

Preliminary Program

(March 14, 2024)

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

**April 14 – 19, 2024
Giardini Naxos, Messina
Sicily, Italy**

Conference Chairs:

Diletta Sciti
CNR-ISSMC, Italy

Laura Silvestroni
CNR-ISSMC, Italy

Frédéric Monteverde
CNR-ISSMC, Italy

Conference Co-Chairs:

Jon Binner
Birmingham University, UK

Raffaele Savino
University of Naples Federico II, Italy

Gregory Thompson
University of Alabama, USA

Eric Wuchina
Naval Surface Warfare Center, USA



Engineering Conferences International

369 Lexington Avenue, 3rd Floor #389

New York, NY 10017, USA

www.engconfintl.org – info@engconfintl.org

Sunday, April 14, 2024

16:00 Conference Check-in, Welcome reception

19:00 – 21:00 Dinner and Networking

Monday, April 15, 2024

- 07:00 – 08:00 Breakfast buffet and registration
- 08:00 – 08:05 Introduction, communications
- 08:05 – 08:55 **Keynote**
The technological challenges for the preparation of the future of space transportation in Europe
Giorgio Tumino, European Space Agency, France
- Session 1: Fundamental properties of UHTCs, UHTCMCs and HE ceramics – I**
- 08:55 – 09:20 **Invited**
Synthesis, densification, and transition metal distribution in dual phase, compositionally complex Ultra-High Temperature Ceramics
William Fahrenholtz, Missouri University of Science and Technology, USA
- 09:20 – 09:40 **Melting temperature and mechanical properties of tantalum carbonitrides Ta₂CxNy**
Jérémie Manaud, European Commission / Joint Research Centre, Germany
- 09:40 – 10:00 **Emissivity and melting temperature of dual-phase high-entropy boride-carbide Ultra-High Temperature Ceramics**
Patrick Hopkins, University of Virginia, USA
- 10:00 – 10:30 Coffee Break
- Session 2: Processing, synthesis of new compounds and novel methods, and scale-up issues – I**
- 10:30 – 10:55 **Invited**
Synthesis of Ultrahigh Temperature materials using UHS and USP
Ji-Cheng Zhao, University of Maryland, USA
- 10:55 – 11:15 **Pre-ceramic polymer grafted nanoparticles as a route to Ultra-High Temperature Ceramics**
Matthew Dickerson, US Air Force Research Laboratory, USA
- 11:15 – 11:35 **Thermal and chemical stability of entropy stabilised ultra-high temperature carbides**
Christopher Butler, Imperial College London, United Kingdom
- 11:35 – 12:00 **Invited**
Fabrication and characterization of binary to quinary transition metal diborides
Roberto Orru', University of Cagliari, Italy
- 12:00 – 12:15 Discussion
- 12:15 – 13:30 Lunch

Monday, April 15, 2024 (continued)

Session 3: Environmental Response I

- 13:30 – 13:55 **Invited**
Twenty years of plasma wind tunnel testing on Ultra High Temperature Ceramics in Italy
Mario De Stefano Fumo, Italian Aerospace Research Centre, Italy
- 13:55 – 14:15 **Thermochemical instabilities at high temperature ceramic surfaces**
Francesco Panerai, University of Illinois at Urbana-Champaign, USA
- 14:15 – 14:35 **Substoichiometric zirconium carbide exposed to inductively coupled air plasma**
Matthew Konnik, University of Illinois at Urbana-Champaign, USA
- 14:35 – 14:55 **Behavior of borides and carbides obtained by plasma spraying under simulated atmospheric re-entry condition**
Arthur Charrue, CEA-DAM, France
- 14:55 – 15:15 **Natural advanced ceramics: shock-generated structures with superior physical properties**
John Spray, University of New Brunswick, Canada
- 15:15 – 15:35 **TBD**
- 15:35 – 16:00 Afternoon Coffee Break

Session 4: Characterization and Properties I

- 16:30 – 16:55 **Invited**
High-fidelity 3D microstructural characterization of ZrB₂ during hot-pressing
Scott McCormack, University of California, Davis, USA
- 16:55 – 17:15 **3D printing of several technologies in one: A new approach to shape technical ceramics**
Arnaud Roux, 3DCeram Sinto, France
- 17:15 – 17:35 **Multi-scale characterization and fabrication of nanocomposite ceramics with improved toughness**
Marco Sebastiani, Università degli Studi Roma Tre, Italy
- 17:35 – 17:55 **Influence of GdO coatings on the oxidation behavior of Zirconium Diboride**
Jan Erik Foerster, German Aerospace Center, Germany
- 17:55 – 18:15 Discussion
- 18:30 – 19:00 Hang posters
- 19:15 – 21:00 Dinner
- 21:00 – 22:00 **Poster Session I (odd-numbered posters)**

Tuesday, April 16, 2024

- 07:00 – 08:00 Breakfast Buffet
- Session 5: Fundamental properties of UHTCs, UHTCMCs and HE ceramics II**
- 08:00 – 08:10 Introduction, communications
- 08:10 – 08:35 **Invited**
Hierarchical titanium carbide fiber growth by laser chemical vapor deposition
Gregory Thompson, University of Alabama, USA
- 08:35 – 08:55 **Novel contactless measurement technique to determine the thermal conductivity and spectral emissivity of UHTCs at Ultra-High Temperatures (>2000 °C)**
Hunter Schonfeld, University of Virginia, USA
- 08:55 – 09:15 **Revealing atomic scale structure in chemically complex ceramics**
Nicholas Bedford, University of New South Wales, Australia
- 09:15 – 09:40 **Invited**
Unrevealing hardening and strengthening mechanisms in high-entropy ceramics from lattice distortion
Yanhui Chu, South China University of Technology, China
- 09:40 – 10:00 **Nanoindentation-based indicators for crystal plasticity of rock salt carbides**
Tamás Csanádi, Institute of Materials Research, Slovak Academy of Sciences, Slovakia
- 10:00 – 10:30 **Coffee Break**
- Session 6: Processing, synthesis of new compounds and novel methods, and scale-up issues II**
- 10:30 – 10:55 **Invited**
Synthesis, constituents, and processing technologies for UHTCMCs
Michael Cinibulk, AFRL, USA
- 10:55 – 11:15 **Polymer-derived ceramics for Ultra-High Temperature aerospace applications: Are they a viable option?**
Elia Zancan, University of Birmingham, United Kingdom
- 11:15 – 11:35 **Breaking the brittleness barrier: Advancements in tough and versatile polymer-derived ceramic structures through Lcd 3d printing and pyrolysis**
Hamidreza Yazdani Sarvestani, National Research Council Canada, Canada
- 11:35 – 11:55 **Liquid phase sintering of C fiber reinforced Ultra-High Temperature Ceramics Composites**
Luca Zoli, CNR-ISSMC, Italy
- 11:55 – 12:15 Discussion
- 12:15 – 13:30 Lunch

Tuesday, April 16, 2024 (continued)

Session 7: Characterization and Properties II

- 14:00 – 14:25 **Invited**
The role of carbon in oxidation of refractory metal carbides
Elizabeth Opila, University of Virginia, USA
- 14:25 – 14:45 **Testing compositionally complex diboride ceramics up to 2500 K in dissociated air plasma**
Frederic Monteverde, CNR-ISSMC, Italy
- 14:45 – 15:05 **UHTC high temperature characterizations using CO₂ laser beam**
Aurélie Julian-Jankowiak, DMAS, ONERA, Université Paris-Saclay, France
- 15:05 – 15:25 **High Temperature oxidation of Ta and TaC in molecular and dissociated oxygen**
Connor Stephens, University of Virginia, USA
- 15:25 – 15:45 **Oxidation mechanisms of multicomponent carbide ceramics**
Ke Ren, Beijing Institute of Technology, China
- 15:45 – 16:15 Afternoon Coffee Break

Session 8: Environmental Response II

- 16:15 – 16:40 **Invited**
Nb-based coatings to improve the oxidation resistance of UHTCMCs at 1700°C
Antonio Vinci, ISSMC - CNR, Italy
- 16:40 – 17:00 **Impact of arc-jet tests at 2200°C and thermal vacuum cycles on microstructure and mechanical behaviour of Cf-ZrB₂ UHTCMCs**
Pietro Galizia, CNR-ISSMC, Italy
- 17:00 – 17:20 **Modelling of residual deformations, failure and delaminations in SPS ZrB₂/SiC UHTCMC in complex stress states**
Antonio Maria Caporale, Politecnico di Milano, Italy
- 17:20 – 17:40 **Influence of diamond grinding process on material removal mechanisms and surface roughness of 2d-Carbon Fiber Reinforced ZrB₂**
Ralf Goller, Technical University of Applied Sciences Augsburg, Germany
- 17:40 – 18:00 Discussion
- 18:30 – 19:30 **Poster Session 2 (Even-numbered posters)**
- 19:30 – 21:30 Dinner

Wednesday, April 17, 2024

07:00 – 08:00	Breakfast Buffet
	Session 9: Modelling I
08:00 – 08:10	Introduction, communications
08:10 – 08:35	<u>Invited</u> Disordered enthalpy-entropy descriptor for high-entropy ceramics discovery Stefano Curtarolo, Duke University, USA
08:35 – 08:55	Research on the formation law of Ultra-High Temperature High-Entropy Ceramics based on machine learning Lian Zhu, National University of Defense Technology, China
08:55 – 09:20	<u>Invited</u> Point defects and their influence on the thermodynamics and kinetics of UHTC materials Christopher Weinberger, Colorado State University, USA
09:20 – 09:40	Phase stability in high-entropy transition metal carbides MC_{1-x} (0.5 ≤ x ≤ 1) Tessa Davey, Bangor University, United Kingdom
09:40 – 10:05	<u>Invited</u> Modeling oxidation kinetics of silicon carbide-containing refractory diborides Pavel Mogilevsky, Air Force Research Laboratory, USA
10:05 – 10:30	Coffee Break
	Session 10: Processing, synthesis of new compounds and novel methods, and scale-up issues III
10:30 – 10:55	<u>Invited</u> Fabrication and characterization of UHTC materials Sea Hoon Lee, Korea Institute of Materials Science, South Korea
10:55 – 11:15	Analysis of mechanical properties and oxidation resistance of zirconium diboride with chopped carbon fibers made via material extrusion Jonathan Kaufman, UES Inc, USA
11:15 – 11:35	ZrB₂ based UHTCMCs: Processing and characterization Manish Patel, Defence Metallurgical Research Laboratory, India
11:35 – 11:55	Development of sustainable UHT Ceramic Matrix Composites Dietmar Koch, University of Augsburg, Germany
11:55 – 12:15	Discussion
12:15 – 12:30	Box Lunch
13:15	Excursion with Dinner

Thursday, April 18, 2024

- 07:00 – 08:00 Breakfast Buffet
- Session 11: Characterization and Properties III**
- 08:00 – 08:10 Introduction, communications
- 08:10 – 08:35 **Invited**
Short and long-range order in compositionally complex transition metal diborides
Mattia Gaboardi, Materials Physics Center, Spain
- 08:35 – 08:55 **Microstructural evaluation and mechanical properties of high-entropy (TiZrHfNbTa)C carbides reinforced with SiC whiskers**
Alexandra Kovalčíková, Institute of Materials Research Slovak Academy of Sciences, Slovakia
- 08:55 – 09:15 **Environmental conical nozzle levitator equipped with dual lasers**
Fox Thorpe, University of California, Davis, USA
- 09:15 – 09:35 **Uncovering atomic-scale polymer-to-ceramic transformations in SiC and SiOC polymer derived ceramics made from polycarbosilanes and polysiloxanes precursors**
Haira Hackbarth, University of New South Wales, Australia
- 09:35 – 09:55 **Near-net shape manufacturing of UHTCMCs via water-based slurry impregnation and polymer infiltration and pyrolysis**
Francesca Servadei, CNR-ISSMC, Italy
- 09:55 – 10:30 Coffee Break
- Session 12: Characterization and Properties IV**
- 10:30 – 10:55 **Invited**
Oxidation behavior of high entropy carbides and carbonitrides
Lavina Backman, US Naval Research Laboratory, USA
- 10:55 – 11:15 **Thermomechanical and electrical characterization of high-energy-milled TiB₂ pressure-less sintered**
Simone Taraborelli, Industrie Bitossi, Italy
- 11:15 – 11:35 **Multi-phase solid solutions: Microstructure, mechanical properties and oxidation behavior**
Laura Silvestroni, National Research Council of Italy, Italy
- 11:35 – 11:55 **Mechanical and oxidation behaviour of multi-component dual-phase (Ti,Zr,Ta) boride-carbide based Ultra High Temperature Ceramic**
Kunwar Yadav, Indian Institute of Technology Kanpur, India
- 11:55 – 12:15 Discussion
- 12:15 – 13:30 Lunch

Thursday, April 18, 2024 (continued)

Session 13: Environmental response III

- 14:00 – 14:25 **Invited**
Aerothermodynamic testing of Multi-Phase Ultra-High-Temperature Ceramics in a super/hypersonic plasma wind tunnel
Stefano Mungiguerra, University of Naples Federico II, Italy
- 14:25 – 14:55 **Performance selection of (Hf, Zr) B2-based Ultra-High Temperature Ceramic Matrix Composites**
Vinothini Venkatachalam, University of Birmingham, United Kingdom
- 14:55 – 15:15 **Plasma wind tunnel test of UHTCMC leading edge prototypes in hypersonic conditions**
Diletta Sciti, CNR-ISSMC, Italy
- 15:15 – 15:25 **Metal-ceramic composites for extreme high temperature applications: Ir/HfO₂ thermal protection coating**
Fayuan Li, National University of Defense Technology, China
- 15:25 – 16:00 Afternoon Coffee Break
- Session 14: Environmental response IV**
- 16:00 – 16:25 **Invited**
Oxidation of composites at around 2000°C under an oxyacetylene torch environment inside a X-ray tomography equipment
Laurence Maillé, LCTS, France
- 16:25 – 16:45 **Oxidation kinetics and in-situ emittance measurements to 2200°C of ZrB₂ solid-solution-based ceramics**
Mark Opeka, Kratos SRE, USA
- 16:45 – 17:05 **Ablation behavior of C/SiC composites in plasma wind tunnel**
Yiguang Wang, Beijing Institute of Technology, China
- 17:05 – 17:25 **A Tekna PlasmoSonic High Enthalpy Wind Tunnel to reproduce hypersonic flight and spacecraft re-entry conditions ablation behavior of C/SiC composites in plasma wind tunnel**
Romain Vert,
- 17:25 – 17:45 Discussion
- 20:00 – 22:30 Gala Dinner

Friday, April 19, 2024

07:00 – 08:00	Breakfast
08:00 – 08:10	Communications
	Session 15: Applications I
08:10 – 08:35	<u>Invited</u> Ultrahigh Temperature fuel forms for nuclear thermal propulsion Gregory Hilmas, Missouri University of Science and Technology, USA
08:35 – 09:00	<u>Invited</u> High-temperature absorbers of concentrated solar radiation: A new application for Ultra-High Temperature Ceramics Elisa Sani, National Institute of Optics, CNR-INO, Italy
09:00 – 09:20	Irradiation resistance of thermo-optical properties of Zirconium Diboride by 3MeV electrons Yinglu Tang, Delft University of Technology, Netherlands
09:20 – 09:40	Design of transforming UHTC metal ceramic multilayer composites John Stotts, Colorado State University, USA
09:40 – 10:00	Fabrication of Ultra-High Temperature Ceramics Matrix Composites by slip casting followed by pressure less sintering Matteo Mor, CNR-ISSMC, Italy
10:00 – 10:20	FAST/SPS: NEW industrial post-process for full densification of 3D UHTC from additive manufacturing Arnaud Fregeac, NORIMAT, France
10:20 – 11:00	Coffee Break
11:00 – 12:00	Special Session: European Ceramic Society Presentation Jon Binner, Birmingham University, United Kingdom
	Poster and Best oral winner Awards
	CONFERENCE SUMMARY AND ECI UHTC VII PLANNING
12:00	Lunch and Departure

Poster Presentations

1. **Synthesis and physical properties of super hard high entropy boride ceramics**
Suzana Filipovic, ITN SANU, USA
2. **Processing and properties of boride-silicon carbide-boron carbide ceramics**
Steven Smith, Missouri University of Science and Technology, USA
3. **A novel rapid and cost-effective preparation strategy for high-entropy ceramic composites: High-entropy alloy in-situ reactive melt infiltration**
Wenjian Guo, National University of Defense Technology, China
4. **Spark plasma sintered zirconium carbide oxidation mechanisms under different temperatures and oxygen partial pressures**
Yun-Ching Lin, Delft University of Technology, Netherlands
5. **Characterization of (Zr,Ti)B₂-SiC composites obtained by hot press sintering of ZrB₂-SiC-TiO₂ powder mixtures**
Rosa Maria da Rocha, Institute of Aeronautics and Space, Brazil
6. **Synthesis of Ultra High Temperature Ceramics by Spark Plasma Sintering: Non-reactive and reactive routes**
Laurence Maillé, LCTS, France
7. **Improvement of prepreg fabrication process for UHTCMCs**
Kiichi Nishiguchi, Mitsubishi Heavy Industries, Ltd., Japan
8. **Sustainable additive manufacturing of ZrB₂ with recycled carbon fiber**
Jyoti Jyoti, CNR-ISSMC, Italy
9. **Milling time impact on the physical properties of Ta₂O₅ nanoparticles**
Robinson Cruz, Federal University of Santa Catarina, Brazil
10. **Densification and mechanical property evaluation of TiB₂-B₄C ceramic composites using various sintering techniques**
Simone Failla, CNR-ISSMC, Italy
11. **Influence of metal type on the hardness of transition metal carbide films**
Gregory Thompson, University of Alabama, USA
12. **Aqueous tape casting of ZrB₂-SiC and ZrB₂-MoSi₂ laminates produced with low binder concentration**
Rosa Maria Rocha, Institute of Aeronautics and Space, Brazil
13. **Vulcain set-up: Assessment of material behavior under plasma jet**
Aurélie Quet, CEA-DAM, France
14. **Synthesis of titanium carbide nanofibers**
Ivan Shepa, Institute of Materials Research, Slovak Academy of Sciences, Slovakia
15. **Synthesis of HfZrTi(OCN) entropically stabilized UHTCs**
Evan Schwind, Naval Surface Warfare Center, Carderock Division, USA
16. **Thermal erosion test of ZrB₂-based ceramics**
Dariia Chernomorets, CNR-ISSMC, Italy

17. **Ablation resistance of titanium diborate based composites derived from Ti-Si or Ti-Al intermetallic systems**
Zbigniew Pedzich, AGH University of Krakow, Poland
18. **Reactive sintering of dense borides-based composites derived from boron carbide and Ti-Si intermetallic system**
Dawid Koziem, AGH University of Krakow, Poland
19. **MXene high-temperature phase behavior and application as additives in Ultra-High Temperature Ceramics (UHTCs)**
Laura Silvestroni, CNR-ISSMC, Italy
20. **Synthesis and properties of Ultra-High Temperature ceramics nanocomposites**
Ian McCue, Northwestern University, USA
21. **Microstructures, phase and mechanical characterization of Al₂O₃-ZrO₂-TiO₂ coating produced by atmospheric plasma spray**
Cynthia Sin Ting Chang, ANAXAM, Switzerland
22. **Phase equilibrium investigations and thermodynamic modelling of the Y₂O₃ Ta₂O₅ system**
Manuel Löffler, TU Bergakademie Freiberg, Germany
23. **Synthesis and Calorimetry of High-Purity Multicomponent Carbides**
William Rosenberg, UC Davis, USA
24. **Advancing fusion energy: Exploring IV-B group transition metals Borides as promising plasma-facing materials**
Pietro Galizia, CNR-ISSMC, Italy
25. **ZrB₂-SiC ceramics toughened with paper-derived graphite for a sustainable approach**
Luca Zoli, CNR-ISSMC, Italy
26. **Interactions between EBCs and CMAS: A thermodynamic approach**
Michel Vilasi, University of Lorraine, France
27. **Spark Plasma Sintering and Characterization of (Zr_{0.5}Ta_{0.5})B₂ and (Zr_{0.5}Hf_{0.5})B₂ Ultra High Temperature Ceramics**
Mariano Casu, University of Cagliari, Italy
28. **Development of processable polymer derived Ultra-High Temperature Ceramics and composites**
Timothy Pruyn, US Air Force Research Laboratory, USA