

11-5-2017

Conference Program

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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

Dongming Zhu

NASA Glenn Research
Center

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Sunday, November 5, 2017

16:30 - 18:30	Conference check-in
18:30 - 19:00	Reception (<i>sponsored by Rishi Raj</i>)
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.*
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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 Rapping, 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 Gatzert, 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 Ogawa¹, Yoshihisa Tanaka², Taishi Yokoi¹, Hideki Kakisawa², Satoshi Kitaoka¹
¹Japan Fine Ceramics Center, Japan; ²National Institute of Materials Science, Japan
- 2. Oxidation mechanisms of ZRB₂-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