

Program

Ultra-High Temperature Ceramics: Materials for Extreme Environment Applications

**August 3 - 8, 2008
Granlibakken Conference Center
Lake Tahoe, California**

Conference Chair

**Eric Wuchina
Naval Surface Warfare Center, USA**

Conference Co-Chair

**Alida Bellosi
Institute of Science & Technology for Ceramics, Italy**



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The organizers would like to thank the following sponsors for their generous support of this conference:

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Sunday, August 3, 2008

16:00 - 18:00	Registration, – Lobby, Granlibakken Conference Center
18:00 - 19:30	Dinner
19:30 - 21:00	Welcome Reception

IMPORTANT ANNOUNCEMENTS

- Audiotaping, videotaping and photography of presentations are strictly prohibited.
- Speakers – Please leave at least 5 minutes for questions and discussion.
- Please do not smoke at any conference functions.
- Turn your cellular telephones to vibrate or off during technical sessions.
- Be sure to make any corrections to your name/contact information on the Master Participant List or confirm that the listing is correct. A corrected copy will be sent to all participants after the conference.

Monday, August 4, 2008

07:15 – 08:00

Breakfast (buffet)

08:00 – 08:15

Welcome and Conference Overview
Conference Organizers: E. Wuchina and A. Bellosi
ECI Technical Liaison: J. Routbort

Session 1: Thermodynamic Considerations

Session Chair: E. Wuchina

08:15 - 08:55

Keynote Speaker
“CALPHAD descriptions of UHTC equilibrium and kinetics”
L. Kaufman, CALPHAD Inc., Brookline, MA, USA

08:55 – 09:15

“High-temperature interfacial interactions in Ni-X/HfB₂ systems”
A. Passerone, IENI-CNR, Italy

09:15 – 09:35

“Novel thermal protection materials systems designs for hypersonics”
J. Perepezko, University of Wisconsin, Madison, WI, USA

09:35 – 9:55

Coffee break

Session 2: Processing

Session Chair: D. Ellerby

9:55 – 10:25

“Effectiveness of Ta- and Mo-Disilicides on sintering and properties of UHTC ceramic composites”
A. Bellosi, ISTEC-CNR, Research Institute for Science and Technology of Ceramics, Italy (INVITED)

10:25 – 10:45

“TiC-TiB₂ nanostructured composites for high-temperature wear parts fabricated by spark plasma sintering”
D. Vallauri, Department of Materials Science and Chemical Engineering, Politecnico di Torino, Italy

10:45 – 11:05

“Advances in microstructural control of ultra high temperature ceramics”
S. Johnson and M. Stackpoole, Eloret Corporation/NASA Ames Research Center, Moffett Field, CA, USA

11:05 – 11:25

“Processing, microstructure, and properties of HfB₂-SiC composites consolidated by spark plasma sintering technique”
D. Jiang, Department of Chemical Engineering and Material Science, University of California, Davis, Davis, CA, USA

11:25 – 11:45

“Processing and oxidation behavior of ZrB₂-SiC prepared by spark plasma sintering”
C. Carney, UES, Inc., Dayton, OH, USA

Monday, August 4, 2008 (continued)

Session 3: Coatings

Session Chair: E. Corral

- 11:55 – 12:15 “Mechanical and thermal properties of bulk and thin coatings of ZrB₂/SiC composites”
E. Corral, Sandia National Laboratories, Albuquerque, NM, USA
- 12:15 – 12:35 “UHTC coatings by plasma spraying”
T. Valente, Sapienza University of Roma, Italy
- 12:35 – 12:55 “Thick UHTC Coatings Consisting of ZrB₂/SiC and Additional UHTC Phases”, Y. Blum, SRI International, Menlo Park, CA
- 13:00 – 14:00 Lunch
- 14:00 – 16:30 Free time
- 16:00 – 16:30 Afternoon coffee

Session 4: Applications

Session Chair: M. Opeka

- 16:30 – 17:10 Keynote Speaker
“Hypersonic applications: The case for advanced materials”
K. B. Bowman, Air force Research Laboratory, WPAFB, Dayton, OH, USA
- 17:10 – 17:50 Keynote Speaker
“CIRA technological achievements on UHTCs for space applications”
G. Marino, CIRA – Italian Aerospace Research Center, Italy
- 17:50 – 18:20 Invited Speaker
“UHTC development at NASA: Challenges and successes”
S. Johnson, NASA-AMES Research Center, Moffett Field, CA, USA
- 18:20 – 18:40 “Status and perspectives of the hypersonic flyers in Thales Alenia Space Italia”
F. Fossati, Thales Alenia Space Italia, Italy
- 18:45 – 20:15 Dinner
- 20:15 – 21:15 Social hour

Tuesday, August 5, 2008

07:15 – 08:00

Breakfast

Session 5: Testing – Oxidation

Session Chair: A. Bellosi

08:00 – 08:40

Keynote Speaker

“Testing and modeling UHTC materials in dissociated atmospheres”

J. Marschall, Stanford Research Center, Menlo Park, CA, USA

08:40 – 09:00

“Ultra high temperature ceramics under simulated hypersonic re-Entry conditions”

F. Monteverde, Institute of Science and Technology for Ceramics, National Research Council, Italy

09:00 – 09:20

“High temperature, long duration plasma torch test of a UHTC nose-cone demonstrator”

(G. Marino), L. Scatteia¹, D. Alfano¹, F. Monteverde², R. Savino³, and S. Cantoni¹, ¹CIRA – Centro Italiano Ricerche Aerospaziali, Italy; ²CNR-ISTEC, Faenza; ³University of Naples, DIAS, Naples, IT

09:20 – 10:00

Keynote Speaker

“Characterization and oxidation behavior of ZrB₂ matrix UHTCs,”

P. Hu, Center for Composite Materials, Harbin Institute of Technology, China

10:00 – 10:15

Coffee break

10:15 – 10:45

Invited Speaker

“The kinetics of oxidation of ZrB₂-based UHTC composites”

K. Nickel¹, V. Presser¹, A. Chyrkin², V. Lavrenko³, and O. Grigoriev³; ¹Department of Applied Mineralogy, ²University of Tuebingen, Germany, Forschungszentrum, Julich, ³ Frantsevich Institute f. Problems in Materials Science, NAS Kiev (INVITED)

10:45 – 11:15

“Oxidation of ZrB₂-SiC-TaSi₂ materials at ultra high temperature”

E. Opila, NASA-Glenn Research Center, Cleveland, OH, USA

11:15 – 11:35

“Oxidation of ZrB₂ ceramics with tungsten additions”

W. Fahrenholtz, Missouri University of Science & Technology, Rolla, MO, USA

11:35 – 11:55

“Oxidation resistance of ZrB₂-based composites up to 2000°C”

R.F. Speyer, Georgia Institute of Technology, Atlanta, GA, USA

11:55 – 12:15

“High temperature oxidation of ZrB₂ and ZrB₂-SiC Composites”

W.M. Kriven, Department of Materials Science & Engineering, University of Illinois at Urbana-Champaign, USA

Tuesday, August 5, 2008 (continued)

12:15 - 12:35 "Oxidation of Ti_3SiC_2 and Ti_2AlC in 1000-1400°C temperature range in air"
M. Radovic, Department of Mechanical Engineering, Texas A&M University, College Station, TX, USA

12:35 – 13:00 *Ad hoc* discussions

13:00 – 14:00 Lunch

14:00 – 17:30 *Ad hoc* discussions and/or free time

Session 6: Testing - Mechanical Behavior I

Session Chair: M. Opeka

17:30 – 17:50 "Advanced instrumented microhardness at ultra high temperature and acoustic emission to detect crack initiation of ceramic coatings"
N. Gitis, CETR Corp.

17:50 -18:10 "High-temperature thermo-physical property measurement using LaserSpot heating and inverse heat conduction analysis"
R. Hrubciak, Florida International University, Miami, FL, USA

18:10 – 18:30 "Determination of elastic properties of solids at high temperatures by resonant ultrasound spectroscopy"
M. Radovic, Department of Mechanical Engineering, Texas A&M University, College Station, TX, USA

18:30 – 20:00 Dinner

Session 7: Posters

20:00 – 22:00 Poster Session and Social Hour

1. "TEM Analysis of ZrB_2 -Based UHTCs: Process-Derived Defects and Effect of SiC Content," E. Eakins¹, D. Jayaseelan¹, W. Lee¹, F. Monteverde², D. Sciti², A. Bellosi², Department of Materials, Imperial College, London, UK; ²CNR-ISTEC, Faenza, Italy
2. "Engineered Ceramic Composite for Hypersonic Wind-Tunnel Applications," A. Miles, K. Mehta, R. Nageswaran, SMAHT Ceramics, Inc., Salt Lake City, UT

Tuesday, August 5, 2008 (continued)

3. "Tailor-Made Reticular Cordierite Foams Manufactured by a Direct Foaming Process," E.R. Silva, Instituto Superior Tecnico, IBB-Centre for Biological and Chemical Engineering, Italy
4. "Calculation of Power Dissipation in SiC-Based Schottky Barrier Diode Having Uniform Doping," R. Talwar and A.K. Chatterjee, RIMT-IET, MandiGobindgarh, India
5. "Synthesis and Properties of Carbon-Rich Hafnia Thin Films," D. Pejakovic, SRI International, Menlo Park, CA
6. "Processing of ZrB₂-based Ultra-High Temperature Ceramic Composites by Reactive Hot Pressing," L. Rangaraj¹, C. Divakar¹, and V. Jayaram², ¹Materials Science Division, National Aerospace Laboratories, (CSIR), Bangalore, India, ²Department of Materials Engineering, Indian Institute of Science, Bangalore, India
7. "High-temperature protective photonic coatings," L Braginsky and V. Shklover, Lab of Crystallography, Department of Materials, ETH Zurich, 8093 Zurich, Switzerland

Wednesday, August 6, 2008

- 07:15 – 08:00 Breakfast
- Session 8: Testing – Mechanical Behavior II**
Session Chair: W. Fahrenholtz
- 08:00 – 08:30 Invited Speaker
“Structure-property relations in monolithic and functionally engineered ZrB₂-based ceramics”
G. E. Hilmas, Missouri University of Science & Technology, Rolla, MO, USA
- 08:30 -08:50 “Effect of particle size on the microstructure and mechanical properties of ZrB₂-SiC composites”
X. Zhang, Center for Composite Materials, Harbin Institute of Technology, China
- 08:50 – 09:20 Invited Speaker
“Flexural creep deformation of ZrB₂-SiC ceramics”
I. Talmy, Naval Surface Warfare Center – Carderock Division, W. Bethesda, MD, USA
- 09:20 – 9:40 “Creep of Ti₃SiC₂ and Ti₂AlC in 1000-1400°C temperature range in air”
M. Radovic, Department of Mechanical Engineering, Texas A&M University, College Station, TX, USA
- 09:40 – 10:00 Coffee break
- 10:00 – 10:20 “Mechanical and thermal properties of hot isostatic pressed HfB₂-based ceramics”
M. Opeka, Naval Surface Warfare Center – Carderock Division, W. Bethesda, MD, USA
- 10:20 – 10:40 “High-temperature elastic and damping properties of ultra refractory ZrB₂-based ceramics”
A. K. Swarnakar, Department of Metallurgy and Materials Engineering, Katholieke Universiteit Leuven, Netherlands
- 10:40 – 11:00 “A multiparameter facility for conducting thermo-mechanical tests in air, partial pressures, vacuum, or inert environments up to 4000-5000F”
B. Patel, Southern Research Institute, Birmingham, AL, USA
- 11:00 – 12:00 Lunch
- 12:30 - (Optional) boat tour on Lake Tahoe
- 18:30 - 20:30 Dinner
- 20:30 – 21:30 Social Hour

Thursday, August 7, 2008

07:15 – 08:00

Breakfast

Session 9: Carbides and Cermets

Session Chair: E. Wuchina

08:00 – 08:30

“Microstructure-property relationships in TaC-based refractory compounds”

S. DiPietro¹, M. Opeka², E. Wuchina², J. Spain³, ¹Exothermics, Inc., Amherst, NH; ²NSWCCD, W. Bethesda, MD; ³Southern Research Institute, Birmingham, AL

08:30 – 08:50

“Development, characterization and evaluation of TaC-based materials for solid rocket motor applications”

D. Butts¹, T. McKechnie¹, E. Wuchina², M. Opeka², and J. Spain³, ¹Plasma Processes, Inc., Huntsville, AL; ²NSWCCD, W. Bethesda, MD; ³Southern Research Institute, Birmingham, AL

09:10 – 09:30

“Polymer-derived refractory carbide-based ultrahigh temperature CMC”

H.Yun, Matech, Inc., CA, USA

09:30 – 09:50

Coffee break

09:50 – 10:10

“Ultra-high temperature ceramic fibers”

E.J.A. Pope, Matech, Inc., CA, USA

10:10 – 10:30

“Preparation and properties of high-temperature cermets”

I. Talmy, Naval Surface Warfare Center – Carderock Division, W. Bethesda, MD, USA

10:30 – 10:50

“Fabrication of dense, near net-shaped, ultra-high melting carbide/metal composites with tailored microstructures by the displacive compensation of porosity (DCP) process”

K. Sandhage, Georgia Institute of Technology, Atlanta, GA, USA

10:50 – 12:00

Ad hoc discussions

12:00 – 13:30

Lunch

13:30 – 16:00

Ad hoc discussions or free time

Thursday, August 7, 2008 (continued)

Session 10: Imaging and Microscopy

Session Chair: E. Opila

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|---------------|---|
| 16:00 – 16:30 | Invited Speaker
“Non-destructive imaging and analysis”
W. Chiu, University of Connecticut, USA |
| 16:30 – 16:50 | “Microstructural characterization of melt-infiltrated C/ZrC composites for ultrahigh temperature applications”
N. Wali, J.M. Yang, University of California – Los Angeles, CA, USA |
| 16:50 – 17:10 | “TEM characterization of carbide-based ultra-high temperature ceramics”
L. Silvestroni, CNR-ISTEC, Italy |
| 17:10 – 17:30 | “TEM investigation of ZrB ₂ -Based UHTCs”
D.D. Jayaseelan, Imperial College, London, UK |
| 17:30 – 18:30 | <i>Ad hoc</i> discussions |
| 18:30 – 20:30 | Conference banquet |

Friday, August 8, 2008

07:15 - 08:00

Breakfast

08:00 – 11:00

Wrap-up discussions: State of the technology, research needs
and future plans
(coffee served in conference room at 09:00)

11:30

Lunch (Sandwich Buffet)
For those leaving early “to go” containers will be available