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
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Conference Co-Chairs:
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Birmingham University, UK
Raffaele Savino
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<td>16:00</td>
<td>Conference Check-in, Welcome reception</td>
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<td>19:00 – 21:00</td>
<td>Dinner and Networking</td>
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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  

*Preceramic 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
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  **Invited**

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  **Invited**

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 MC1-x (0.5≤x≤1)**
Tessa Davey, Bangor University, United Kingdom

09:40 – 10:05  **Invited**

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  **Invited**

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  **Invited**

_Ultrahigh Temperature fuel forms for nuclear thermal propulsion_  
Gregory Hilmas, Missouri University of Science and Technology, USA

08:35 – 09:00  **Invited**

_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 Kozien, 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 (Zr0.5Ta0.5)B2 and (Zr0.5Hf0.5)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