada, The University of Pacific, Stockton, CA

Manufacturing & Processing Advances 1A Room: L5

Session Chair: Sungho Yoon, Iowa State University, Ames, IA

9:15 AM Foldable GFRP Boat Using Partially Flexible Composites

A. Todoroki, K. Kumagai, R. Matsuzaki, Tokyo Institute of Technology, Tokyo, Japan

9:40 AM Thermal and Thermal Stress Analyses of the State-change Tooling

A. Vuppala, S.-Y. Luo, University of Nevada, Reno, NV; G. Calvert, J. Cao, L. Clements, 2Phase Technologies, Inc., Santa Clara, CA

10:05 AM Block Copolymers for Epoxy Toughening

R. Barsotti, S. Schmidt, N. Macy, M. Wells, Arkema, King Of Prussia, PA; R. Inoubli, St. Magnet, Arkema, Lacq, France; C. Navarro, Arkema, Cerdato, France

Defense Applications of Multifunctional Materials- Panel

9:15AM - 12:00PM Room: L14

Panel Moderators: Dr. Richard Vaia, Air Force Research Lab and Dr. B. L. ("Les") Lee Air Force Office of Scientific Research

Two major drivers governing the development of new Defense systems for the future Armed Forces have been the achievement of maximum load-carrying capability per unit weight/volume and the incorporation of a variety of functional properties dictated by the system requirements. Traditionally, these two issues are addressed separately, resulting in incremental improvements in mono-functional materials. However, dramatic improvements in system-level efficiency can be achieved by developing "multifunctional" materials that inherently possess the capacity to simultaneously meet the above two requirements. This panel discussion is intended to provide an overview of how the above described goals can be achieved and to assess the present needs, future possibilities and potential barriers.

Panelists:

Mr. Bill Baron (Air Force Research Lab, Air Vehicles Directorate)
Dr. Danny O'Brien (Army Research Lab)
Dr. Edward Silverman (Northrop-Grumman)
Dr. Jim Thomas (Naval Research Lab)
Dr. Richard Vaia (Air Force Research Lab, Materials Directorate)

Nanocomposites: Processing IB Room: Sultana-Mississippi

Session Chair: Holly Stretz, Tennessee Technological University, Cookeville, TN

11:00 AM Polyimide Nanocomposite Memebranes for Separation of Water and Ethanol

J.O. Iroh, W. Zhang, A. Anim-Mensah, J-P. Lee, University of Cincinnati, Cincinnati, OH

11:25 AM The Effects of Single-Wall Carbon Nanotubes on the Shear Piezoelectricity of Biopolymers

C. Lovell, J. M. Fitz-Gerald, Department of Materials Science and Engineering, University of Virginia, Charlottesville, VA; J.S. Harrison, Advanced Materials and Processing Branch, NASA Langley Research Center, Hampton, VA; C. Park, National Institute of Aerospace, Hampton, VA

11:50 AM The Effects of Different Functionalized Carbon Nanotubes on Toughened Carbon Fibre Reinforced Epoxy

T.-J. Lin, M.-C. Shih, Epotech Composite Corporation, Taichung, Taiwan

Design for Multifunctionality: Capability vs. Application IB Room: L12

Session Chair: Gail Jefferson, NASA Langley Research Center, Hampton, VA

11:00 AM Analyzing Interlaminar Shear Strength of Multi-Scale Composites via Combined Finite Element and Progressive Failure Analysis Approach

M. Garg, F. Abdi, Alpha Star Corporation, Long Beach, CA; S. McHugh, Lockheed Martin Corporation, Palo Alto, CA

11:25 AM Tailoring Thermal Properties in Composite Materials and its Interfaces for Thermo-Mechanical Applications

A.K. Roy, Air Force Research Laboratory, AFRL/RXBT, Wright-Patterson AFB, OH; S. Sihn, S. Ganguli, University of Dayton Research Institute, Dayton, OH; V. Varshney, Universal Technology Corporation, Dayton, OH

11:50 AM Development Of Multifunctional Structural Composites For Energy Harvesting

T. Pereira, Z. Guo, T. Yamazaki, H.T. Hahn, University of California Los Angeles, Los Angeles, CA

Aerospace Structures and Applications 1B Room: L3

Session Chair: George Khawand, General Dynamics ATP, Burlington, VT

11:00 AM Residual Stress Modeling in the Milling Process Considering the Tribological Behavior of the Material Pair for Dry Conditions

B. M. Abraham, S. Y. Liang, J. Morehouse, Georgia Institute of Technology, Atlanta, GA

11:25 AM Design, Characterization, Control, and Optimization of a 'Super String' Deployable Structure

Matt Buckler, Marc Zupan, UMBC- University of Maryland Baltimore County, Baltimore, MD; M. A. Brown, TTH Research, Laurel, MD

11:50 AM Epoxy Paint Failure in B-52 Fuel Tanks – Preliminary Development of a Model for the Process

R. Gandikota, A. Aliband, D.W. Lenz, L.E. Stevenson, T. Whitmer, R. Cash, W.T. Stevenson, Wichita State University, Wichita, KS

Infrastructure Applications 1B Room: L10

Session Chair: Hwai-Chung Wu, Wayne State University, Detroit, MI

11:00 AM Damage Sensing of Bond Interface between FRP Reinforcement and Steel Girders

S. Yamada, Y. Yoshida, S. Saito, Toyohashi University of Technology, Toyohashi, Japan; S. Yamada, Topy Industries, Ltd, Toyohashi, Japan; I. Komiya, Fukui Fibertech Co, Toyohashi, Japan

11:25 AM Interfacial Bond Behaviour Between FRP and Reinforced Concrete Beams
M. Han, H.A. Toutanji, J.A. Gilbert, University of Alabama in Huntsville, Huntsville, AL
11:50 AM Development of Fiber Reinforced Cementitious Composites
H.-C. Wu, Wayne State University, Detroit, MI

Manufacturing & Processing Advances 1B Room: L5
Session Chair: Sungho Yoon, Iowa State University, Ames, IA
11:00 AM Effect of Low Profile Additive (LPA) on the Physical and Mechanical Properties of Polyester
M.K Saraswat, K.M.B Jansen, L.J Ernst, Delft University of Technology, Delft, The Netherlands; R.Grimbergen, DSM Composites Resin, Zwolle, The Netherlands; F. Lauterwasser, DSM Composites Resin Deuschland GmbH, Ludwigshafen, Germany
11:25 AM Impact Characterization of Core-Filled Pultruded Biocomposite Panels
R. R. Vuppalapati, K. Chandrashekhara, W. E. Showalter, Missouri University of Science and Technology, Rolla, MO
11:50 AM A Design of Experiments (DoE) Approach to Material Properties Optimization of Electrospun Nanofibres
S.R. Coles, D. K. Jacobs, K. Kirwan, University of Warwick, Coventry, UK; J. Stanger, N. Tucker, Crop and Food Research Institute, Christchurch, New Zealand

Nanocomposites: Processing 2A Room: Sultana-Mississippi
Session Chair: Derrick Dean, University of Alabama, Birmingham, AL
2:00 PM High-Temperature Cyanate Ester Adhesives Reinforced with Alumina Nanoparticles
M.R. Kessler, W. Lio, X. Sheng, M. Akinc, Iowa State University, Ames, IA
2:25 PM Effect of Surface Morphology Modifications on Mechanical Properties of Fiber Reinforcments
M.S. Buckler, H.C. Malecki, M. Zupan, UMBC- University of Maryland Baltimore County, Baltimore, MD
2:50 PM A Two-Tier Approach for Addition of MWNT to Manufacture Fiber-Reinforced Polymer Nanocomposites
A. Rodriguez, C. Lim, M. Guzman, P. Kashani, B. Minaie, Wichita State University, Wichita, KS

Design for Multifunctionality: Capability vs. Application 2A Room: L14
Session Chair: Seun Kahng, Seun Kahng, NASA Langley Research Center, Hampton, VA
2:00 PM Fabrication and Electromechanical Characterization of a Piezoelectric Structural Fiber for Multifunctional Composites
Y. Lin, H.A. Sodano, Arizona State University, Tempe, AZ
2:25 PM Mechanical and Interface Properties of Carbon Nanofibers for Polymer Nanocomposites
T. Ozkan, Q. Chen, M. Naraghi, I. Chasiotis, University of Illinois at Urbana-Champaign, Urbana, IL

2:50 PM Deformation and Fracture of Epoxy Nanocomposites with Silica Inclusions
Q. Chen, I. Chasiotis, University of Illinois at Urbana-Champaign, Urbana, IL; C. Chen, University of Dayton Research Institute, Dayton, OH; A. Roy, Air Force Research Laboratory, Wright-Patterson AFB, Dayton, OH

Nanostructured Multifunctional Materials 1A Room: L12
Session Chair: Lawrence Drzal, Michigan State University, East Lansing, MI
2:00 PM Enhancing the Through-Thickness Thermal Conductivity of Carbon Fiber Polymer-Matrix Composites by Nanostructuring the Interlaminar Interface
S. Han, J.T. Lin, Y. Yamada, D.D.L. Chung, University at Buffalo, State University of New York, Buffalo, NY
2:25 PM Multiscale Fiber Reinforced Composites Using a Carbon Nanofiber/Epoxy Nanophased Matrix: Processing, Properties, and Thermomechanical Behavior
K.J. Green, D. Dean, U. Vaidya, University of Alabama at Birmingham, Birmingham, AL
2:50 PM Dispersion Optimization of Exfoliated Graphite Nanoplatelets in Polypropylene: Extrusion vs Precoating of PP Powder
H.-M. Park, K. Kalaitzidou, H. Fukushima, L.T. Drzal, Michigan State University, East Lansing, MI

Infrastructure Applications 2A Room: L10
Session Chair: Hwai-Chung Wu, Wayne State University, Detroit, MI
2:00 PM Dynamic Mechanical Thermal Analyses of Polymeric Concrete Repair Materials
T.S. Rushing, U.S. Army Engineer Research and Development Center Geotechnical and Structures Laboratory, Vicksburg, MS
2:25 PM Lifecycle Predictions of Filament-Wound Polyurethane Utility Poles
M. Brown, M. Berksoy, RS Technologies, a Division of Resin Systems, Inc., Calgary, Alberta, Canada

Manufacturing & Processing Advances 2A Room: L5
Session Chair: Dale Brosius, Quickstep Technologies, Brighton, MI
2:00 PM Non-Autoclave Prepreg Manufacturing Technology
G.G. Bond, J.M. Griffith, G.L. Hahn, The Boeing Company, Berkeley, MO
2:25 PM The Creation of Ductile, Composite Prepregs, with Close to UD Properties
R. Ford, B. Griffiths, Integrated Materials Technology Ltd [IMT], Bury St. Edmunds, Suffolk, UK
2:50 PM Tool-Shape Optimization to Minimize Warpage in Autoclave Processed L-Shaped Composite Part
A.-R Khorsand, J. Raghavan, G. Wang, University of Manitoba, Winnipeg, Canada

Composite Design & Analysis 1A Room: L3
Session Chair: Ed Semmes, Marshall Space Flight Center, MSFC, AL

2:00 PM Finite Element Analysis of Off-Axis Unidirectional Laminates with Intralaminar Damage
Y. Zhang, Institute for Aerospace Research, National Research Council Canada, Ottawa, ON, Canada
2:25 PM A Computational Approach for Predicting A- and B-Basis Allowables for Polymer Composites
G. Abumeri, M. Garg, Alpha Star Corporation, Long Beach, CA; M. Reza Talagani, Delft University of Technology, Delft, The Netherlands
2:50 PM Multi-Layer 2D Numerical Model for Z-Pin Composite Laminates: Compression Response and Failure
H. Huang, A.M. Waas, University of Michigan, Ann Arbor, MI

Nanocomposites: Processing 2B Room: Sultana-Mississippi
Session Chair: Derrick Dean, University of Alabama, Birmingham, AL
3:45 PM Fabrication of Ferrofluids at Controlled PH Values for Biomedical Applications
R. Asmatulu, B. Cooper, H. Misak, Wichita State University, Wichita, KS
4:10 PM Solvent Evaporation and Agitation Time Effects on Mechanical Properties of Polymeric Nanocomposites
K.A. Shenoy, R. Asmatulu, and B. Bahr, Wichita State University, Wichita, KS

Environmental Considerations 1B Room: L10
Session Chair: Session Chair: Germán Reyes, University of Michigan Dearborn, Dearborn, MI
3:45 PM Stochastic Modeling of Damage Evolution and Stiffness Degradation in Composites under Environmental Ageing
R. Rahman, A. Haque, University of Alabama, Tuscaloosa, AL
4:10 PM Particle and Fiber Exposures During Processing of Hybrid Carbon-Nanotube Advanced Composites
B.L. Wardle, N. Yamamoto, R. Guzman deVilloria, E.J. Garcia, A. John Hart, M. Hallock, Massachusetts Institute of Technology, Cambridge, MA; D. Bello, K. Ahn, University of Massachusetts, Lowell, Lowell, MA

Nanostructured Multifunctional Materials 1B Room: L12
Session Chair: Lawrence Drzal, Michigan State University, East Lansing, MI
3:45 PM The Effect of Exfoliated Graphite Nanoplatelet Size on the Mechanical and Electrical Properties of Vinyl Ester Nanocomposites
W. Liu, Inhwan Do, H. Fukushima, L.T. Drzal, Michigan State University, East Lansing, MI
4:10 PM Nanostructured Coupling Agents for Multifunctional Composites
K. Green, M. Abdalla, N. Horton, A. Noble, D. Dean, University of Alabama at Birmingham, Department of Materials Science and Engineering, Birmingham, AL; M.T. Universal Technology Corporation, Dayton OH; J. Fielding,Air Force Research Laboratory, WPAFB, OH; S. Miller, Polymeric Materials Branch, Structures and Materials Division, NASA John H. Glenn Research Center, Cleveland, OH
4:35 PM Multifunctional Polymer-Matrix and Cement-Matrix Structural Materials

D.D.L. Chung, University at Buffalo, State University of New York, Buffalo, NY

Reinventing Reality: The Quest for Multifunctional Material Properties- Panel
3:45PM - 5:00 PM Room: L14
Panel Moderator: Steve Rodgers, ITT Integrated Structures
The foundational enabler for any technology is discovering, developing or creating the right material to support that technology. Most often, engineering has been the fine art of compromise; the material properties may not always be perfect for the application, but they can be effectively optimized through appropriate design trades. Now, however, there is a new class of materials designed for optimization, materials in which the properties are designed for multiple, and sometimes mutually exclusive, functions.

This panel will give you an opportunity to hear from the leaders of SAMPE's Technical Communities about how they pursue the creation of Multifunctional Materials. After presentations on the development of ***resins***, the effective use of ***nanotechnology***, the onset of new ***predictive computer modeling*** techniques and the impact of multifunctional development on the realm of ***morphing materials*** you will have the opportunity to personalize the information you receive during an open 30-minute question and answer period with these industry experts.

Panelists:
LaNetra Clayton Tate, Ph.D, Applied Technology Directorate, NASA
Joseph H. Koo, Sc. D., The University of Texas at Austin
David Rigby, Accelrys Software Inc.
Jeff Baur, Air Force Research Lab

Manufacturing & Processing Advances 2B Room: L5
Session Chair: Dale Brosius, Quickstep Technologies, Brighton, MI
3:45 PM Development of Time-Temperature-Transformation Diagram during Cure of Polymer Composites Using Shear Rheometry and Thermal Analysis
P. Kashani, S. Alavi-Soltani, F. Ghods, B. Minaie, Wichita State University, Wichita, KS
4:10 PM Development of a Ultra-High-Pressure RESS System for Synthesizing Nano-Sized Energetic Materials
A.C. Cortopassi, K.K. Kuo, P.J. Ferrara, T.M. Wawiernia, J.T. Essel, The Pennsylvania State University, University Park, PA
4:35 PM Effects of High-Pressure RESS Operating Conditions on the Size of Synthesized Nano-Scale RDX Particles
T.M. Wawiernia, K.K. Kuo, P.J. Ferrara, A.C. Cortopassi, J.T. Essel, The Pennsylvania State University, University Park, PA

Composite Design & Analysis 1B Room: L3
Session Chair: Ed Semmes, Marshall Space Flight Center, MSFC, AL
3:45 PM Investigation of Composite Surface Effect Ship (SES) Hull Structure Under Hydrodynamic Loading Using Fluid-Structure Interaction
S. Ma, H. Mahfuz, Nanocomposites Laboratory, Ocean Engineering Department, Florida Atlantic University, Boca Raton, FL

4:10 PM Investigation of Infusion of Ultra High Molecular Weight Polyethylene (UHMWPE) and Carbon Nanotube (CNT) into Low Density Polyethylene (LDPE) Filaments
M. Khan, H.Mahfuz, T.Leventouri, Florida Atlantic University, Boca Raton, FL
4:35 PM Life Prediction of Carbon Fiber/PEKK Thermoplastic Composite Material for Structures Design
E. Dan-Jumbo, R. Keller, B. Westerman, The Boeing Co., Seattle, WA; A. Kuraishi, S.W. Tsai, J. Wang, Stanford University, CA

Wednesday, September 10

Nanocomposites: Applications 1A Room: Sultana-Mississippi
Session Chair: Antonio Avila, Universidade Federal de Minas Gerais, Horizonte, MG
9:15 AM Processing and Performance of Nanoclay Infused Low Density Polyurethane Foams
D.C. Robinson, M.V. Hosur, S. Jeelani, Tuskegee University, Tuskegee, AL
9:40 AM Stab Characterization of Ballistic Fabrics Impregnated with Shear Thickening Fluid
H.M. Rao, J. Mayo. Jr., M.V. Hosur, S. Jeelani, Tuskegee University, Tuskegee, AL
10:05 AM Nanocomposite Mold Design and Manufacturing; Part II: Mold Manufacturing and Testing
K. Han, B. Rice, D. Johnson, J. Hartings, T. Glenchur, J. Hickey, University of Dayton Research Institute, Dayton, OH

Electromagnetic Multifunctional Materials 1A Room: L12
Session Chair: Sarah Frankland, National Institute of Aerospace, Hampton, VA
9:15 AM Measurements of Shielding Effectiveness in Polymer Coating and Composite Systems
A. Small, M. Hirsch, T. Plaisted, Luna Innovations Incorporated, Blacksburg, VA
9:40 AM Multifunctional Integration and Characterization of Thin Film Silicon Solar Cells on Carbon Fiber Reinforced Epoxy Composites
K. J. Maung, H. T. Hahn, Y. S. Ju, University of California, Los Angeles, CA
10:05 AM Mechanical and Electromagnetic Characterization of Pultruded Polymeric Composite Materials
E. Lackey, J.G. Vaughan, R. Averill, L. Bennett, W. Elliott Hutchcraft, R.K. Gordon, University of Mississippi, University, MS

Composite Fatigue & Fracture 1A Room: L3
Session Chair: Kevin Koudela, Penn State University, State College, PA
9:15 AM Fatigue Modeling of Marine Composites
E.C. Strauch, K. L. Koudela, Applied Research Laboratory, The Pennsylvania State University, State College, PA
9:40 AM Influence of Time-Dependent Damage on Creep of Multidirectional Polymer Composite Laminates
A. Asadi, J. Raghavan, Composite Materials and Structures Research Group, University of Manitoba, Winnipeg, Canada

10:05 AM A Computational Investigation of Impact into Multi-Plies of Plain-Woven Fabric
M. Grujicic, W. C. Bell, T. He, G. Arakere, Clemson University, Clemson, SC; B. A. Cheeseman, Army Research Laboratory - Survivability Materials Branch, Aberdeen, Proving Ground, MD; K. L. Koudela, J. F. Tarter, Applied Research Laboratory, The Pennsylvania State University, State College, PA

Composites for the Automotive Industry 1A Room: L10
Session Chair: Libby Berger, General Motors, Warren, MI
9:15 AM Interlayer Hybrid Composites of Chopped and Woven Carbon Fiber
M.A. Janney, Materials Innovation Technology LLC, Fletcher, NC
9:40 AM Initial Design of the Automotive Composites Consortium Structural Composite Underbody
H.P. Fuchs, Multimatic Engineering Services Group, Livonia, MI
10:05 AM Materials and Processes for a Structural Composite Underbody
L. Berger, General Motors Research and Development Center, Warren, MI; E. Banks, Polywheels Manufacturing Ltd., Livonia, MI; R. Wlosinski, USCAR, Southfield, MI

Composites from Agricultural Products 1A Room: L5
Session Chair: Michael Kessler, Polymer Composites Research Group, Ames, IA
9:15 AM High Strength Green Composites
A.N. Netravali, Department of Fiber Science & Apparel Design, Cornell University, Ithaca, NY
9:40 AM Plant Protein Based Plastics and Applications
D. Grewell, G. Srinivasan, M. Baboi, M.R. Kessler, W. Graves, M. Helgeson, Iowa State University, Ames, IA
10:05 AM Bio-Based Materials from Vegetable Oils
A. Campanella, R. P. Wool, University of Delaware, Newark, DE

Industrial Applications of Multifunctional Materials-Panel
Room: L14 9:15AM - 10:30AM
Panel Moderator: Guru R. Kathawate, G.R. Kathawate & Associates, Inc.
Every industry is facing many challenges today due to the increase in oil prices and the global awareness on developing environmentally friendly products. These two events have triggered concerns and worry at every level from politicians and industrialists to the common man. The engineering community is being challenged in a big way. This forces materials engineers and scientists to think of ways and means to look at how multifunctional materials can be used to build high performance and efficient products in a creative way at low cost
Our team of panelists consisting of experts from global industry and academia, discuss their views on how multifunctional materials can be used to develop products to overcome some of these problems.

Panelists:

W.H. Katie Zhong, Washington State University
Jim Kuenz, E-A-R Specialty Composites, Inc.
Abhijit Gupta, Northern Illinois University
Alan K.T. Lau, The Hong Kong Polytechnic University

Room: Sultana-Mississippi Nanocomposites: Applications 1B
Session Chair: Antonio Avila, Universidade Federal de Minas Gerais, Horizonte, MG
11:00 AM Synthesis and Characterization of Nanocomposite Coatings for the Protection of Metal Surfaces
R. Asmatulu, S. Revuri, Wichita State University, Wichita, KS
11:25 AM Effect of Surface Modification on the Rheology of Montmorillonite Clay/Polyimide Nanocomposites
J.O. Iroh, University of Cincinnati, Cincinnati, OH; E. Garcia, General Electric Aircraft Engines, Cincinnati, OH
11:50 AM Potting Compound Strength Enhancement Using Carbon Nanomaterials
J. Baalman, M. Guzman, A. Rodriguez, B. Minaie, Wichita State University, Wichita, KS

Electromagnetic Multifunctional Materials 1B Room: L12
Session Chair: Sarah Frankland, National Institute of Aerospace, Hampton, VA
11:00 AM Three Phase Composites for Multifunctional Structural Capacitors
Fen Chao, Nicola Bowler, Xiaoli Tan, Michael R. Kessler, Iowa State University, Ames, IA; Guozheng Liang, Northwestern Polytechnical University, Xi'an, China
11:25 PM Structure-Battery Composites for Marine Applications – Part I: Multifunctional Design and Fabrication
W.R. Pogue III , J.P. Thomas, Multifunctional Materials Branch, Naval Research Laboratory, Washington, D.C; M.A. Siddiq Qidwai, A. Rohatgi, Science Applications International Corporation, c/o Naval Research Laboratory, Washington, D.C.
11:50 PM Structure-Battery Composites for Marine Applications – Part II: Multifunctional Performance Characterization
A. Rohatgi, M.A. Siddiq Qidwai, Science Applications International Corporation, c/o Naval Research Laboratory, Washington, D.C; W.R. Pogue III , J.P. Thomas, Multifunctional Materials Branch, Naval Research Laboratory, Washington, D.C

Composite Fatigue & Fracture 1B Room: L3
Session Chair: Kevin Koudela, Penn State University, State College, PA
11:00 AM The Bearing Strength of Titanium-Graphite Fiber Metal Laminates
J.M. Hundley, H.T. Hahn, J.-M. Yang, University of California Los Angeles, Los Angeles, CA; A.B. Facciano, Raytheon Missile Systems, Tucson, AZ
11:25 AM Strain Mapping for Performance and Failure Prediction in Composites Using Digital Image Correlation
G.P. Dillon, J.F. Tarter, C.Byrne, C.L. Rachau, C.L. Muhlstein, J.G. Collins, The Pennsylvania State University, University Park, PA

Composites for the Automotive Industry 1B Room: L10
Session Chair: Libby Berger, General Motors, Warren, MI
11:00 AM Creep Characterization of Seven Automotive Composite Materials

M.C. Cook, J.M. Henshaw, The University of Tulsa, Tulsa, OK; and D.Q. Houston, Ford Motor Company, Detroit, MI

11:25 AM Design Considerations for Energy Absorption in Automotive Sandwich Composites

J. Van Otten, S.E. Stapleton, D.O. Adams, University of Utah, Salt Lake City, UT

11:50 AM An Integrated Approach Linking Process to Structural Modeling with Microstructural Characterization for Injection-Molded Long-Fiber Thermoplastics

B. Nghiep Nguyen, S.K. Bapanapalli, M.T. Smith, Pacific Northwest National Laboratory, Richland, WA; V. Kunc, B.J. Frame, R.E. Norris Jr., Oak Ridge National Laboratory, Oak Ridge, TN; J.H. Phelps, C.L. Tucker III, University of Illinois at Urbana-Champaign, Department of Mechanical Science and Engineering, Urbana, IL; X. Jin, J. Wang, Moldflow Ithaca, Ithaca, NY

Composites from Agricultural Products 1B Room: L5

Session Chair: Michael Kessler, Polymer Composites Research Group, Ames, IA

11:00 AM Curing and Properties of Thermoset Canola Oil Based Resins

M. Fahimian, Devi Adhikari, J. Raghavan, University of Manitoba, Winnipeg, Canada; R. P. Wool, University of Delaware, Newark, DE

11:25 AM Thermal Analysis of Bio-based Rubber Composites from Plant Oils

S. Yoon, Iowa State University, Ames, IA and Kumoh National Institute of Technology, Gyeongbuk, Korea; W. Jeong, M. Valverde, Richard Larock, M.R. Kessler, Iowa State University, Ames, IA

11:50 AM Properties of Poly(Lactic Acid)/Polypropylene Blends

J.-F. Zhang, L.Grigorian, J. Zhu, T. Robinson, S. Ray Chaudhuri, YTC America Inc., Camarillo, CA

Future Directions of Multifunctional Materials Research-Panel
11:00AM - 12:15PM Room: L14

Panel Moderator: Alan Kin-tak Lau, The Hong Kong Polytechnic University
The development of multifunctional materials has been undergoing a progressive period since the last decade, the fields of research and applications have covered a large variety of ranges which include but not limited to civil infrastructures, aerospace structures and components, domestic product design and development, micro-electro-mechanical systems (MEMs), Nano-electro-mechanical systems (NEMs), bio-medical and bio-engineering applications. In this panel session, the discussion will be focused on the future development of multifunctional materials and structures, and how to get start on creating cross-disciplinary research and collaboration between universities, research centres and the industry, in which the connection between upstream research and then downstream applications has to be effectively linked. The identification of the future trends on materials research and then narrowing down the focus to multifunctional-materials research to support the directions will be discussed.

Panelists:
Dae-Soon Lim, Korea University
Deborah D.L. Chung, University at Buffalo
Jinsong Leng, Harbin Institute of Technology
Russ Maguire, Multifunctional Mat'ls & Structures Enterprise TIG

Featured Lecture: Research on Multifunctional Materials & Structural Health Monitoring in Japan
1:15PM - 2:00 PM Room: L10
Presenter: Dr. Nobuo Takeda, The University of Tokyo, Chiba, Japan
The author has been leading a series of Japanese industry-university collaboration projects on smart materials/structures and structural health monitoring (SHM) these several years. Some representative research results are presented on multi-functional materials and SHM of composite structures developed in these projects.

NDE & Structural Health Monitoring 1A Room: L14
Session Chair: Emmanuel Ayorinde, Wayne State University, Detroit, MI
2:00 PM Ultrasonic Nondestructive Evaluation of Composite Materials and Structures
D.K. Hsu, Iowa State University, Ames, IA
2:25 PM Automated Portable Ultrasonic Disbond Inspection System for Ground Vehicle Metal Matrix Composite Track Shoes
X. Zhao, D. Xiang, F. Yan, Z. Ren, Intelligent Automation Inc., Rockville, MD; B.B. Raju, U.S. Army RDECOM/TARDEC, Warren, MI
2:50 PM Acoustic Emission (AE) Monitoring of the Pulsatile Flow of Corn Oil in Water Suspension through a Porous Medium
G. C. Chungag, E. O. Ayorinde, Wayne State University, Detroit, MI

Thermo-Mechanical Multifunctional Materials 1A Room: L12
Session Chair: Greg Odegard, Michigan Technological University, Houghton, MI

2:00 PM Full Field Strain Analysis of Lightweight Aluminum Foam Hybrid Structures
G. Reyes and A. Talakola, University of Michigan-Dearborn, Dearborn, MI
2:25 PM Damping, Tensile, and Impact Properties of Superelastic Shape Memory Alloy (SMA) Fiber Reinforced Polymer Composites
J. Raghavan, Trevor Bartkiewicz, Shawna Boyko, Mike Kupriyanov, University of Manitoba, Winnipeg, Canada; N. Rajapakse, University of British Columbia, Vancouver, Canada; B. Yu, Manitoba Hydro, Winnipeg, Canada
2:50 PM Cure Behavior of Dye-Doped Epoxy System for 2-Photon Fluorescence Imaging
R.E. Toivola, A.C. Young, B.D. Flinn, A.K. Jen, University of Washington Material Science & Engineering, Seattle, WA

Composite Fatigue & Fracture 2A Room: L10
Session Chair: Golam Newaz, Wayne State University, Detroit, MI
2:00 PM Mixed Mode Testing of Woven Fabric Polymer Composites
T.P. Bruce, J.T. Wood, The University of Western Ontario, London, Canada
2:25 PM Damage Mapping of Fatigued Skin-Stringer Specimens in Three Dimensions
V. Feret, P. Hubert, McGill University, Montreal, Canada; I Paris, Bombardier Aerospace, St-Laurent, Canada
2:50 PM Stress Redistributions in Unit Cells of Fiber-Reinforced Composites with Interface Degradation
V. Mondragón, L.A. Godoy*, M.A. Pando, F.J. Acosta, University of Puerto Rico at Mayagüez, Mayagüez, PR

Composites for the Automotive Industry 2A Room: Sultana-Mississippi
Session Chair: Libby Berger, General Motors, Warren, MI
2:00 PM Effect of Nanoclay Dispersion on Processing of Polyester Nanocomposite
M. Ali Bashir, P. Hubert, McGill University, Montreal, Quebec
2:25 PM Multi-Task Research Program to Develop Commodity Grade, Lower Cost Carbon Fiber
C. D. Warren, F.L. Paulauskas, F.S. Baker, C. Cliff Eberle, A. Naskar, Oak Ridge National Laboratory, Oak Ridge, TN

Composites from Agricultural Products 2A Room: L5
Session Chair: Michael Kessler, Polymer Composites Research Group, Ames, IA
2:00 PM Effect of Chemical Modifications of Bamboo Fibers on BFRP Composites
R. Kumar, P.K. Kushwaha, Indian Institute of Technology Delhi, New Delhi, India
2:25 PM Studies on Application of Under Water Shock Wave on Jute Fiber and its Characteristics
G.M.Shafiur Rahman, H. Maehara, S. Itoh, Kumamoto University, Japan

Carbon-Carbon Composites & Foams 1A Room: L3
Session Chair: Patrick Lake, Applied Sciences, Inc., Cedarville, OH

2:00 PM Nano-Aramid Fiber Reinforced Polyurethane Foam
E.B. Semmes, Marshall Space Flight Center, MSFC, AL ; A. Frances, E. I. DuPont de Nemours and Company, Richmond, VA
2:25 PM Preliminary Flexural Testing Results of Aluminum Foam-Polypropylene Interpenetrating Phase Composites
N. Dukhan, N. Rayess, J. Hadley, The University of Detroit Mercy, Detroit, MI
2:50 PM Electrode Grade Composite Graphite From Coal Feedstocks
E.B. Kennel, M. Mukka, A.H. Stiller, J.W. Zondlo, West Virginia University, Morgantown, WV

NDE & Structural Health Monitoring 1B Room: L14
Session Chair: Emmanuel Ayorinde, Wayne State University, Detroit, MI
3:45 PM Evaluation and Detection of Bonding and Delamination in Sandwich Structures by Thin Film Thermal Sensor
M. Khairul Alam, M.S. Anghelescu, Ohio University, Athens, OH; G. Eberle, Alcan Technology & Management Ltd., Neuhausen, Switzerland
4:10 PM Frequency and Temperature Aspects of Fatigue NDE of Some Sandwich Beams
E.O. Ayorinde, Wayne State University, Detroit, MI
4:35 PM Probability of Detection Study on Impact Damage to Honeycomb Composite Structure Using Thermographic Inspection
A.J. Hodge, J.L. Walker II, Damage Tolerance and Assessment Branch, Marshall Space Flight Center, AL

Thermo-Mechanical Multifunctional Materials 1B Room: L12
Session Chair: Greg Odegard, Michigan Technological University, Houghton, MI
3:45 PM The Design of a Hybrid Material for Multifunctional Performance Using Advanced Analysis Techniques and Testing
E. Askari, K. Nelson, O. Weckner, J. Xu, The Boeing Company, Seattle, WA; S. A. Silling, Sandia National Laboratories, Albuquerque, NM
4:35 PM Tensile and Interface Properties of Small Diameter Fibers Using Nano-Tensile Testing
M. Kant, D. Penumadu, University of Tennessee, Knoxville, TN

Composite Fatigue & Fracture 2B Room: L10
Session Chair: Golam Newaz, Wayne State University, Detroit, MI
3:45 PM Tensile Failure of Fibrous Monolithic Composites
D.M. Hrobak, M. Zupan, UMBC - University of Maryland Baltimore County, Baltimore, MD
4:10 PM Strain-Life Fatigue Approach Applied to Glass Fibre Reinforced Polypropylene
J. Rehkopf, Exponent, Farmington Hills, MI; A. Conle, Ford Motor Company, Dearborn, MI
4:35 PM Delamination Fracture Mechanisms of Continuous Fiber Polymer Composites Subjected to Mixed Mode Loading
T.P. Bruce, J.T. Wood, The University of Western Ontario, London, Ontario, Canada

Nanocomposites: CNT/CNF Alignment 1B Room: Sultana-Mississippi
Session Chair: Chuck Bakis, The Pennsylvania State University, University Park, PA
3:45 PM Processing of Hybrid Advanced Composites Utilizing Capillarity-Driven Wetting of Aligned Carbon Nanotubes
H. Cebeci, R. Guzman de Villoria, B.L. Wardle, D.S. Saito, N. Yamamoto, K. Ishiguro, E.J. Garcia, A. John Hart, S. Wicks, Massachusetts Institute of Technology, Cambridge, MA
4:10 PM Tailored Alignment of Functionalized Multiwall Carbon Nanotubes in Epoxy
A. Sharma, C.E. Bakis, Engineering Science and Mechanics Dept., Penn State University, University Park, PA; K. Well Wang, Mechanical Engineering Dept., University of Michigan, Ann Arbor, MI
4:35 PM Electroconductive PET/SWNT Films By Solution Casting
B.W. Steinert, D.R. Dean, University of Alabama at Birmingham, Birmingham, AL

Testing of Composites 1B Room: L5
Session Chair: Don Adams, Wyoming Test Fixtures, Inc., Salt Lake City, UT
3:45 PM Tensile Specimen Design and Experimental Procedures for Characterizing Polymeric Composites Using X-Ray Based Micro-Tomography
V. Kunc, B. Frame, Oak Ridge National Laboratory, Oak Ridge, TN; B. Nghiep Nguyen, Pacific Northwest National Laboratory, Richland, WA; S. Case, Virginia Polytechnic Institute and State University, Department of Engineering Science and Mechanics, Blacksburg, VA; S. Young, D. Penumadu, University of Tennessee, Civil and Environmental Engineering, Perkins Hall, Knoxville, TN
4:10 PM Functionalized Surface Single Fiber Pull-Out: Experiment
S. Markkula, H. Malecki, M. Zupan, UMBC – University of Maryland Baltimore County, Baltimore, MD
4:35 PM Comparisons of Interfacial Shear Strength Measurements for Bonded Materials and Composite Materials
A. Krishnan, L.R. Xu, Vanderbilt University, Nashville, TN

Carbon-Carbon Composites & Foams 1B Room: L3
Session Chair: Patrick Lake, Applied Sciences, Inc., Cedarville, OH
3:45 PM Structural Carbon Foams From Waste Coal
E.B. Kennel, M. Mukka, O. Anthony Olajide, A.H. Stiller, West Virginia University, Morgantown, WV; R.A. Wolfe, Banner Elk, NC
4:10 PM Highly Graphitic C/C Composites for Thermal Management
A. Palmer, P. Lake, D. Burton, M. Lake, Applied Sciences, Inc. Cedarville, OH
4:35 PM Machining, Bonding, Sealing, and Venting of Carbon Foam for Production Tooling
G.D. Shives, D.J. Miller, R. L. Shao, A.K. Francis, D.M. Kaschak, GrafTech International, Parma, OH

Thursday, September 11

Featured Lecture: Ionic Polymer-Metal Composite as a New Actuator and Transducer Material
8:15AM - 9:00AM Room: L10
Presenter: Kwang Kim, University of Nevada, Reno, NV
Ionic Polymer-Metal Composites (IPMCs) are a unique polymer transducer that when subjected to an imposed bending stress, exhibits a measurable charge across the chemically and/or physically placed effective electrodes. IPMCs are also known as bending actuators capable of large bending motion when subjected to a low applied electric voltage across the electrode. The manufacturing of IPMC actuators and sensors starts with ion exchange (or permeable) polymers (often called ionomers). Ion exchange materials are designed and synthesized to selectively pass ions of a single or multiples charges, ie. either cations or anions or both. The current state-of-the-art IPMC manufacturing technique incorporates two distinct preparation processes: initial compositing process and subsequent surface electroding process. Due to different preparation processes, morphologies of precipitated platinum are significantly different. The initial compositing process requires an appropriate platinum salt in the context of chemical reduction processes. The principle of the compositing process is to metalize the inner surface of the material (usually, in a membrane shape, Pt nano-particles) by a chemical-reduction means. The ion-exchange polymer is soaked in a salt solution to allow platinum-containing cations to diffuse through via the ion-exchange process. Later, a proper reducing agent is introduced to platinize the materials. The metallic platinum particles are not homogeneously formed across the material but concentrate predominantly near the interface boundaries. In this presentation, the basic principles of IPMC actuator/transducer and its manufacturing techniques will be discussed.

Nanocomposites: Electrical and Thermal 1A Room: Sultana-Mississippi
Session Chair: Greg Yandek, Air Force Research Lab, Edwards AFB, CA
9:15 AM Nanostructured Thermal Interface Pastes For Microelectronic Cooling
C. Lin, D.D.L. Chung, University at Buffalo, State University of New York, Buffalo, NY
9:40 AM Adherent Carbon-Based Films Exhibiting High Electrical Conductivity
Y. Yamada, D.D.L. Chung, University at Buffalo, State University of New York, Buffalo, NY
10:05 AM Dielectric Properties of ZnO/PVDF Flexible Composites
C. Dağdeviren, M. Papila, Sabancı University, Istanbul, Turkey

Nanocomposites: Analysis and Characterization 1A Room: L12
Session Chair: Chuck Bakis, The Pennsylvania State University, University Park, PA
9:15 AM Mechanical Characterization of Multi-Wall Carbon Nanotube/Poly(Methyl Methacrylate) Nanocomposites: A Metrology Comparison Study
E.U. Onyegam, J. H. Koo, J.H. Im, P.S. Ho, Austin, TX
9:40 AM A Scaling Parameter for Determining Exfoliation Efficiency in Nanocomposites
H.A. Stretz, V.D.N. Palla, Tennessee Technological Univ., Cookeville, TN
10:05 AM Chemistry of Mechanical Performance: Memory, Self-Healing Behavior, and High Impact Resistance in Nanocomposites
C.E. Powell, G.W. Beall, C. Booth, Texas State University-San Marcos, San Marcos, TX

Thermoplastic Composites 1A Room: L5
Session Chair: Uday Vaidya, The University of Alabama at Birmingham, Birmingham, AL

9:15 AM Manufacturing Study of Unidirectional AS4D/PEKK tape
C.Ó. Brádaigh, R. Canavan, J. Lee, J-M. Bocquel, P. Mallon, ÉireComposites Teoranta, An Choill Rua, Indreabhán, Co. Galway, Ireland

9:40 AM Processing and Mechanical Characterization of Thermoplastic Nanocomposites
S. Roy, K. Narasimhan, University of Alabama, Tuscaloosa, AL

10:05 AM The Effect of Forming Processes on the Environmental Resistance of Carbon/PPS
S. Wijskamp, A. Leusink, R. Lenferink, W. Kok, Ten Cate Advanced Composites, The Netherlands

Sandwich Structures 1A Room: L10
Session Chair: Alan Nettles, NASA Marshall Space Flight Center, MSFC, AL

9:15 AM Study on Failure Mode of Aluminum/PU Foam Sandwich Plate Under Bending Loads
L. Sun, W. Chen, Beijing University of Aeronautics and Astronautics, Beijing , P.R.China

9:40 AM Assessment of Extruded Polystyrene Foam for Sandwich Composite Applications
C.C. Wellnitz, I. Miskioglu, ME-EM Department, Michigan Technological University, Houghton, MI; J.D. Zawisza, The Dow Chemical Company, Dow Chemical U. S. A., Midland, MI

10:05 AM Cyclic Response of Pin-Reinforced Foam Core Sandwich Panels
S.M. Storck, M. Zupan, UMBC- University of Maryland Baltimore County, Baltimore, MD; D. D. R. Cartie, Cranfield University, Cranfield, UK

Requirements for the Next Generation of Composites Engineers - Panel
9:15AM - 10:30AM Room: L14
Panel Moderator: Brad Lucht, Honeywell FM&T, Kansas City, MO

What should engineering education be like in the future to prepare the next generation of composites engineers?

Modifying the engineering education system will require the continuous and ongoing interaction between engineers in industry and educators in academe.

What role can SAMPE play to facilitate the exchange of ideas and information between these groups?

The panelists will discuss their views on what academia can do to provide the composites engineers that industry needs, and what industry can do to support the development of academic programs that will produce these engineers.

Panelists:
Ben Wang, Florida State University
Les Kramer, Lockheed Martin Missiles and Fire Control

Shridhar Yarlagadda, University of Delaware
Gail Hahn, Boeing Phantom Works
Beckry Abdel-Magid, Winona State University
Peter Wu, Spirit AeroSystems

DoD Workshop
9:15AM - 5:00PM Room: L3
Organizers: B. L. ("Les") Lee, Air Force Office of Scientific Research; James Thomas, Naval Research Lab; and Bruce LaMattina, Army Research Office

Recent progress in various research fronts indicate a possibility of dramatic improvements in system-level efficiency by designing "self-powered" load-bearing structures with integrated energy harvest/storage capabilities. Usable electrical energy can be harvested from ambient solar radiation, waste heat, and mechanical vibrations relying on photovoltaic, thermoelectric/thermionic, and piezo/magneto-electric means respectively. Harvested electricity can, in turn, undergo immediate in-situ usage (e.g. self-powered sensors), or be stored in capacitors or batteries for in- or ex-situ usage. Batteries, capacitors or other micro-devices for energy storage as well those elements used for energy harvesting can be embedded or integrated into load-bearing structures in various forms such as thin film laminates or surface coating layers. An alternative approach, the development of new materials with inherent dual functionality of energy harvesting/storage and mechanical stiffness/strength can enable the design of energy harvest and/or storage system as a truly multifunctional load-bearing structure. The creation of such multifunctional design and materials demands vigorous interdisciplinary research activities in defining predictive models and the key materials/structural parameters. This workshop is intended to provide an overview of how the above capabilities are being developed and implemented for their integration into load-bearing structures. The Workshop will consist of the presentations of eleven invited speakers and open panel discussions with the speakers as panelists and the audience participating.

Speakers and Presentations:
- Minoru Taya, University of Washington - KEYNOTE: "Energy Harvesting and Storage Systems and Their Integration to Aero Vehicles"
- Bruce Lanning, ITN Energy Systems: "Multifunctional Power Systems Using Flexible Thin Film Solid State Lithium Batteries and Polycrystalline CIGS Solar Cells"
- Jerry Fleming, Luna Innovation: "Development of High Power Density Thermoelectric Modules for a Miniaturized Thermal Energy Harvesting System."
- Greg Carman, UCLA: "An Overview of Mechanical and Thermal Energy Harvesting Systems Developed at UCLA"
- Max Shtein, University of Michigan: "Fiber-Based Devices for Solar and Thermal Energy Harvesting Composites for Aerospace Applications"
- Tom Hahn, UCLA: "Multifunctional Energy Harvesting & Storage Structural Composites"
- Marty Dunn, University of Colorado: "Design Methods for Multifunctional Composites with Energy Harvesting and Storage Functionalities"

- Ann Marie Sastry, University of Michigan: "Intercalation of Li in Structural Materials: Toward Structural Batteries for Compact Power"
- Brian Sanders and Greg Reich, Air Force Research Lab: “Structurally Integrated Thermal Energy Harvesting System”
- Eric Wetzel, Army Research Lab: “Structural Batteries and Capacitors for Army Applications”
- Siddiq Qidwai, Naval Research Lab: “Structurally Integrated Energy Storage Composites for Unmanned Underwater Vehicles”

Nanocomposites: Electrical and Thermal 1B Room: Sultana-Mississippi
Session Chair: Greg Yandek, Air Force Research Lab, Edwards AFB, CA
11:00 AM Polyimide Nanocomposites for Tunable Coefficient of Thermal Expansion
G.R Sharma, M.R. Coleman, Cora Lind, The University of Toledo, Toledo, OH
11:25 AM Carbon Nanotube Reinforced Polymers for Multifunctional Composite Structures
S. Chung, R. Foedinger, Materials Sciences Corporation, Horsham, PA; M. Weisenberger, M. Meier, University of Kentucky Center for Applied Energy Research, Lexington, KY; J. K. Roberts, U.S. Army Aviation and Missile Research Development and Engineering Center Redstone Arsenal, AL
11:50 AM Electrical Conductivity Measurements and Lightning Strike Results of Nano/Macromaterials Enhanced Polymeric Composites
T. Gibson, University of Dayton Research Institute, Dayton, OH; J. Chase Fielding, Air Force Research Laboratory, Materials and Manufacturing Directorate, Wright-Patterson AFB, OH

Nanocomposites: Analysis and Characterization 1B Room: L12
Session Chair: Chuck Bakis, The Pennsylvania State University, University Park, PA
11:00 AM Multi-scale Modeling of Bending Behavior of Carbon Nanotube-Reinforced Composites
L. Cui, L, Sun, Beijing University of Aeronautics and Astronautics, Beijing, China
11:25 AM Dynamic Mechanical Analysis of Graphite Platelet and Nanoclay Reinforced Vinyl Ester, and MWCNT Reinforced Nylon 6,6 Nanocomposites
A. Almagableh, S. Gupta, P. Raju Mantena, A. Al-Ostaz, Composite Structures and Nano-Engineering Research, The University of Mississippi, University, MS
11:50 AM Uncertain Mechanical Properties of Nanocomposite Materials
L.R. Xu, A. Krishnan, C.M. Lukehart , Vanderbilt University, Nashville, TN

Thermoplastic Composites 1B Room: L5
Session Chair: Uday Vaidya, The University of Alabama at Birmingham, Birmingham, AL
11:00 AM Continuous Reinforced Thermoplastic Composites For Aircraft Applications
M. Favaloro, Ticona Engineering Polymers, Amesbury, MA
11:25 AM A Comparison of Maximum Use Temperatures for High Performance Thermoplastic Composites

H. Ramathal, M. Favaloro, Ticona Engineering Polymers, Amesbury, MA

11:50 AM Full Field Strain Analysis of Thermoplastic Woven Composites

G. Reyes and S.T. Mane, University of Michigan-Dearborn, Dearborn, MI

Sandwich Structures 1B Room: L10

Session Chair: Alan Nettles, NASA Marshall Space Flight Center, MSFC, AL

11:00 AM A Fastener-Free Primary Structural Joint Between Sandwich Panels

J.H. Fogarty, The Boeing Company, St. Louis, MO

11:25 AM Modeling High Velocity Impact of Fire Exposed Sandwich Composites

J. Mosbrucker, M. Hanson, L. Gibbon, and C.A. Ulven, North Dakota State University, Fargo, ND

11:50 AM Compression After Impact Testing of Sandwich Structures Using a Four Point Bend Test

A.T. Nettles, J.R. Jackson, NASA Marshall Space Flight Center, Huntsville, AL; T.S. Gates, NASA Langley Research Center, Hampton, VA

High Temperature Resins & Composites 1B Room: L14

Session Chair: Stan Prybyla, Breakthrough Technology Development, Brecksville, OH

11:00 AM Evaluation of Toughness and Hot/Wet Performance of Epsilon Resin System

W.H. Li, S. Lehmann, Henkel Corporation, Bay Point, CA

11:25 AM Effects of 4,4'-Diphenylmethane Bismaleimide on Toughened Epoxy Matrix

P.C. Chen, C.-H. Chiu, Feng Chia University, Taichung, Taiwan; M.-C. Shih, Epotech Composite Corporation, Taichung, Taiwan

11:50 AM Improved Matrix for Carbon Fiber Composites for Aircraft

S.E. Bender, J. Economy, University of Illinois at Urbana-Champaign, Urbana, IL

Featured Lecture: Polymer Nanocomposites Research in Canada
1:15PM-2:00PM Room: L10

Presenter: Suong V. Hoa, Concordia University, Montreal, Quebec, Canada

Research on polymer nanocomposites in Canada has been focused mainly on the incorporation of nanoparticles such as nanoclays, carbon nanotubes, carbon nanofibers into polymeric systems including thermoplastics such as epoxies, polystyrene, polylactic acid (PLA), and polyethylene terephthalate (PET). Apart from industrial uses, significant applications are for aerospace.

Significant advances have been made for the incorporation of clays into epoxies. A few methods have been developed to provide good dispersion of nanoclays in epoxies. The effects of the pre-mixing stage and curing stage have been examined. Good dispersion provides excellent improvement in the fracture toughness (5 times the fracture toughness of the unmodified epoxy), flammability resistance, and resistance against water absorption. Different models have been developed:

- Model for the effects of different mixing parameters (temperature and speed of mixing) for the high speed mixing process.
- Model for the absorption of water into polymer nanocomposites

- Model for the increase in fracture toughness due to fine dispersion of particles.

Incorporation of carbon nanotubes into epoxies have been shown to form a sensor network that can provide more consistent detection of occurrence of cracks in composite laminates as compared to strain gauges.

Manufacturing & Processing Advances 3A Room: L5
Session Chair: Dale Brosius, Quickstep Technologies, Brighton, MI
2:00 PM RSRM Nozzle Flex Boot Material Replacement (ITAR)
C.J. Jordan, D.E. Gorringe, ATK Launch Systems, Promontory, UT
2:25 PM PBI-NBR Closed Mold Fabrication Process Development (ITAR)
D. Gorringe, C. Jordan, ATK Launch Systems, Promontory, UT
2:50 PM Fabrication of Silicon Carbide and Refractory Metal Based Composites for Nuclear Applications Using Polymer Infiltration and Pyrolysis
A.K. Singh, R.P. Singh, School of Mechanical and Aerospace Engineering, Oklahoma State University, OK

Nano-Industrial Applications 1A Room: Sultana-Mississippi
Session Chair: Patrick Lake, Applied Sciences, Inc., Cedarville, OH
2:00 PM Industrial Applications For Carbon Nanofiber Reinforced Polymer Composites
C. Leer, P. Lake, D. Burton, M. Lake, Applied Sciences, Inc., Cedarville, OH
2:25 PM Metal-Free Thermal Conductive Polymers
E. Hammel, X. Tang, A. Eder, Electrovac AG, Klosterneuburg, Austria
2:50 PM Smart Nanocomposites for Industrial Health Monitoring
G. Maheshwari, N. Mallik, S. Narayanan Sundaramurthy, M.Dadhania, W. Li, D. Hurd, Y.H. Yun, M.J. Schulz, J. Abot, Wondong, E. Head, V. Shanov, C. Jayasinghe, P. Salunke, L. Lee, University of Cincinnati, Cincinnati, OH; S. Yarmolenko, J. Sankar, North Carolina A&T State University, Greensboro, NC

Thermoplastic Composites 2A Room: L14
Session Chair: Selvum Pillay, The University of Alabama at Birmingham, Birmingham, AL
2:00 PM Prestressed Carbon / Fiber Thermoplastic Electromagnetic Railgun (ITAR)
A. Littlefield, J. Root, R. Mysliwiec, K. Olsen, US Army RDECOM-ARDEC Benét Laboratories, Watervliet, NY
2:25 PM Processing and Characterization of Thin-Walled Long Fiber Reinforced Thermoplastic (LFT) Composites
H. Ning, S. Pillay, U. Vaidya, J. Barry Andrews, The University of Alabama at Birmingham, Birmingham, AL
2:50 PM Development of a Thermoplastic Prepreg Manufacturing Process by Continuous Resin Infusion
J. Cody Ragone, K. Mallick, University of Michigan – Dearborn, Dearborn, MI

Multifunctional Materials with Integral NDE 1A Room: L12

Session Chair: Soma Perooly, Proto Manufacturing Inc., Ypsilanti, MI

2:00 PM Direct Laser Fabrication of Conical Si Tips With Nanoscale Sharpness

J.P. Moening, D.G. Georgiev, The University of Toledo, Toledo, OH

2:25 PM Effect of Ion Bombardment on the Properties of Magnetron Sputtered Samarium Cobalt Films on Chromium Underlayers

M.K. Ghantasala, Western Michigan University, Kalamazoo, MI; J. Wang, Swinburne University of Technology, Hawthorn, VIC, Australia; S. Perooly, Proto Manufacturing Inc. Ypsilanti, MI

High Temperature Resins & Composites 2A Room: L10

Session Chair: Stan Prybyla, Breakthrough Technology Development, Brecksville, OH

2:00 PM Influence of Ply Stacking Sequence on Anisotropic Oxidation Growth in Laminated Composites (ITAR)

G.P. Tandon, W.R. Ragland, University of Dayton Research Institute, Dayton, OH; G.A. Schoeppner, Air Force Research Laboratory/RXBC, WPAFB, OH

2:25 PM Thermal Oxidative Barrier Coating for Polymer Matrix Composites (ITAR)

W.R. Ronk, T.A. Bullions, GE Aviation, Cincinnati, OH

2:50 PM High-Temperature Finishes for Silicon Carbide-Reinforced Composites (ITAR)

R.E. Allred, J.-M. Gosau, J.P. Barlow, Adherent Technologies, Inc.,Albuquerque, NM

Nanocomposites: Fire Behavior 1B Room: Sultana-Mississippi

Session Chair: Antonio Avila, Universidade Federal de Minas Gerais, Horizonte, MG

3:45 PM Residual Impact Strength of Nanocomposites after Intense Heat Exposure

A.F. Ávila, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil; J.H. Koo, The University of Texas at Austin, Austin, TX; A.Q. Bracarense, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil

4:10 PM Kinetics of Thermal Degradation of Thermoplastic Polyurethane Elastomer Nanocomposites

D.W.K.Ho, J.H. Koo, J.C. Lee, O.A. Ezekoye, The University of Texas at Austin, Austin, TX

4:35 PM Enhancement of Flame Retardancy in Epoxy and Bismaleimide/Carbon Fiber Composites by the Incorporation of Buckypaper on the Composite Surface

Q. Wu, J. Bao, C. Zhang, Z. Liang, B. Wang, Florida State University, Tallahassee, FL

Joints in Composite Structures 1B Room: L5

Session Chair: Guru Kathawate, G.R. Kathawate & Associates, Inc., Lake Orion, MI

3:45 PM Hybrid Composite Joining Techniques (ITAR)

F. Thomas, E. Semmes, Marshall Space Flight Center, MSFC, AL

4:10 PM Bearing Strength and Failure Behavior of Bolted Stitched CFRP Laminates

A. Yoshimura, Y. Iwahori, Advanced Materials Group, Aerospace Research and Development directorate, JAXA, Tokyo, Japan

4:35 PM Joining Thick Composite Panels with the Use of Unitary 3-D Woven Couplers and Patches

A. Bogdanovich, D. Mungalov, 3TEX, Inc., Cary, NC; O.O. Ochoa, S. Min Lee, Texas A&M University College Station, TX

Thermoplastic Composites 2B Room: L14
Session Chair: Selvum Pillay, The University of Alabama at Birmingham, Birmingham, AL

3:45 PM Influence of Nanoclay Addition on Properties of Unsaturated-Polyester Nanocomposite Gel Coat System
P. Jawahar, K. Kanny, Durban University of Technology, Durban, South Africa; M. Balasubramanian, Indian Institute of Technology Madras, Chennai, India

4:10 PM Damping Behavior of Long Fiber Reinforced Thermoplastic (LFT) Composites
A. Goel, Pennsylvania State University, University Park, PA; K.K. Chawla, U.K. Vaidya, University of Alabama at Birmingham, Birmingham, AL

4:35 PM Preparation and Characterization of Commodity Thermoplastics Reinforced with Natural Fiber Byproduct
M.A. Fuqua, S. Huo, and C.A. Ulven, North Dakota State University, Fargo, ND

Resins & Adhesives 1B Room: L12
Session Chair: Terry Tsuchiyama, The Boeing Company, Seattle, WA

3:45 PM Advanced Epoxy System for Large Scale Composite Ship Component Manufacturing Using the VARTM Process
J. Pacanovsky, Triangle Polymer Technologies, Inc., Triangle Park, NC; A.Kelkar, R. Bolick, North Carolina A&T State University, Greensboro, NC

4:10 PM Results of an Out Time Study of a New 350°F Cure Structural Adhesive Film
P.E. Rajtar, D. Salnikov, 3M Aerospace and Aircraft Maintenance Division, St. Paul, MN

High Temperature Resins & Composites 2B Room: L10
Session Chair: Stan Prybyla, Breakthrough Technology Development, Brecksville, OH

3:45 PM High Temperature Resin Transfer Molding Development and Characterization (ITAR)
T. Storage, Materials and Manufacturing Directorate, WPAFB, OH; T. Gibson, University of Dayton Research Institute, Dayton, OH

4:10 PM Thermo-Oxidative Characterization of BMI Subjected to Service Environment (ITAR)
S. Putthanarat, G.P. Tandon, University of Dayton Research Institute, Dayton, OH; G.A. Schoeppner, AFRL/RXBC, WPAFB, OH