Program

Ultra-High Temperature Ceramics:
Materials for Extreme Environment Applications IV

September 17 – 20, 2017

Cumberland Lodge,
Windsor, UK

Conference Chairs:

Jon Binner
University of Birmingham, UK

Bill Lee
Imperial College, London, UK

Organising Committee:

Bill Fahrenholtz
Missouri University of Science & Technology, USA

Sylvia Johnson
Recently retired from NASA, USA

Mike Reece
Queen Mary University London, UK

Diletta Sciti
ISTEC, Italy

Carolina Tallon
Virgina Tech, USA

Eric Wuchina
Naval Surface Warfare Center, USA

Yanchun Zhou
Aerospace Research Institute of Materials and Processing Technology, China

Engineering Conferences International
32 Broadway, Suite 314 - New York, NY 10004, USA
Phone: 1 - 212 - 514 - 6760, Fax: 1 - 212 - 514 - 6030
www.engconfintl.org – info@engconfintl.org

Cumberland Lodge
The Great Park,
Windsor,
Berkshire,
SL4 2HP
UK
Tel: +44-1784 432 316

Engineering Conferences International (ECI) is a not-for-profit global engineering conferences program, originally established in 1962, that provides opportunities for the exploration of problems and issues of concern to engineers and scientists from many disciplines.

Previous conferences in this series

Ultra-High Temperature Ceramics:
Materials for Extreme Environment Applications
August 3-8, 2008
Lake Tahoe, California

Conference Chairs:
Eric Wuchina, Naval Surface Warfare Center, USA
Alida Bellosi, Institute of Science & Technology for Ceramics, Italy

Ultra-High Temperature Ceramics:
Materials for Extreme Environment Applications II
May 13-18, 2012
Hernstein, Austria

Conference Chairs:
Bill Fahrenholtz, Missouri University of Science & Technology, USA
Bill Lee, Imperial College, London, UK
Eric Wuchina, Naval Surface Warfare Center, USA
Yanchun Zhou, Aerospace Research Inst. Of Materials & Processing Technology, China

Ultra-High Temperature Ceramics:
Materials for Extreme Environment Applications III
April 12-16, 2015
Gold Coast, Australia

Conference Chairs:
George Franks, The University of Melbourne, Australia
Carolina Tallon, The University of Melbourne, Australia

Conference Sponsors

CERAMIC AND GLASS INDUSTRY FOUNDATION

NETZSCH

Journal of the European Ceramic Society (JECS) Trust

JECS Trust

Endorsed by

The American Ceramic Society
www.ceramics.org

ECERS

Sunday, 17 September 2017

16:30 – 18:00	Conference Check-in	(Tapestry Hall)
18:00 – 18:30	Opening Reception	(Drawing Room)
18.30 – 19.30	**Plenary Lecture:** *UHTCs – Too hot to handle*	
	Pete Brown, DSTL, UK	(Flitcroft)
19:30 – 21:00	Dinner	(Cumberland)
21:00 – 22:30	Drinks in the bar (pay bar)	

NOTES

- *Locations of sessions and meals are listed in the program.*
- *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.*
- *Please do not smoke at any conference functions.*
- *Turn your mobile telephones to vibrate or off during technical sessions.*
- *Please write your name on your program so that it can be returned to you if lost or misplaced.*
- *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, 18 September 2017

07:30 – 08:30 Breakfast (Dining Room)

08:30 – 08:45 Opening Remarks: Conference Chairs & ECI Technical Liaison (Flitcroft)

Session I: Applications, Testing and Challenges **Session Chairs: Jon Binner & Bill Lee**

08:45 – 09:30 **Keynote:** *Extended Potentials of UHTCMCs in Space Vehicle Extreme Environment Applications - Large System Intergrator View and Expectations*
Wolfgang Fischer, ArianeGroup, Germany

09:30 – 10.00 **Invited:** *Ultra high temperature ceramics for hypersonic space vehicles: opportunities and challenges*
Bikramjit Basu, IIS Bangalore, India

10:00 – 10:30 **Invited:** *Testing ultra-high temperature ceramics for thermal protection and rocket applications*
Raffaele Savino, University of Naples, Italy

10:30 – 11:00 Coffee break (Bar area)

11:00 – 11.20 *High enthalpy testing of UHTC materials for space applications*
Burkard Esser & A Gülhan, German Aerospace Centre, Cologne, Germany

11:50 – 12:10 *Thermo-chemical surface instabilities of SiC-ZrB_2 ceramics in high enthalpy supersonic dissociated airflows*
Frederic Monteverde, Institute of Science and Technology for Ceramics, Italy

12:10 – 12:30 *Phase transformations in oxides above 2000°C: Experimental technique development*
Sergey V Ushakov & A Navrotsky, University of California at Davis, USA

12:30 – 13:30 Lunch (Dining Room)

Session II: Synthesis and Processing **Session Chairs: Frederic Monteverde & Carolina Tallon**

13:30 – 14:00 **Invited:** *Processing and evaluation of UHTC loaded composites*
Carmen Carney & M Cinibulk, AFRL, USA and D King & TA Parthasarathy, UES Inc, USA

14:00 – 14:30 **Invited:** *Synthesis and properties of carbon fiber reinforced UHTC composites*
Sea-Hoon Lee, Korea Institute of Materials Science, S. Korea

14:30 – 14:50 *Enabling the next generation of near-net-shaping techniques for UHTCs*
Carolina Tallon, Virginia Polytechnic Institute and State University, USA; S Leo & GV Franks, The University of Melbourne and Defence Materials Technology Center, Australia

14:50 – 15:10 *Ultra-high temperature ceramic coatings and structures formed by vacuum plasma spray*
Daniel Butts, Plasma Processes, Huntsville, USA

15:10 – 15:30 *Feasibility research of gaining "refractory high entropy carbides" through in situ carburization of refractory high entropy alloys*, Yuanlin Ai, S Bai, L Zhu & Y Ye, National University of Defense Technology, Changsha, China

Monday, 18 September 2017 (continued)

15:30 – 16:00 Tea break (Bar area)

Session III: Materials for Extreme Environments (XMat) – A UK-funded research programme
Session Chairs: Mike Finnis & Mike Reece

16:10 – 16:40 **Invited:** *Ultra high temperature ceramic composite materials*
Virtudes Rubio & J Binner, University of Birmingham, UK; T Ackerman, MBDA, Stevenage, UK; S Cousinet, X Bertrand & N Pommepuy, MBDA, Paris, France

16:40 – 17:10 **Invited:** *Flash spark plasma sintering of UHTCs*
Salvatore Grasso, T Saunders, EG Castle, P Tatarko, M Reece, Queen Mary University London, UK; J Binner & J Zou, University of Birmingham, UK; O Cedillos-Barraza, E Zapata-Solvas, S Humphry-Baker, WE Lee, A Duff, T Mellan, MW Finnis, Imperial College London, UK; M Fides, R Sedlák, T Csanádi, V Girman, P Hvizdos & J Dusza, Institute of Materials Research, Slovak Academy of Sciences, Slovakia

17:10 – 17:40 **Invited:** *Creep of HfB_2-based UHTCs up to 2000^oC*
Eugenio Zapata-Solvas, C Liu, WE Lee, Imperial College London, UK; L Feng & SH Lee, Korea Institute of Materials Science, Korea; S Grasso & M Reece, Queen Mary University of London, UK; D Gomez-Garcia & A Dominguez-Rodriguez, University of Seville, Spain

17:40 – 18:10 **Invited:** *Theory and simulation of ultra-high-temperature ceramics*
Tom Mellan, T Davey, S Azadi, MW Finnis, Imperial College London, UK; AI Duff, STFC Daresbury Laboratory, UK

18:10 – 18:30 *Electronic structures and thermal properties of 312-MAX phases*
Sam Azadi & MW Finnis, Imperial College London, UK

18:30 – 18:50 *Porous ZrB_2 manufacturing for transpiration cooling systems for hypersonic flights*
Laura Larrimbe, WE Lee & L Vandeperre, Imperial College London, UK

19:30 – 22:00 Wine tasting followed by a Banquet dinner (Cumberland)

Tuesday, 19 September 2017

07:30 – 08:30 Breakfast – including a discussion of UHTC-V (Dining room)

Session IV: Thermodynamics, Phase Stability and Modelling **Session Chairs: Bikramjit Basu & Ted Besmann**

08:30 – 09:00 **Invited:** *Uranium nitride-silicide advanced nuclear fuel: Higher efficiency and greater safety*
Ted Besmann, TL Wilson, EE Moore, M Bogala & MJ Noordhoek, University of South Carolina, USA; ES Wood & AT Nelson, Los Alamos National Laboratory, USA; JW McMurray, Oak Ridge National Laboratory, USA; SC Middleburgh & P Xu, Westinghouse Electric Co., USA

09:00 – 09:30 **Invited:** *A computational investigation of the phase and microstructural stability in transition metal carbides and nitrides*
Chris Weinberger, Colorado State University, USA; X-X Yu, Northwestern University, USA; H Yu, Drexel University, USA; G Thompson, University of Alabama, USA

09:30 – 10:00 **Invited:** *Theoretical prediction on room and high temperature mechanical and thermal properties of the matrix and interphase materials for future UHTCf/UHTC composites*
Yanchun Zhou, H Xang & F-Z Dai, Aerospace Research Institute of Materials and Processing Technology, China

10:00 – 10:20 *In-situ phase diagram determination of the HfO_2-Ta_2O_5 binary up to 3000˚C*
Scott J. McCormack & WM Kriven, University of Illinois at Urbana-Champaign, USA; R Weber, Materials Development, Inc., Arlington Heights, USA; D Kapush & A Navrotsky, University of California at Davis, USA

10:20 – 10:40 *Recent advances in study of high-temperature behavior of non-stoichiometric TaC_X, HfC_X and ZrC_X in the domain of their congruent melting point*
Mikhail Sheindlin, T Falyahov, A Frolov, S Petukhov & A Vasin, Joint Institute for High Temperatures of RAS, Moscow, Russia

10:40 – 11:10 *Effect of electronic structure on phase equilibria in the AlB_2-ScB_2-YB_2-ZrB_2-HfB_2-NbB_2-TaB_2 system*
Mark Opeka & J Zaykoski, Naval Surface Warfare Center, W. Bethesda, USA

11:10 – 11.40 Coffee break (Bar area)

Session V: Posters

11:40 – 15:00 Poster session (including buffet lunch served in the Tapestry Room) (Drawing Room)

Session VI: Next generation ceramic composites for combustion harsh environments and space (C3HARME) – A European-funded (H2020) research programme
Session Chair: Diletta Sciti & Thomas Reimer

15:00 – 15:30 **Invited:** *Introduction to H2020 project C3HARME: Next generation ceramic composites for combustion harsh environments and space*
Diletta Sciti, L Silvestroni, F Monteverde, A Vinci & L Zoli, Institute of Science and Technology for Ceramics, Italy

Tuesday, 19 September 2017 (continued)

15:30 – 16:00 **Invited:** *Processing of UHTCMCs*
Jon Binner & V Rubio, University of Birmingham, UK; D Sciti, L Silvestroni, F Monteverde, A Vinci & L Zoli, Institute of Science and Technology for Ceramics, Faenza, Italy; M Parco, Technalia, San Sebastian, Spain; T Reimer, D Koch, DLR, Stuttgart, Germany; A Schoberth & Sebastian Heilmeyer, Airbus Group Innovation, Munich, Germany; S Sanvito & Y Zhang, Trinity College Dublin, Ireland

16:00 – 16:30 **Invited:** *Testing approach to new fibre-reinforced UHTC materials in the C3HARME project*
Thomas Reimer, M Kuetemeyer & N Jain, DLR, Germany; L Silvestroni, F Monteverde & L Zoli, Institute of Science and Technology for Ceramics, Faenza, Italy; J Binner & V Rubio, University of Birmingham, UK; RA Savino, S Mungiguerra & GD Di Martino, University of Naples, Italy

16:30 – 16:50 *Influence of SiC on the oxidation resistance of carbon fibre reinforced UHTCMCs*
Antonio Vinci, D Sciti, & L Zoli, Institute of Science and Technology for Ceramics, Italy

16:50 – 17:10 *Melt modification for manufacturing of UHTCMC by reactive melt infiltration*
Marius Kütemeyer, DLR, Stuttgart, Germany

17:10 – 17:30 *Synthesis and characterization of group IV and V metal diboride nanocrystals via borothermal reduction of metal oxide with $NaBH_4$*
Luca Zoli, L Silvestroni, P Pinasco & D Sciti, Institute of Science and Technology for Ceramics, Italy

18:00 – 19:00 Dinner

19:00 – Exploring Windsor (and its pubs)

Wednesday, 20 September 2017

07:30 – 08:30 Breakfast (Dining Room)

Session VII: High Entropy Ceramics **Session Chair: Elizabeth Opila & Eric Wuchina**

08:30 – 09:00 **Invited:** *Science of entropy-stabilized ultra-high temperature materials: synthesis, validation and properties*
Elizabeth Opila & P Hopkins, University of Virginia, USA; D Brenner & J-P Maria, North Carolina State University, USA; S Curtarolo, Duke University, USA; K Vecchio & J Luo, University of California at San Diego, USA

09:00 – 09:30 **Invited:** *Science of entropy-stabilized ultra-high temperature materials: predictive and multi-physics modelling*
Don Brenner & J-P Maria, North Carolina State University, USA; E Opila & P Hopkins, University of Virginia, USA; S Curtarolo, Duke University, USA; K Vecchio & J Luo, University of California at San Diego, USA

09:30 – 09:50 *Modelling and synthesis of high-entropy refractory carbides, nitrides and carbonitrides*
Kenneth Vecchio, TJ Harrington, OF Dippo, M Samiee, J Gild & J Luo, University of California at San Diego, USA; P Sarke, C Toher & S Curtarolo, Duke University, USA

09:50 – 10.10 *First principles computational descriptor for entropy forming ability*
Stefano Curtarolo, P Sarker & C Toher, Duke University, USA; TJ Harrington & KS Vecchio, University of California at San Diego, USA; J-P Maria & D Brenner, North Carolina State University, USA

10:10 – 10.30 M*easurements and simulations of the phonon thermal conductivity of entropy stabilized alloys*
Patrick Hopkins, A Giri, J Braun, C Rost & L Backman, University of Virginia, USA; M Lim, Z Rack, S Daigle, K Ferri, T Borman, J-P Maria, D Brenner, North Carolina State University, USA; J Gild, T Harrington, J Luo & K Vecchio, University of California at San Diego, USA; C Toher, P Sarker & S Curtarolo, Duke University, USA; E Opila, University of Virginia, USA

10:30 – 11.00 Coffee break (Bar area)

11:00 – 11:20 *High-entropy metal diborides: a new class of ultra-high temperature ceramics*
Jian Luo, J Gild, T Harrington, Y Zhang, T Hao & K Vecchio, University of California at San Diego, USA; C Toher, P Sarker & S Curtarolo, Duke University, USA; J Braun, L Backman, E Opila & P Hopkins, University of Virginia, USA; S Daigle, J-P Maria, D Brenner, North Carolina State University, USA

11:20 – 11:40 *Science of entropy-stabilized ultra-high temperature thin films: Synthesis, validation and properties*
Jon-Paul Maria, T Borman & D Brenner, North Carolina State University, USA; E Oplia, P Hopkins & T Rost, University of Virginia, USA; K Vecchio & T Harrington, University of California at San Diego, USA; C Toher & S Curtarolo, Duke University, USA

11:40 – 12:00 *High entropy transition metal carbides*
Elinor Castle, S Grasso & M Reece, Queen Mary University of London, UK; T Csanadi & J Dusza, Institute of Materials Research, Slovak Academy of Sciences, Slovakia

Wednesday, 20 September 2017 (continued)

12:20 – 13:20 Lunch (Dining Room)

Session VIII: UHTC Properties & Performance Session Chairs: Bill Fahrenholtz & Greg Hilmas

13:20 – 13:50 **Invited:** *Thermomechanical deformation behavior and mechanisms in transition metal carbides*
Greg Thompson, M Ross, CJ Smith & N de Leon, University of Alabama, USA and CR Weinberger, Colorado State University, USA

13:50 – 14:10 *Slip activation controlled nanohardness anisotropy of ZrB_2 grains*
Tamás Csanádi & J Dusza, Institute of Materials Research, Slovak Academy of Sciences, Slovak Republic; WG Fahrenholtz & GE Hilmas, Missouri University of Science and Technology, USA

14:10 – 14:30 *Mechanical properties of zirconium diboride ceramics*
Gregory E Hilmas & WG Fahrenholtz, Missouri University of Science and Technology, USA

14:30 – 14:50 *Thermal properties of zirconium diboride ceramics*
William G. Fahrenholtz & GE Hilmas, Missouri University of Science and Technology, USA

14:50 – 15:10 *Protection against oxidation, by CVD or SPS coatings of hafnium carbide and silicon carbide, on carbon/carbon composites*
Alexandre Allemand, CEA, Monts, France; C Verdon, O Szwedek, Y Le Petitcorps & S Jacques, Université de Bordeaux, France

15:10 – 15:30 *Oxidation of UC: an in-situ high temperature environmental scanning electron microscopy study*
Claudia Gasparrini, MJD Rushton, WE Lee, Imperial College London UK; R Podor, Institut de Chimie Séparative de Marcoule, France; D Horlait, CNRS/IN2P3 and University of Bordeaux, France; O Fiquet, Commissariat à l'Energie Atomique, Cadarache, France

15:30 – 15:40 Concluding Remarks: Conference Chairs & ECI Technical Liaison

15:40 Finish and depart

List of Posters

1. *Hafnium iridide as a component of materials for extreme applications*
   Natalya I Baklanova & VV Lozanov, Institute of Solid State Chemistry and Mechanochemistry, Novosibirsk, Russia [O04]

2.

3. *Effects of transition metals on thermal properties of ZrB_2*
   Austin D Stanfield, WG Fahrenholtz & Greg E Hilmas, Missouri University of Science and Technology, USA [P01]

4. *Oxidation resistance of multi-component carbide and boride UHTCS*
   Lavina Backman & E Opila, University of Virginia, USA; J Gild, T Harrington, K Vecchio & J Luo, University of California at San Diego, USA [P05]

5. *Mechanical properties of borothermally synthesized ZrB_2*
   Alec C Murchie, GE Hilmas & WG Fahrenholtz, Missouri University of Science and Technology, USA [P08]

6. *Tailoring hardness and deformation slip mechanisms in Hf-Ta-C*
   Chase J Smith, X-X Yu, Q Guo & GB Thompson, University of Alabama, USA; CR Weinberger, Colorado State University, USA [O14]

7. *Exploring new approaches and applications for multi-scale porous UHTCS*
   Carolina Tallon, D Hicks, Virginia Polytechnic Institute and State University, United States; C Minas, ETH, Zurich, Switzerland; L Jukes & GV Franks, The University of Melbourne, Australia [P14]

8. *Characterization of the sintering process of carbide and nitride ceramics using advanced thermal analysis methods*
   Juergen Blumm, NETZSCH-Geraetebau GmbH, Germany

9. *Characterizing novel transducers for high temperature thermal measurements using time domain thermoreflectance*
   Christina M Rost, L Backman, E Opila & PE Hopkins, University of Virginia, USA; K Ferri, C Dawes, T Borman, J-P Maria, North Carolina State University, USA [P12]

10. *AP-CVD ZrB_2 process development for discrete and duplex UHTC coatings*
    Hollie Heard, Archer Technicoat Ltd, High Wycombe, UK [P03]

11. *Preparation, oxidation and ablation resistance of IrAl intermetallic coating*
    Li'an Zhu, S Bai, Y Ye & H Zhang, National University of Defense Technology, Changsha, China [O39]

12. *Novel Ir-X thermal protection coatings designed for extreme aerodynamic heating environment*
    Kaili Zhang, S Bai, L Zhu & Y Ye, National University of Defense Technology, Changsha, China [P09]

13. *Fabrication of high-entropy nitrides and carbonitrides*
    Olivia F Dippo, TJ Harrington, E Marin, WM Mellor, MC Quinn, KS Vecchio, University of California at San Diego, USA; P Sarker, C Toher & S Curtarolo, Duke University, USA [P02]

14. *Modelling and synthesis of high-entropy refractory carbides*
    Tyler J Harrington, OF Dippo, M Samiee, J Gild, J Luo & KS Vecchio, University of California at San Diego, USA; P Sarker, CToher & S Curtarolo, Duke University, USA [P04]

15. *Synthesis of high entropy metal diborides*
    Joshua Gild, T Harrington, Y Zhang, T Hu, K Vecchio & J Luo, University of California at San Diego, USA [P06]

16. *Influence of chemical disorder on atomic structure in high-entropy diborides*
    Samuel Daigle & D Brenner, North Carolina State University, USA; J Gild & J Luo, University of California at San Diego, USA; L Backman & E Opila, University of Virginia, USA [P10]

17. *Influence of mass and charge disorder on the phonon thermal conductivity of some high entropy ceramics by molecular dynamics simulation*
    Mina Lim, Z Rak, S Daigle & D Brenner, North Carolina State University, USA; A Giri, J Braun, C Rost & P Hopkins, University of Virginia, USA [P11]

18. *Science of high entropy ultra-high temperature thin films: synthesis and characterization*
    Trent Borman, J-P Maria & D Brenner, North Carolina State University, USA; E Opila, L Backman, P Hopkins & C Rost, The University of Virginia, USA; K Vecchio & T Harrington, The University of California at San Diego, USA; C Toher & S Curtarolo, Duke University, USA [P13]

19. *Hyperbaric pressure – laser assisted chemical vapor deposition of ceramic Si-based fibers*
    Katherine Vinson & GB Thompson, University of Alabama, USA; J Maxwell, R Hooper & J Allen, Dynetics Inc., Huntsville, USA [O18]

20. *Study of the pyrolysis mechanism of SiBCN polymer precursor*
    Yifen Xu, J Hu & Z Feng, Aerospace Research Institute of Materials & Processing Technology, Beijing, China [P07]

21.

22. *Plasma wind tunnel characterization of plasma-sprayed UHTC coatings*
    Mario De Stefano Fumo, Centrol Italiano Aerospaziali (CIRA)

23. *Characterization of the thermal properties of entropy stabilized oxides and high entropy diborides*
    Jeff Braun, C Rost, A Giri & P Hopkins, University of Virginia, USA; J Gild & J Luo, University of California, San Diego, USA; M Lim, J-P Maria & D Brenner, North Carolina State University, USA