43rd Annual Conference on Composites, Materials, and Structures

ITAR Restricted Sessions
U.S. Citizens and U.S. Permanent Residents

Final Program

January 28-31, 2019
Radisson Resort at the Port
Cocoa Beach / Cape Canaveral, FL

*No Photographs Permitted*
# Program at a Glance

## Sunday Evening, January 27, 2019

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>6:00-9:00pm</td>
<td>Pre-Registration - Complimentary Refreshments (Convention Center Lobby)</td>
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## Monday, January 28, 2019

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>8:30-12:00</td>
<td>Morning Session Plenary Session (Salons 1 &amp; 2)</td>
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<tr>
<td>1:30-5:20</td>
<td>Afternoon Sessions: Session 1: Ceramic Matrix Composites 1 (Salons 1 &amp; 2)</td>
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<tr>
<td></td>
<td>Session 2: Extreme Environment Materials (Jamaica off hotel lobby)</td>
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<table>
<thead>
<tr>
<th>Time</th>
<th>Activities (Pavilion)</th>
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<tbody>
<tr>
<td>12:00-1:30</td>
<td>Exhibitor Set-up</td>
</tr>
<tr>
<td>5:00-7:00</td>
<td>ITAR Restricted Expo and Networking Social</td>
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## Tuesday, January 29, 2019

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>8:30-11:40</td>
<td>Morning Sessions: Session 1: Ceramic Matrix Composites 2 (Salons 1 &amp; 2)</td>
</tr>
<tr>
<td>8:30-12:00</td>
<td>Session 2: Structural Ceramics (Jamaica off hotel lobby)</td>
</tr>
<tr>
<td>1:30-4:20</td>
<td>Afternoon Session: Session 1: Ceramic Matrix Composites 3 - Manufacturing (Salon 1)</td>
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<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>5:00-7:00</td>
<td>ITAR Restricted Expo and Networking Social</td>
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<tr>
<td>7:30-8:30</td>
<td>Exhibitor Breakdown</td>
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## Wednesday, January 30, 2019

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>8:15-12:00</td>
<td>Morning Sessions: Session 1: Behavior and Life of Ceramic Matrix Composites 1 (Salon 1)</td>
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<tr>
<td>8:30-12:00</td>
<td>Session 2: Carbon-Carbon Composites Materials 1 (Salon 2)</td>
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<tr>
<td>1:30-5:20</td>
<td>Afternoon Sessions: Session 1: Behavior and Life of Ceramic Matrix Composites 2 (Salon 1)</td>
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<td></td>
<td>Session 2: Carbon-Carbon Composites Materials 2 (Salon 2)</td>
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## Thursday, January 31, 2019

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<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>8:30-12:00</td>
<td>Morning Session: Hypersonic Vehicle Materials / Structural Evaluations 1 (Salon 2)</td>
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<tr>
<td>1:30-4:00</td>
<td>Afternoon Session: Hypersonic Vehicle Materials / Structural Evaluations 2 (Salon 2)</td>
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<thead>
<tr>
<th>Time</th>
<th>Activities (Pavilion)</th>
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<tbody>
<tr>
<td>5:00-6:30</td>
<td>CMH-17 Handbook Working Group Meeting (Bermuda Meeting Room)</td>
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## Additional Meeting at the Hotel

<table>
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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>5:00-6:30</td>
<td>Steve Atmur, Northrop Grumman, Rocket Center, WV</td>
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<tr>
<td></td>
<td>Email: <a href="mailto:Steven.Atmur@ngc.com">Steven.Atmur@ngc.com</a></td>
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<tr>
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<tbody>
<tr>
<td>12:00-2:00</td>
<td>CMH-17 Handbook General Coordination Meeting (Bermuda and Montego Meeting Rooms)</td>
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<tr>
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<tbody>
<tr>
<td>12:00-2:00</td>
<td>Steve Atmur, Northrop Grumman, Rocket Center, WV</td>
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<td></td>
<td>Email: <a href="mailto:Steven.Atmur@ngc.com">Steven.Atmur@ngc.com</a></td>
</tr>
</tbody>
</table>
MONDAY MORNING – JANUARY 28, 2019
Plenary Session
Location: Salons 1 & 2

7:30-8:30am Registration and Continental Breakfast
8:35-8:45am Welcome Remarks by John Holowczak, USACA Chair
8:45-9:00am Opening Comments by Mark Opeka, Program Chair
9:00-9:40am Army High Temp Materials Portfolio Review
   J. Robert Esslinger, U.S. Army Aviation and Missile Research, Development and Engineering Center, Redstone Arsenal, AL
9:40-10:20am AFRL Hypersonics Strategy
   David Pratt, Air Force Research Laboratory, Wright Patterson AFB, OH
10:20-10:40am BREAK
10:40-11:20am Hypersonic Materials Investment Direction(s)
11:20-12:00pm A Blast from the Past - Materials Advances from 1956 (yes, 1956)
   Hollis ("H.O.") Davis, Texan, Retired Materials Engineer, Poet, Coffee Connoisseur and more
12:00-1:30pm Lunch on your own
MONDAY AFTERNOON – JANUARY 28, 2019
Session 1: Ceramic Matrix Composites 1
Session Chairs: John Holowczak, UTRC, East Hartford, CT
Mike Peretti, GE Aviation, Baltimore, MD
Dennis Fox & J. Douglas Kiser, NASA Glenn Research Center, Cleveland, OH
Location: Salons 1 & 2

1:35-1:40pm  Session Chairs Remarks

1:40-2:00pm  High Pressure Thermal Cycle Test Program for NASA CMC/EBC Vane Test Articles
P. Croteau, United Technologies Research Center, East Hartford, CT

2:00-2:20pm  Modeling Changes in Molecular Weight Distribution and Viscosity of Preceramic Polymers
T. Key and D. Patel UES, Inc./Air Force Research Laboratory, Wright Patterson AFB, OH
G. Wilks, Z. Apostolov and M. Cinibulk, Air Force Research Laboratory, Wright Patterson AFB, OH

2:20-2:40pm  Evaluation of Spread Tow Fabric for Oxide-Oxide CMC Fabrication
W. Simpson, J. Lincoln and A. Tontisakis, Axiom Materials, Santa Ana, CA
A. Beaber, M. Simpson and L. Visser, 3M, St. Paul, MN

2:40-3:00pm  Quad-XÊ™ CMC Composite for Extreme UHT Applications
J. Garnier, S. Perkins and K. Koller, Advanced Ceramic Fibers, LLC, Idaho Falls, ID

3:00-3:20pm  BREAK

3:20-3:40pm  Conceptual Design of Hybrid Ceramic-CMC Vane for a Highly Efficient Gas Turbine
J. Holowczak, P. Croteau, M. Kennedy, L. Hardin and T. Martin, United Technologies Research Center, East Hartford, CT

3:40-4:00pm  Processing and Characterization of Quartz Fiber Reinforced Ceramic Composites for High Temperature Applications
J. Dignam, C. Morand, H. Pham, R. Pepper and R. Bannon, Mentis Sciences, Manchester, NH

4:00-4:20pm  Thermal Conductivity Round-Robin Test Series for Allcomp C-SiC Material
M. Opeka, Naval Surface Warfare Center, Carderock Division, West Bethesda, MD

4:20-4:40pm  Evaluation of Ceramic Matrix Composite Leading Edge Samples Under Simulated Hypersonic Flight Conditions
T. Parthasarathy and M. Petry, UES Inc., Dayton, OH
C. Carney, M. Cinibulk and M. Gruber, Air Force Research Laboratory, Wright Patterson AFB, OH
T. Mathur, ISSI, Dayton OH

4:40-5:00pm  At Risk for Cancelling
Characterization of SiC/SiC Composites Subjected to Sequential Tensile Creep and Dwell Fatigue in Air under Thermal Gradient Conditions
S. Kalluri and R. T. Bhatt, Ohio Aerospace Institute/NASA Glenn, Cleveland, OH

5:00-5:20pm  At Risk for Cancelling
Durability of 2700°F CMCs
R. T. Bhatt, Ohio Aerospace Institute/NASA Glenn Research Center, Cleveland, OH
J. D. Kiser, NASA Glenn Research Center, Cleveland, OH
MONDAY AFTERNOON – JANUARY 28, 2019

Session 2: Extreme Environment Materials
Session Chairs: Danielle Gerstner, Naval Surface Warfare Center, Carderock, West Bethesda, MD
Tim Dominick, Northrop Grumman, Elkton, MD
Robert Haack, Missile Defense Agency, Huntsville, AL
Joseph Plusauskis, Plus Designs, Inc., Rosemont, PA

Location: Jamaica Meeting Room (off hotel lobby)

1:35-1:40pm  Session Chairs Remarks
1:40-2:00pm  Lightweight Graded-Z Filament Wound Shielding Structures
J. Lalli, NanoSonic, Inc., Pembroke, VA
2:00-2:20pm  Additively Manufactured Fins for Hypervelocity Projectile
D. Buesking, D. Caputo and K. Buesking, Materials Research & Design, Inc., Wayne, PA
2:20-2:40pm  Mechanism Based Damage Model for the Design of Composite Cryogenic Tanks
D. Hladio and D. Caputo, Materials Research & Design, Inc., Wayne, PA
2:40-3:00pm  Selective Laser Melting for the Preparation of Ultra-High Temperature Ceramic Coatings on C-C
C. Carney, Air Force Research Laboratory, Wright Patterson AFB, OH
D. King, H. J. Kim and K. Cissel, Air Force Research Laboratory, Wright Patterson AFB, OH and UES Inc., Dayton, OH
S. Storck and M. Trexler, Johns Hopkins University, Applied Physics Laboratory, Laurel, MD
P. Kazmierski, SOCHE, Dayton, OH
3:00-3:20pm  BREAK
3:20-3:40pm  Preferential Oxidation in a High Entropy Carbide Ultra-High Temperature Ceramic (UHTC)
L. Backman and E. Opila, University of Virginia, Charlottesville, VA
3:40-4:00pm  Preliminary Investigation of Hafnium Carbide Selective Oxidation Products
J. Scott and D. Lipke, Missouri University of Science & Technology, Rolla, MO
4:00-4:20pm  Intrinsic thermal properties of ZrB$_2$ and HfB$_2$
A. Stanfield, W. Fahrenholtz and G. Hilmas, Missouri University of Science & Technology, Rolla, MO
4:20-4:40pm  Mechanical Properties of Borothermally Synthesized ZrB$_2$
A. Murchie, G. Hilmas and W. Fahrenholtz, Missouri University of Science & Technology, Rolla, MO
4:40-5:00pm  High Temperature Oxidation Protection Coatings for Carbon/Carbon Composites
W. Erwin, T. McKechnie, A. Shchetkovskiy and M. Renfro, Plasma Processes, LLC, Huntsville, AL
5:00-5:20pm  Status of the Selective Laser Melting of Tungsten-Rhenium Alloys
J. Simms, S. Cooke and R. Anderson, ASRC Federal Astronautics, LLC, Huntsville, AL
MONDAY EVENING – JANUARY 28, 2019

12:00-1:30pm  Exhibitor Set-up
5:00-7:00pm  ITAR RESTRICTED Expo and Networking Social

List of Exhibitors

3M  Matech
Allcomp  Materials Research & Design
Bally Ribbon Mills  Matrix Composites, Inc.
Bullen Ultrasonics, Inc.  MillenniTEK, LLC
Cincinnati Testing Labs  Plasma Processes
COIC  Specialty Materials
Composites Horizons  Starfire Systems, Inc.
EEMS, LLC  Textile Products, Inc.
Element Materials Technology  Textum Weaving, Inc.
Fiber Materials Inc.  Thermal Wave Imaging
Free Form Fibers  Ultramet
Kyocera International, Inc.
<table>
<thead>
<tr>
<th>Company</th>
<th>Company Profile</th>
<th>Booth Number</th>
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<tbody>
<tr>
<td>Composites Horizons</td>
<td>Composites Horizons, LLC, a PCC Company, is a leading supplier of high temperature composite structures and assemblies for aerospace, defense, medical and industrial applications. Supplying customers such as GE, Pratt &amp; Whitney, and Rolls Royce we offer a range of products including both high temperature polymer matrix (BMI, polyimides) composites and oxide based CMC structures. With a new facility and equipment, dedicated to the manufacture of oxide CMCs, we are supporting the commercialization and growth of CMCs in our target markets.</td>
<td>100</td>
</tr>
<tr>
<td>Thermal Wave Imaging</td>
<td>Thermal Wave Imaging is the leading provider of Thermographic NDT Equipment for aerospace and power generation applications. Established in 1993, TWI has played a pioneering role in making thermography a viable NDT and characterization method for polymer composites and advanced and novel aerospace materials (e.g. CMC, C-C, plasma and cold spray coatings). Our systems have been selected for numerous “first-of-kind” applications ranging from the Return to Flight inspection of the C-C leading edge of the NASA Space Shuttle to the first approved inspection of CMC nacelle components for commercial aircraft in 2017.</td>
<td>101</td>
</tr>
<tr>
<td>Free Form Fibers</td>
<td>Free Form Fibers (FFF) is the sole producer of “laser-printed” Silicon Carbide, Boron, and Boron Carbide fibers, among a wide range of materials, in the world. FFF’s unique process harnesses the flexibility of additive manufacturing and the purity of Chemical Vapor Deposition (CVD) in a highly flexible production system for hundreds of simultaneous continuous fibers. If a CVD precursor exists for a given material, it is likely that Free Form Fibers can produce fiber from it. Filaments are small diameter, homogeneous, without a dissimilar core, and can be hundreds of feet long. Diameters can be customized from 15 to 80 microns and modulated along the length. Highly uniform Pyrolytic Carbon and Boron Nitride interphase coatings have been demonstrated with subsequent coating with Silicon Carbide. As with fiber, if a CVD precursor exists for a given material, it is likely that Free Form Fibers can coat its fibers with that material. Fibers are available in tapes of parallel continuous filaments appropriately sized for CMC applications.</td>
<td>102</td>
</tr>
<tr>
<td>Matrix Composites, Inc.</td>
<td>Matrix Composites, Inc. designs and manufactures a broad range of high performance composite components and assemblies. Founded in 1993, Matrix serves the unique needs of customers engaged in critical applications in the Aerospace, Defense and Commercial/General Aviation industries. Full service capabilities include design, development, tooling, fabrication, testing and integration. Supported processes include autoclave cure, compression molding, close tolerance resin transfer molding (RTM) and Hot Isostatic Resin Pressure Molding (HiRPM). Contact us today for build-to-print manufacturing or expert assistance with design, fabrication methods, material selection and tooling guidance.</td>
<td>103</td>
</tr>
<tr>
<td>MillenniTEK, LLC</td>
<td>MillenniTEK manufactures technical ceramics primarily for the nuclear power and defense industries with a specialization in carbide, alumina, zirconia, and diboride-based products. Our end-use applications range from neutron absorbing safety-related components used worldwide in commercial nuclear power plants and in space, to ceramics used for molten metal processing.</td>
<td>104</td>
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<tr>
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<tr>
<td>3M</td>
<td>Manufacturer of Nextel(TM) Ceramic Fibers and woven fabrics for use in multiple aerospace and CMC applications.</td>
<td>105</td>
</tr>
<tr>
<td>Textum Weaving, Inc.</td>
<td>Textum Weaving specializes in 2D and 3D weaving of specialty fibers including ceramic, quartz, carbon, aramid, glass and metal. We have a focus on high heat applications and embrace R&amp;D and application specific programs. With active programs in space, commercial aerospace and industrial our expertise and experience is rivaled by no one.</td>
<td>106</td>
</tr>
<tr>
<td>Cincinnati Testing Labs</td>
<td>Cincinnati Testing Labs is internationally recognized leader in the composite material machining and testing field. Our trusted service supplies material data to highly technical industries.</td>
<td>107</td>
</tr>
<tr>
<td>Bullen Ultrasonics, Inc.</td>
<td>Bullen is recognized as the world's leader in Ultrasonic Machining services and technology. In many difficult ceramic machining applications, Bullen has proven it can provide unparalleled value. Learn why Ultrasonic machining is a better choice than conventional machining technologies.</td>
<td>200</td>
</tr>
<tr>
<td>Allcomp</td>
<td>Allcomp is a manufacturer of many different grades of C-C and C-SiC composites reinforced by 2D, 2.5D (needled) and 3D fiber architectures. These composites are designed and efficiently densified using CVI and PIP processes as required to achieve the desirable properties. These composites can be further oxidation protected using advanced multi-layer and functionally-graded coating systems for extremely high temperature applications. Allcomp is AS 9100 certified small company. Allcomp fabricates flight hardware and prototype components per customer specifications. Allcomp focuses our researches in developing and qualifying cost effective composites with short lead time for commercial and advanced applications.</td>
<td>201</td>
</tr>
<tr>
<td>Bally Ribbon Mills</td>
<td>Bally Ribbon Mills (BRM) develops and manufactures engineered 3D woven products. BRM also fabricates composite parts by film resin infusion, RTM and VARTM processes. BRM manufactures 3D woven ablative thermal protection systems (TPS). The 3D woven structures utilize through-the-thickness, orthogonal and layer-to-layer weaving techniques.</td>
<td>202</td>
</tr>
<tr>
<td>COI Ceramics (COIC)</td>
<td>COI Ceramics (COIC) develops and manufactures oxide and carbide based CMC hardware for DOD, commercial aerospace, and industrial applications. COIC is investing in automation and cost reduction to assure our customers always receive the most repeatable and lowest cost solutions for their applications. Formed in 1999, COIC has been supplying CMC solutions to industry almost 20 years. Specialties include: Flight proven CMC RF radomes and oxide CMC for turbine engine exhaust structures. CMC radomes first flew in 2008 and over 1000 have been produced for the AARGM. CMC exhaust demonstrations have flown on the Boeing 787 and on multiple Sikorsky programs dating back to 2002.</td>
<td>203</td>
</tr>
<tr>
<td>EEMS, LLC</td>
<td>EEMS® is a technology company enabling extreme environment materials solutions through the supply of polymers, resins and related materials that enable manufactures to create products that are able to run hotter, last longer and are lighter than metal. Metal and plastic replacement.</td>
<td>204</td>
</tr>
<tr>
<td>Ultramet</td>
<td>Ultramet Extreme Environment Material Solutions: Ultramet develops and manufactures refractory metals, platinum group metals, and ceramics for extreme environments and high performance serving the defense, aerospace, medical and energy industries. Ultramet is an ISO</td>
<td>205</td>
</tr>
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<tr>
<td>Fiber Materials Inc.</td>
<td>9001:2015-certified producer of flight-qualified components, comprised of engineers, scientists, and support personnel, production and R&amp;D facilities particularly suited to the research, development and production of advanced materials including high temperature capability, corrosion- and erosion-resistant materials. Find your material solutions by visiting us at <a href="http://www.ultramet.com">www.ultramet.com</a> or, by calling (818) 899-0236 PST to speak to a member of our knowledgeable staff.</td>
<td>206</td>
</tr>
<tr>
<td>Element Materials Technology</td>
<td>FMI designs, develops, and manufactures composite materials and components that perform in the most demanding applications and the most extreme environments. Our core strength is the ability to weave the most intricate fiber reinforcement designs and convert them to products which perform beyond the capabilities of conventional laminate composites, ceramics, and metals. Leveraging these fabrication technologies since 1969, we have grown to be the leading supplier of propulsion hot components and thermal protection system materials in the aerospace industry. Our products enable the most difficult missions, survive at the most extreme temperatures, and provide the greatest reliability to our customers. We proudly serve the U.S. Armed Forces, NASA, and aerospace and industry customers.</td>
<td>207</td>
</tr>
<tr>
<td>Textile Products, Inc.</td>
<td>Textile Products Inc. develops and manufactures high performance textile structures for a variety of composite applications. These include Ceramic matrix, Carbon/Carbon and polymer resins systems. Fabric forms include 2D, 3D, multi-layer and customer designs to meet unique customer requirements. Reinforcements include ceramic, carbon, quartz and aramid yarns.</td>
<td>300</td>
</tr>
<tr>
<td>Matech</td>
<td>MATECH specializes in development, prototyping, specialized manufacturing, and application support for high temperature materials and ceramic composites. MATECH is fully integrated, from the manufacture of high temperature ceramic fibers, weaving of fabric, deposition of interface coatings, and CMC densification. MATECH is a leader in ultra-high-temperature (UHT) CMCs for missile propulsion and aerothermal TPS applications. MATECH fabricates CMCs by PIP, CVI, Hybrid CVI/PIP, and FAST CMC processing. MATECH has a dedicated CVI/CVD facility for both interface coatings and erosion resistant EBCs. MATECH has a dedicated weaving lab specializing in high modulus ceramic fibers.</td>
<td>301</td>
</tr>
<tr>
<td>Starfire Systems, Inc.</td>
<td>Starfire Systems, Inc. (SSI) is a specialty material company focused on Polymer Derived Ceramics (PDC) and its Polymer-to-Ceramic TM technology. SSI’s core business is synthesis of silicon-based pre-ceramic polymers and SOL-GEL derived oxide forming materials which are used in polymer matrix composites, oxide and non-oxide ceramic matrix composite (CMC) fabrication. SSI’s high temperature materials are useful in a variety of applications where durable, lightweight and high temperature complex shaped CMC’s are required. Some examples of applications are high end frictional components, electronic components, thermal protection systems, as well as rocket and engine components. As a key functional material</td>
<td>302</td>
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<tr>
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<tr>
<td>Specialty Materials, Inc.</td>
<td>Specialty Material, Inc. (SMI) is the manufacturer of Boron monofilament and prepreg, as well as SCS silicon carbide monofilament. Current major SMI customers include Israeli Aircraft Industries for F-15 tail sections, General Atomics for wing spar caps, and Harris for space applications. SMI’s SCS SiC fibers have outstanding high temperature mechanical properties which can provide toughness to ceramic matrix composites. In addition, it has been used commercially to increase the efficiency of the manufacture of solar cells used in photovoltaic modules. As a result, SMI is one of only two domestic suppliers of SiC fibers with a production capacity. Its premier SiC fiber, SCS Ultra has the highest creep rupture strength of any SiC fiber. Newer smaller diameter weavable versions (2 to 3 mils) of SCS Ultra have recently been developed and are currently being evaluated by turbine engine manufacturers.</td>
<td>400</td>
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<tr>
<td>Materials Research &amp; Design</td>
<td>Materials Research &amp; Design (MR&amp;D) is a small business that provides research and design services to the aerospace materials community. Typical programs at MR&amp;D focus on the simultaneous design of material and structure to optimize component cost, weight, or structural performance. Additional areas of interest focus upon research into the behavior of composite materials and the development of micromechanical models to analyze and understand observed properties. The analytical approach employed by MR&amp;D is based upon a practical understanding of engineering issues founded upon a strong background of theoretical mechanics.</td>
<td>401</td>
</tr>
<tr>
<td>Plasma Processes</td>
<td>Plasma Processes specializes in the development and manufacture of advanced materials, coatings, net-shape structures, and powder processing. We develop, apply and validate coating solutions for thermal protection, electrical isolation, wear and corrosion resistance and dimensional restoration, in addition to the manufacture of net-shape components by vacuum plasma and EL-Form® deposition processes. Plasma serves customers in the government, aerospace/defense and commercial sectors and our quality management system is certified to the AS9100D with ISO 9001:2015 quality standard.</td>
<td>402</td>
</tr>
<tr>
<td>Kyocera International, Inc.</td>
<td>Established in 1959, Kyocera’s track record in fine ceramics is unmatched. We utilize our extensive resources in research, development and production to select the optimal raw materials and manufacturing methods for each application. Breakthroughs and improvements in a wide range of industries are facilitated by the unique qualities of Kyocera’s fine ceramics.</td>
<td>403</td>
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TUESDAY MORNING – JANUARY 29, 2019

Session 1: Ceramic Matrix Composites 2

Session Chairs: John Holowczak, UTRC, East Hartford, CT
Mike Peretti, GE Aviation, Baltimore, MD
Dennis Fox & J. Douglas Kiser, NASA Glenn Research Center, Cleveland, OH

Location: Salons 1 & 2

7:30-8:30am  Registration and Continental Breakfast

8:35-8:40am  Session Chairs Remarks

8:40-9:00am  Comparative High Temperature Oxidation of Commercial and Pre-Commercial Silicon Carbide Fibers
J. Pegna, S. Harrison and J. Schneiter, Free Form Fibers, Saratoga Springs, NY

9:00-9:20am  Single Fiber Creep Performance at 1500°C for Silicon Carbide Fiber Materials
S. Harrison, K. Williams, R. Goduguchinta, E. Vaaler, J. Pegna and J. Schneiter, Free Form Fibers, Saratoga Springs, NY

J. Tomblin, R. Andrulonis and M. Opliger, Wichita State University, Wichita KS
C. Ashforth, Federal Aviation Administration, Des Moines, WA

9:40-10:00am  Ceramic Matrix Composite Mode I Fracture Toughness ASTM Standard Development
C. Iwano, E. O’Connor and B. Sullivan, Materials Research & Design, Wayne, PA
J. Cuneo and J. Koenig, Southern Research, Birmingham, AL

10:00-10:20am  BREAK

10:20-10:40am  Fabricating Oxide CMC Parts from Alternate Weaves: A Path to Lower Cost CMC’s
B. Jackson and M. Davidson, Composites Horizons Inc., Covina, CA
A. Beaber, A. Patel, M. Simpson and L. Visser, 3M Company, St. Paul, MN

10:40-11:00am  Chemical Vapor Infiltrated Protective Coatings for Use in Melt Infiltrated C/SiC Composites
C. Monteleone, S. Poges, P. Kerns and S. Suib, University of Connecticut, Storrs CT
T. Policandriotes, UTC Aerospace Systems, Windsor Locks, CT

11:00-11:20am  In-Process and Post-Test Characterization of CMC Materials Using Sonic NDE Technique
M. Chen, R. Ko and D. King, Air Force Research Laboratory, Wright Patterson AFB, OH

11:20-11:40am  Phase Stability and Melting Points in the Hf-SiC Pseudo-Binary System
M. Opeka, Naval Surface Warfare Center, Carderock Division, W. Bethesda, MD

12:00-1:30pm  Lunch on your own
TUESDAY MORNING – JANUARY 29, 2019

Session 2: Structural Ceramics
Session Chairs: Curtis Martin, Naval Surface Warfare Center, Carderock, West Bethesda, MD
W. Howard Poisl, Raytheon Company, Tucson, AZ
Location: Jamaica Meeting Room (off hotel lobby)

7:30-8:30am  Registration and Continental Breakfast
8:35-8:40am  Session Chairs Remarks
8:40-9:00am  Extended Life, High Mach Throats for AEDC Tunnel-9
G. Tiscia, D. Hladio and K. Buesking, Materials Research & Design, Inc. Wayne, PA
J. Lafferty and N. Fredrick, AEDC Tunnel-9, Silver Spring, MD
J. Spain and T. Barnett, Southern Research, Birmingham, AL
D. Butts, G. Thom and M. Renfro, Plasma Processes, LLC, Huntsville, AL

9:00-9:20am  Hybrid Fins for Hyper Velocity Projectiles
K. Buesking, C. Iwano and E. O’Connor, Materials Research & Design, Inc., Wayne, PA
M. Dahlen and T. Barnett, Southern Research Institute, Birmingham, AL

9:20-9:40am  Reaction Bonded Silicon Nitride Development for High Temperature RF Applications
W. Howard Poisl, Raytheon Missile Systems, Tucson, AZ

9:40-10:00am  Additive Manufacturing of Reinforced Polymer-Derived Ceramics
T. Stewart, Z. Eckel, M. O’Masta, P. Bui, K. Porter, C. Wallace, E. Stonkevitch, J. Hundley and
T. Schaedler, HRL Laboratories, LLC, Malibu, CA

10:00-10:20am  BREAK

10:20-10:40am  Binder Jet Fabrication of Boron Carbide-Silicon Carbide Composites
C. Cramer, Oak Ridge National Laboratory, Knoxville, TN

10:40-11:00am  Novel, Scaleable Additive Manufacturing Process for Dense C, SiC, and ZrO$_2$
J. Klett, Oak Ridge National Laboratory, Knoxville, TN

11:00-11:20am  Metallized Ceramic-Based Structural Insulators
J. Pluscauskis, Plus Designs, Inc., Rosemont, PA
J. Shigley and R. Roberts, Northrop Grumman Innovation Systems, Corinne, UT
D. Butts, Plasma Processes, LLC, Huntsville, AL

11:20-11:40am  Hybrid UHTC Materials
L. Matson, Air Force Research Laboratory, Wright Patterson AFB, OH
I. Park and K. Keller, UES Inc./Air Force Research Laboratory, Wright Patterson AFB, OH
J. Pluscauskis, Plus Designs, Inc., Rosemont, PA

11:40-12:00pm  Recent Advanced Ceramics and CMC Developments at Exothermics in Support of UHTC Applications
S. DiPietro, Exothermics, Inc., Amherst, NH

12:00-1:30pm  Lunch on your own
TUESDAY AFTERNOON – JANUARY 29, 2019

Session 1: Ceramic Matrix Composites 3 - Manufacturing
Session Chairs: Gary Tiscia, Materials Research & Design, Inc., Wayne, PA
               Dick Cheng, Jaxwin Consulting, LLC, Falls Church, VA
Location: Salon 1

1:35-1:40pm  Session Chairs Remarks

1:40-2:00pm  Net Shape Fabrication of 3D Ox-Ox CMCs and Related Coatings

2:00-2:20pm  Carbon Fiber Thermal Expansion for High Temperature Composites
              W. Carter Ralph, Southern Research Institute, Birmingham, AL

2:20-2:40pm  Manufacturing of 2D Carbon-Carbon Composites for High Temperature Applications
              J. Shigley, R. George and R. Roberts, Northrop Grumman Innovation Systems, Corinne, UT

2:40-3:00pm  Alumina-Mullite Oxide Ceramic Composites for High Temperature Applications
              S. Atmur, T. Easler and J. Minnoci, COI Ceramics, Inc., San Diego, CA

3:00-3:20pm  BREAK

3:20-3:40pm  Low Cost Automated Oxide Ceramic Composite Manufacturing Process Development
              S. Atmur, M. Beerman, J. Cruz and J. Minnoci, COI Ceramics, Inc., San Diego, CA
              V. Benson and K. Green, Northrop Grumman Innovation Systems, Inc., Clearfield, UT
              A. Beaber and M. Simpson, 3M Company, St. Paul, MN

3:40-4:00pm  Direct Conversion Process™ for Fi-bar™ SiC/C Fibers
              J. Garnier, S. Perkins, K. Koller, W. Patterson and K. Schroder, Advanced Ceramic Fibers, LLC
              Idaho Falls, ID

4:00-4:20pm  High-Temperature Polymer Composites and the Low-Cost Polymeric Route to UHTC Ceramics
              and C-C Composites
              M. Laskoski, B. Dyatkin, T. Butler and S. Deese, Naval Research Laboratory, Washington, DC
TUESDAY EVENING – JANUARY 29, 2019

5:00-7:00pm  ITAR RESTRICTED Expo and Networking Social
7:30-8:30pm  Exhibitor Breakdown
WEDNESDAY MORNING – JANUARY 30, 2019
Session 1: Behavior and Life of Ceramic Matrix Composites 1
Session Chairs: George Jefferson and Craig Przybyla, Air Force Research Laboratory
Wright Patterson AFB, OH
Jennifer Pierce, University of Dayton Research Institute, Dayton, OH
Location: Salon 1

7:30-8:30am Registration and Continental Breakfast
8:15-8:20am Session Chairs Remarks
8:20-8:40am Simulation of 3D Textile Composite Using HPC: Insights and Challenges
M. Ballard, Air Force Research Laboratory, Wright Patterson AFB, OH
8:40-9:00am A/N720 Double Shear Pin Bearing Analysis and Test
J. Toney, J. Boston and D. Simeroth, Air Force Research Laboratory, Wright Patterson AFB, OH
M. Stephens, Air Force Life Cycle Management Center, Wright Patterson AFB, OH
9:00-9:20am Rapid Thermal Cycling of a SiC/SiC CMC with an Environmental Barrier Coating (EBC)
J. Pierce and T. Whitlow, University of Dayton Research Institute, Dayton, OH
L. Zawada, Universal Technology Corporation, Dayton, OH
J. Pitz, UES Inc., Dayton, OH
G. Jefferson, C. Przybyla and J. Vernon, Air Force Research Laboratory, Wright Patterson AFB, OH
9:20-9:40am Oxidation Modeling of CMCs and EBCs in a Turbine Environment
M. Dion and B. Sullivan, Materials Research & Design, Wayne, PA
9:40-10:00am SiC Fiber Oxidation Kinetics and Mechanical Properties
R. Hay, Air Force Research Laboratory, Wright Patterson AFB, OH
10:00-10:20am BREAK
10:20-10:40am A High-Performance, Integrated Simulation System with Applications to CMC Durability
G. Henson and A. Cerrone, GE Global Research Center, Niskayuna, NY
10:40-11:00am Life-Prediction Methodology Development in Ceramic Matrix Composites (CMCs) Under Interlaminar Shear
C. Faucett, S. Kane, A. Stanley, N. Kedir, L. Sanchez and S. Choi, Naval Air Systems Command, Patuxent River, MD
11:00-11:20am Behavior and Life Prediction of SiC/SiC CMCs for Turbine Applications: Mechanistic Multiscale Modeling
R. Kumar, United Technologies Research Center, East Hartford, CT
11:20-11:40am Mode II Interlaminar Crack Growth Resistance (GIC) Specimen Optimization of Ceramic Matrix Composites
F. Abdi, C. Godines and J. Ahmad, AlphaSTAR Corporation, Long Beach, CA
M. Presby and G. Morscher, University of Akron, Akron, OH
S. Choi, Naval Air Systems Command, Patuxent River, MD
S. Gonczy, Gateway Materials Technology, Mt. Prospect, IL
11:40-12:00pm Effects of Cooling Hole Arrays in SiC/SiC Composites
G. Ostdiek, Air Force Research Laboratory, Wright Patterson AFB, OH
12:00-1:30pm Lunch own your own
WEDNESDAY MORNING – JANUARY 30, 2019
Session 2: Carbon-Carbon Composites Materials 1
Session Chairs: Mark Jones & Chris Tomko, Naval Surface Warfare Center, Dahlgren, Dahlgren, VA
Craig Ohlhorst, NASA Langley Research Center, Hampton, VA
Location: Salon 2

7:30-8:30am  Registration and Continental Breakfast
8:35-8:40am  Session Chairs Remarks
8:40-9:00am  Affordable 2D Carbon-Carbon Extensions for Propulsion Applications
J. Shigley, Northrop Grumman Innovation Systems
9:00-9:20am  AMRDEC Carbon-Carbon Advancements for Hypersonic Applications
M. Johnson, U.S. Army, AMRDEC, Redstone Arsenal, AL
9:20-9:40am  5-Axis 3D Printing of Continuous Fiber Carbon/Carbon Composites
M. Chapiro, Mantis Composites, San Luis Obispo, CA
9:40-10:00am Optimizing a Carbon-Carbon Dogbone Specimen for Tensile Testing
S. Flores, ATA-Engineering, San Diego, CA
10:00-10:20am BREAK
10:20-10:40am C-C Single Lap Shear Joint Testing and Analysis
J. Boston, Air Force Research Laboratory, Wright Patterson AFB, OH
10:40-11:00am Effect of Stacking Sequence on Mode-I Fracture Toughness of Advanced Carbon-Carbon 6 Laminates
M. Colmer, Mississippi State University, Mississippi State, MS
11:00-11:20am Investigation of Advanced Carbon-Carbon Coating Degradation
B. Butler, Maher and Associates, Towson, MD
11:20-11:40am Developments in Ground Test Performance of Fine Weave Pierced Fabric
M. Johnston, Southern Research, Birmingham, AL
11:40-12:00pm A Direct Comparison of RVAP Nosetip Material Performance in the H1 and H3 Arc Jets
B. Carmichael, Southern Research, Birmingham, AL
12:00-1:30pm  Lunch own your own
WEDNESDAY AFTERNOON – JANUARY 30, 2019

Session 1: Behavior and Life of Ceramic Matrix Composites 2

Session Chairs: George Jefferson and Craig Przybyla, Air Force Research Laboratory
Wright Patterson AFB, OH
Jennifer Pierce, University of Dayton Research Institute, Dayton, OH

Location: Salon 1

1:35-1:40pm  Session Chair Remarks

1:40-2:00pm  Advanced High Temperature Propulsion Materials: A Research Update
C. Hofmeister, Mock Oak Ridge Associated Universities, Belcamp, MD
A. Nieto, Naval Postgraduate School, Monterey, CA

2:00-2:20pm  Characterization and Lifing of Ceramic Matrix Composites
M. Goldsmith and T. Steyer, The Boeing Company, St. Louis, MO

2:20-2:40pm  C-C Single Lap Shear Joint Testing and Analysis
J. Boston, J. Toney and D. Simeroth, Air Force Research Laboratory, Wright Patterson AFB, OH
M. Stephens, Air Force Life Cycle Management Center Wright Patterson AFB, OH

2:40-3:00pm  Determination of CMC Allowables by Probabilistic-Generic Basis Strength Values
F. Abdi and C. Godines, AlphaSTAR Corporation, Long Beach, CA
E. Clarkson, National Institute or Aviation Research, Wichita, KS
M. Presby and G. Morscher, University of Akron, Akron, OH

3:00-3:20pm  BREAK

3:20-3:40pm  Imaging the Life-Cycle of CMCs using High-Resolution X-ray Computed Tomography
P. Creveling, N. LeBaron and M. Czabaj, University of Utah, Salt Lake City, UT
C. Przybyla, Air Force Research Laboratory, Wright Patterson AFB, OH
T. Key and D. King, UES, Inc., Dayton, OH
D. Marshall, University of Colorado, Boulder, CO
D. Parkinson and H. Barnard, Advanced Light Source, Lawrence Berkeley National Laboratory, Berkeley, CA

3:40-4:00pm  Acoustic Emission Informed Damage Progression During Fatigue of CMCs
G. Morscher, University of Akron, Akron, OH

4:00-4:20pm  Modeling High Temperature Environment Induced Degradation of EBC Coated SiC-Fiber Reinforced CMCs
T. Parthasarathy and D. Patel, UES Inc., Dayton, OH
C. Przybyla and M. Cinibulk, Air Force Research Laboratory, Wright Patterson AFB, OH

4:20-4:40pm  In-situ Damage Monitoring of a CMC Blade Root Sub-element Subjected to Fatigue Loading
T. Whitlow, University of Dayton Research Institute, Dayton, OH
E. Jones, G. Jefferson and C. Przybyla, Air Force Research Laboratory, Wright Patterson AFB, OH
J. Pierce, University of Dayton Research Institute, Dayton, OH
L. Zawada Universal Technology Corporation, Dayton, OH

4:40-5:00pm  Multi-Scale Process and Performance Simulation of Polymer-Derived Ceramic Composite Systems
R. Cook, e-Xstream Engineering, MSC Software, Newport Beach, CA

5:00-5:20pm  Using X-Ray Tomography Techniques to Study Damage Progression in SiC/SiC Composites
A. Hilmas, K. Sevener and J. Halloran, University of Michigan, Ann Arbor, MI
WEDNESDAY AFTERNOON – JANUARY 30, 2019

Session 2: Carbon-Carbon Composites Materials 2
Session Chairs: Mark Jones & Chris Tomko, Naval Surface Warfare Center, Dahlgren, Dahlgren, VA
Craig Ohlhorst, NASA Langley Research Center, Hampton, VA
Location: Salon 2

1:35-1:40pm  Session Chair Remarks

1:40-2:00pm  Low Conductivity PAN Based Carbon Fibers for Ablative Applications
M. Weisenberger, J. Craddock, J. Burgess and E. Hochstrasser, University of Kentucky, Lexington, KY
B. Hayes, Kaneka Aerospace LLC, Benicia, CA
S. Chung and E. Andrew, Materials Sciences LLC, Horsham, PA
J. Richman and J. Roberts, U.S. Army Aviation and Missile Research, Development and Engineering Center, Redstone Arsenal, AL

2:00-2:20pm  The Effect of Thermal Loading on the Compression Response of Advanced Carbon-Carbon
B. Kubitschek, Analytical Services and Materials, Hampton, VA

2:20-2:40pm  In-Plane Biaxial Testing and Stress Interaction of a Quasi-isotropic Carbon-Carbon Composite
J. Hawbaker, Southern Research, Birmingham, AL

2:40-3:00pm  Comparison of Biaxial Continuum Damage Mechanics Model with Test Data for Advanced Carbon-Carbon-6
C. Volle, Old Dominion University, Norfolk, VA

3:00-3:20pm  BREAK

3:20-3:40pm  Evaluation of The Impact Resistance of Advanced Carbon-Carbon Composites
B. Kubitschek, Analytical Services and Materials, Hampton, VA
M. Bowering, Texas A&M University, College Station, TX

3:40-4:00pm  Thermo-mechanical Testing and Post-Test Data Correlation of Carbon-Carbon Control Surface Manufacturing Demonstration Article
B. Campanella, Materials Research & Design, Inc., Wayne, PA

4:00-4:20pm  Generating Material Properties from Flight-Representative Structures
J. Podhiny, Materials Research & Design, Inc., Wayne, PA

4:20-4:40pm  Mechanical Properties of a Cut Ply Quasi-60 Carbon-Carbon Composites
B. Kubitschek, Analytical Services and Materials, Hampton, VA
W. Vaughn, NASA Langley Research Center, Hampton, VA
THURSDAY MORNING – JANUARY 31, 2019

Session 1: Hypersonic Vehicle Materials / Structural Evaluations 1

Session Chairs: Jacques Cuneo, Southern Research, Birmingham, AL and Brett Hauber, University of Dayton Research Institute, Dayton, OH

Anthony Calomino, NASA Langley Research Center, Hampton, VA

Larry Hudson & Craig Stephens, NASA Armstrong Flight Research Center, Edwards, CA

Location: Salon 2

7:30-8:30am  Registration and Continental Breakfast

8:35-8:40am  Session Chairs Remarks

8:40-9:00am  AFRL High Speed Systems Division’s Strategic Plan for Hypersonic Structures
T. Eason, D. Pratt, J. Boston and J. Toney, Air Force Research Laboratory, Wright Patterson AFB, OH

9:00-9:20am  Near-Net Shape Additive Manufactured Inlet for High Speed Missile
D. Driemeyer and J. L’Hote, The Boeing Company, St. Louis, MO

B. Carmichael, Southern Research, Birmingham, AL

9:40-10:00am Development of 3D Woven Reinforced Oxide-Oxide Materials for Antenna Window Applications

10:00-10:20am BREAK

10:20-10:40am Five Point Bend Test Specimen Design and Test Data Correlation for Oxide-Oxide Materials
W. Higginson, K. Howren and B. Sullivan, Materials Research & Design, Inc., Wayne, PA

10:40-11:00am High Fidelity Loads Prediction on Hypersonic Vehicle Control Surfaces
B. Hauber, University of Dayton Research Institute, Dayton, OH

11:00-11:20am Hybrid Ceramic-Metal Control Fin for Hypervelocity Projectiles
W. O’Connor and C. Iwano, Materials Research & Design, Inc., Wayne, PA

T. Barnett and M. Dahlen, Southern Research, Birmingham, AL

E. Levadnuk, Greenleaf Corporation, Saegertown, PA


11:20-11:40am Program Report for the AFRL TRIAD CMC Fastener Characterization Program
J. Cuneo and J. Koenig, Southern Research, Birmingham, AL

T. Patton, Booz Allen Hamilton, Dayton, OH

J. Boston, Air Force Research Laboratory, Wright Patterson AFB, OH

11:40-12:00pm Analysis and Testing of CMC Fasteners for Hypersonic and Other Flight Vehicles
L. Weller and B. Sullivan, Materials Research & Design, Inc., Wayne, PA

J. Cuneo, Southern Research, Birmingham, AL

12:00-1:30pm Lunch own your own
THURSDAY AFTERNOON – JANUARY 31, 2019

Session 1: Hypersonic Vehicle Materials / Structural Evaluations 2

Session Chairs: Jacques Cuneo, Southern Research, Birmingham, AL and Brett Hauber, University of Dayton Research Institute, Dayton, OH
Anthony Calomino, NASA Langley Research Center, Hampton, VA
Larry Hudson & Craig Stephens, NASA Armstrong Flight Research Center, Edwards, CA

Location: Salon 2

1:35-1:40pm  Session Chair Remarks

1:40-2:00pm  Space Shuttle Thermal Protection System Materials: Summary of Work performed by Southwest Research Institute
S. Chocron, J. Walker and D. Grosch, Southwest Research Institute, San Antonio, TX

2:00-2:20pm  Next Generation Reentry Vehicle Trajectory and Thermal Protection System Sizing
N. McGillivray, Southern Research, Birmingham, AL

2:20-2:40pm  Hypersonic Structurally Integrated CMC Skins (HySICS): Subelement Testing and Wing-Root Region Subcomponent Analysis

2:40-3:00pm  High Temperature Instrumentation for use in Hypersonic Applications
S. Massey, Southern Research, Birmingham, AL

3:00-3:20pm  BREAK

3:20-3:40pm  Advanced Flexible Insulations for Hypersonic Application
S. Miller, S. D. Miller & Associates, Flagstaff, AZ
M. Berg, Applied Electrodynamics LLC, Manhattan, KS
M. Blosser, Max Blosser Consulting, Williamsburg, VA

3:40-4:00pm  A First-Principles Model of Radiative Transport through Fibrous Insulation
M. Berg, Applied Electrodynamics LLC, Manhattan, KS
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Conference Program Chair

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