Program

Advanced Ceramic Matrix Composites: Science and Technology of Materials, Design, Applications, Performance and Integration

November 5 - 9, 2017

LaFonda on the Plaza - Santa Fe, New Mexico, USA

Conference Chair

Yutaka Kagawa
Tokyo University of Technology

Conference Co-Chairs

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NASA Glenn Research Center

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Sunday, November 5, 2017

16:30 - 18:30	Conference check-in
18:30 - 19:00	Reception (*sponsored by Rishi Raj)*
19:00 - 20:30	Dinner

NOTES

- *Technical Sessions will be held in the Ballroom South.*
- *Poster Sessions will be held in the Ballroom North.*
- *The ECI office will be in the Stiha Room.*
- *Meals will be in La Terraza and Garden Terrace except for breakfast and lunch on Thursday which will be in the Santa Fe Room.*
- *Audio, still photo and video recording by any device (e.g., cameras, cell phones, laptops, PDAs, watches) is strictly prohibited during the technical sessions, unless prior permission has been granted by the author and ECI.*
- *Speakers – Please have your presentation loaded onto the conference computer prior to the session start (preferably the day before).*
- *Speakers – Please leave at least 3-5 minutes for questions and discussion.*
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- *After the conference, ECI will send an updated participant list to all participants. Please check your listing now and if it needs updating, you may correct it at any time by logging into your ECI account.*

Monday, November 6, 2017

07:00 - 08:45	Breakfast
08:45 - 09:00	Opening Remarks Conference Chair: Yutaka Kagawa ECI Conference Technical Liaison: Ram Darolia
	Session I: Plenary Session Session Chairs: Yutaka Kagawa and Ram Darolia
09:00 - 09:45	**Keynote: Development and commercialization of GE's ceramic matrix composites (CMCs) for aircraft engines** Krishan Luthra, GE Global Research, USA
09:45 - 10:15	**High temperature composite overview in France** Marc Montaudon, Eric Bouillon, Safran Ceramics
10:15 - 10:45	**Application of CMC materials into aero-engines** Kuniyuki Imanari, IHI Corporation, Japan
10:45 - 11:15	Coffee break
11:15 - 11:45	**ONR and NAVY Research in Ceramic Matrix composites systems for advanced naval engines** David Shifler, Office of Naval Research, USA
11:45 - 12:15	**Overview of NASA transformational tools and technologies Project's 2700°F CMC/EBC Technology Challenge** Janet B. Hurst, NASA Glenn Research Center, USA
12:15 - 12:40	**Ceramic matrix composites at GE Aviation** Jim Steibel, General Electric Aviation, USA
12:40 - 14:00	Lunch break
	Session 2: Integrated Design and Applications – 1 Session Chairs: Yutaka Kagawa and Dongming Zhu
14:00 - 14:25	**Fiber creep and rupture models for design of advances high-temperature SiC-based ceramic matrix Composites** James DiCarlo, NASA Glenn Research Center, USA
14:25 - 14:50	**Progress of silicon carbide fibers and their application to ceramic matrix composites** Michio Takeda, NGS Advanced Fibers Co., Ltd, Japan

Monday, November 6, 2017 (continued)

14:50 - 15:15	**Ceramic composites for high temperature aerospace structures and propulsion systems** David Marshall, University of Colorado, USA Olivier Sudre, Teledyne Scientific Company, Thousand Oaks, CA; Brian Cox, Arachne Consulting, Sherman Oaks, CA
15:15 - 15:40	**Twenty years of experience with carbon/ceramic brakes: Status and perspectives** Walter Krenkel, University of Bayreuth, Germany
15:40 - 16:00	Coffee break
	Session 2: Integrated Design and Applications – 2 Session Chairs: Dongming Zhu and Rishi Raj
16:00 - 16:25	**Overview of ceramic matrix composite research at NASA Glenn Research Center** James D. Kiser et al, NASA Glenn Research Center, USA
16:25 - 16:50	**Informatics based structure-property linkages for transverse strength of ceramic matrix composites** Dipen Patel, Triplicane Parthasarathy, Daniel Rapking, Michael Braginsky, Craig Przybyla, Air Force Research Laboratory, USA
16:50 - 17:15	**Engineering framework for Safran interlocked ceramics components** David Marsal, Eric Bouillon, Nicolas Laval, Safran Ceramics
17:15 - 17:40	**SiC-based ceramic matrix composite behavior enhancement for gas turbines hot sections** Eric Bouillon, Nicolas Laval, David Marsal, Safran Ceramics, France
17:40 - 18:05	**Updated Composite Materials Handbook-17 (CMH-17) Volume 5 - Ceramic Matrix Composites** James Doug Kiser, NASA Glenn Research Center, USA
18:30 - 20:00	Dinner
20:00 - 21:30	**Poster Session/Social hour (*Sponsored by CoorsTek, Inc.)***

Tuesday, November 7, 2017

07:00 - 09:00	Breakfast
	Session 3: Advanced Materials and Architectures, Interfaces and Composite System Performance Session Chairs: Walter Krenkel and James D. Kiser
09:00 – 09:25	**Constituent development for higher temperature capable ceramic matrix composites** Michael K. Cinibulk, Air Force Research Laboratory, USA
09:25 – 09:50	**Interface engineering in oxide/oxide composites** K.K. Chawla, University of Alabama at Birmingham, USA
09:50 - 10:15	**Creep durability of 3D woven SiC/SiC composites with (CVI+PIP) hybrid matrix** R.T. Bhatt, OAI/NASA Glenn Research Center, USA
10:15 - 10:40	**SiC fibers and SiC/SiC ceramic matrix minicomposites damage behavior** Amjad Almansour, NASA Glenn Research Center, USA
10:40 - 11:10	Coffee break
11:10 - 11:35	**Image analysis, synthesis and image-based modeling of ceramic-matrix composites** Gerard L. Vignoles, University of Bordeaux, France
11:35 - 12:00	**Effect of fiber distributions on the mechanical performance of CMC materials: Virtual manufacturing and testing approach** Wooseok Ji, Hye-gyu Kim, Ulsan National Institute of Science and Technology, Korea
12:00 - 12:25	**Effect of mechanical machining on surface roughness of CMCs** Ralf Goller, Achim Rösiger, Augsburg University of Applied Sciences
12:30	Pick up boxed lunch
12:45	Buses depart for excursion to Optional Excursion to Bandelier National Monument followed by stop at Santa Fe Brewing Company (drinks on your own). After excursion: Dinner on your own in Santa Fe

Wednesday, November 8 2017

07:00 - 09:00	Breakfast
	Session 4: Processing and Mechanical Behavior, NDE, Modeling and Life Prediction Session Chairs: Rishi Raj and Craig Przybyla
08:35 - 09:00	**In-situ 3D visualization of composite microstructure during polymer-to-ceramic conversion** Frank Zok, University of California Santa Barbara, USA
09:00 - 09:25	**A methodology based on in-situ crack propagation and modeling for designing ceramic composites for use at high temperature** Raj N. Singh, Oklahoma State University, USA
09:25 - 09:50	**Virtual simulation and design of barrier coatings for ceramic composites** Matthew R. Begley, University of California, Santa Barbara, USA
09:50 - 10:15	**Multi-scale modeling of damage and delaminations failure in ceramic matrix composites** Rajesh S. Kumar, UTRC/Pratt & Whitney, USA
10:15 - 10:40	**Monitoring damage accumulation using acoustic emission and electrical resistance at room and elevated temperatures of SiC-based composites** Greg Morscher, University of Akron, USA
10:40 - 11:00	Coffee break
	Session 5: Polymer Derived Ceramics and Processing Session Chairs: David Marshall and Greg Morscher
11:00 - 11:25	**Dual function polymer-derived non-oxide/oxide matrix prepared by additive manufacturing** Rishi Raj, University of Colorado, USA
11:25 - 11:50	**Fundamentals of polymer precursor method for synthesizing silicon carbide based ceramic fibers** Masaki Narisawa, Osaka Prefecture University; Yuka Ikemoto, Japan Synchrotron Radiation Research Institute; Kenji Suzuki, Advanced Institute of Materials Science, Japan
11:50 - 12:15	**Implications of coupled crystallization and decomposition reactions for CMC processing using polymer derived ceramics** David Poerschke, University of Minnesota, USA

Wednesday, November 8 2017 (continued)

12:15 - 12:40	**SiC-SiC CMCs Using BN powder coated silicon carbide fibers** Eric Ness, Koichi Machida, Shinichiro Aonuma, Charles Lewinsohn, CoorsTek Inc., USA
12:40 - 14:00	Lunch
	Session 6: Environmental Effects and CMAS Degradation Session Chairs: Carlos Levi and Satoshi Kitaoka
14:00 - 14:25	**Non-oxide ceramic matrix composites for application in hot gas atmospheres – requirements and potential** Hagen Klemm, Willy Kunz, Bernd Gronde, Katrin Schönfeld, Fraunhofer IKTS Dresden, Germany
14:25 - 14:50	**Borosilicate wetting on ceramic matrix composites and Si-based substrates** Megan Wilson, Elizabeth Opila, University of Virginia, USA; Tim Keenan, Alfred University
14:50 - 15:15	**Ceramic matrix composite environmental barrier coating durability model** Mike Dion and Brian Sullivan, MR&D, USA
15:15 - 15:40	**Evaluation of ceramic matrix composite leading edge samples under simulated hypersonic flight conditions** Triplicane Parthasarathy, Carmen Carney, Mike Cinibulk, Tarun Mathur, Mark Gruber, Air Force Research Laboratory, USA
15:40 - 16:00	Coffee break
16:00 - 16:25	**CMAS challenges to CMC-T/EBC systems** Carlos Levi, D.L. Poerschke, W. Summers, J.H. Shaw, R.W. Jackson, D. Park, K.M. Grant, N. Verma, F.W. Zok, University of California Santa Barbara, USA
16:25 - 16:50	**Boria effects on the oxidation mechanisms of SiC/BN/SiC CMCs** Elizabeth Opila, Valentina Avincola, Bohuslava McFarland, Megan Wilson, Madeline Morales, University of Virginia, USA
16:50 - 17:15	**Issues of advanced ceramic matrix composites in aeroengine applications** Sung R. Choi, Naval Air Systems Command, Patuxent River, USA
17:15 - 17:40	**Calcium-magnesium alumino-silicates (CMAS) reaction mechanisms and resistance of advanced turbine environmental barrier coatings - SiC/SiC ceramic matrix composites** Dongming Zhu, Gustavo Costa, Bryan Harder, Valerie L. Wiesner, Janet B. Hurst NASA Glenn Research Center, USA

Wednesday, November 8, 2017 (continued)

17:40 - 18:05	**Degradation of oxide/Si/(SiC/SiC) model environmental barrier coatings system after unexpected melting condition of Si bond coat layer** Yutaka Kagawa, Yutaro Arai, Tokyo University of Technology, Japan
19:30 - 21:30	Conference Banquet

Thursday, November 9, 2017

07:00 - 09:00	Breakfast
	Session 7: Environmental Barrier Coatings-1: Processing and Test Development Session Chairs: Hagen Klemm and Kang Lee
09:00 - 09:25	**Current EBC development and testing at NASA** Kang Lee, Deborah Waters, Gustavo Costa, Bernadette Puleo, NASA GRC, USA
09:25 - 09:50	**Advanced design of EBC based on mass-transfer mechanisms in oxides under oxygen potential gradients at high temperatures** Satoshi Kitaoka, Tsuneaki Matsudaira, Masashi Wada, Taishi Yokoi, Masasuke Takata, Japan Fine Ceramics Center, Japan
09:50 - 10:15	**APS Y_2O_3 environmental barrier coatings for oxide ceramic matrix composites** Peter Mechnich, DLR, Germany
10:15 - 10:40	**Development of NASA's advanced environmental barrier coatings for SiC/SiC composites: Prime-reliant design and durability perspectives** Dongming Zhu, NASA GRC, USA
10:40 - 11:00	Coffee break
	Session 7: Environmental Barrier Coatings-2: Mechanics and Failure mechanisms Session Chairs: Hideki Kakisawa and Peter Mechnich
11:00 - 11:25	**Delamination resistance of oxide environmental barrier coatings from SiC/SiC substrate** Yutaka Kagawa, Tokyo University of Technology, Japan
11:25 - 11:50	**Failure resistant thermal and environmental barrier coating concepts** Haydn Wadley, University of Virginia, USA
11:50 - 12:15	**An evaluation method for interface toughness of environmental barrier coatings (EBCs) on ceramic matrix composites (CMCs)** Hideki Kakisawa, National Institute for Materials Science, Japan
12:15 - 12:40	**Development of thermally sprayed environmental barrier coatings** Emine Bakan, Caren Sophia Gatzen, Daniel Emil Mack, Robert Vaßen, Forschungszentrum Jülich GmbH, Germany
12:40 - 14:00	Lunch and Departures

Poster Presentations

1. **Residual stress measurement of YB silicates by Raman Spectroscopy: First-principles and experimental studies**
   Takafumi Ogawa [1], Yoshihisa Tanaka [2], Taishi Yokoi [1], Hideki Kakisawa [2], Satoshi Kitaoka [1]
   [1]Japan Fine Ceramics Center, Japan; [2]National Institute of Materials Science, Japan

2. **Oxidation mechanisms of ZrB_2-based ultra high temperature ceramic matrix composites**
   Ryo Inoue, Yasuo Kogo, Tokyo University of Science; Yuki Kubota, Ken Goto, Japan Aerospace Exploration Agency (JAXA)

3. **Microstructure control of multi-layered EBC prepared by dual electron beam PVD**
   Taishi Yokoi, Norio Yamaguchi, Satoshi Kitaoka, Masasuke Takata, Japan Fine Ceramics Center, Japan

4. **Numerical simulation of energy release rate for interface crack initiation due to thermal stress in environmental barrier coatings for Silicon Carbide (SIC) fiber reinforced in SIC matrix composite**
   Emi Kawai, Yoshitaka UMENO, University of Tokyo, Japan

5. **The potential of plasma activation for EB-PVD of EBC systems on CMC components**
   Burkhard Zimmermann, Gösta Mattausch, Frank-Holm Rögner, Bert Scheffel, Jens-Peter Heinß, Christoph Metzner, Fraunhofer Institute for Organic Electronics, Germany

6. **SIC/SIC composite thruster for a non-toxic liquid propellant rocket engine**
   Ken Goto, Shinichiro Tokudome, Tsuyoshi Yagishita, Japan Aerospace Exploration Agency, Japan

7. **Measurement of delamination toughness of EBC layer from 2D/3D SIC/SIC substrate: Experiment and analysis**
   Yuto Aoki, Junya Inoue, Yutaka Kagawa, Tokyo University of Technology, Japan

8. **How not to measure the tensile strength of high-modulus fibers**
   Joseph Pegna, Shay L. Harrison, Free Form Fibers, USA

9. **Cost-performance analysis of silicon carbide fibers**
   Shay Harrison, Joseph Pegna, Free Form Fibers, USA

10. **WITHDRAWN**

11. **High-temperature ceramic matrix composites using microwave enhanced chemical vapor infiltration**
    Matthew Porter, University of Birmingham, United Kingdom

12. **Interfacial characteristics and microstructural evolution of ceramics exposed to high temperature sand laden combustion environments**
    Dongming Zhu, NASA Glenn Research Center, USA

13. **Environmental barrier coating fracture, fatigue and high-heat-flux environment failure mechanisms and stochastic progressive damage simulation**
    Dongming Zhu, Noel Nemeth, NASA Glenn Research Center, USA