

Symposium 10: Ceramics and Composites for Advanced Nuclear Energy and Hazardous Waste Treatment Applications

Incorporating the 9th International Workshop on SiC/SiC Ceramic Composites for Fusion Energy Applications and the 3rd International Workshop on Carbon and Silicon Carbide Composites for Advanced Fission.

Supported by Division of Materials Science and Technology, Atomic Energy Society of Japan.

Main Organizers

- Tatsuya Hinoki, Kyoto University, Japan
- Yutai Katoh, Oak Ridge National Laboratory, USA
- Alex Cozzi, Savannah River National Laboratory, USA

Co-Organizers

- Aldo R. Boccaccini, Imperial College London, United Kingdom
- Shaoming Dong, Shanghai Institute of Ceramics, China
- Monica Ferraris, Politecnico di Torino, Italy
- Hans Hegeman, NRG Petten, The Netherlands
- Fumihisa Kano, Toshiba Corporation, Japan
- Akira Kohyama, Muroran Institute of Technology, Japan
- Jacques Lamon, University of Bordeaux, France
- Charles Lewinsohn, Ceramtec, Inc., USA
- Ji Yeon Park, Korea Atomic Energy Research Institute, Korea
- Kazuhiro Sawa, Japan Atomic Energy Agency, Japan
- Lance Snead, Oak Ridge National Laboratory, USA
- Yoshikazu Suzuki, Kyoto University, Japan
- Takashi Takagi, Ibiden Co., Ltd., Japan
- Toyohiko Yano, Tokyo Institute of Technology, Japan

Oral Session

Monday, November 15

Room: 1001

14:15 - 15:45: Overview for SiC/SiC Composites R&D

Chairs: Tatsuya Hinoki (Kyoto University, Japan) and Lance L. Snead (Oak Ridge National Laboratory, USA)

14:15 - 14:45

S10-001 The Present Status of SiC/SiC R & D for Nuclear Application in Japan (Invited)

A. Kohyama; Muroran Institute of Technology, Japan

14:45 - 15:15

S10-002 EU Overview of SiC/SiC Developments (Invited)

S. M. G. de Vicente¹, E. Diegele², N. Baluc³; ¹EFDA CSU-Garching, Germany, ²F4E, Spain, ³CRPP-EPFL, Switzerland

15:15 - 15:45

S10-003 Silicon Carbide Composite Research and Development in U.S. Fusion Programs: Status and Recent Achievement

Y. Katoh¹, L. L. Snead¹, K. Ozawa¹, C. H. Henager², S. Sharafat³, R. J. Shinavski⁴, M. E. Sawan⁵; ¹Oak Ridge National Laboratory, USA, ²Pacific Northwest National Laboratory, USA, ³University of California, Los Angeles, USA, ⁴Hypertherm High-Temperature Composites, Inc., USA, ⁵University of Wisconsin-Madison, USA

15:45 - 16:00 Break

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16:00 - 18:00: Radiation Effect

Chairs: Yutai Katoh (Oak Ridge National Laboratory, USA) and Toyohiko Yano (Tokyo Institute of Technology, Japan)

16:00 - 16:30

S10-004 New Method to Quantifying the Helium Bubbles in SiC/SiC Composites Irradiated under Simulated Fusion Reactor Conditions (Invited)

J.-J. Kai; National Tsing Hua University, Taiwan

16:30 - 16:45

S10-005 Stability and Properties of SiC and its Composites at High Neutron Fluence

L. L. Snead¹, Y. Katoh¹, K. Ozawa¹, T. Nozawa²; ¹Oak Ridge National Laboratory, USA, ²Japan Atomic Energy Agency, Japan

16:45 - 17:00

S10-006 Irradiation Effect on Mechanical Properties of NITE-SiC/SiC Composites

T. Hinoki¹, K. Ozawa², K. Toyoshima¹, Y.-B. Choi³, Y. Katoh², T. Koyanagi¹, S. Kondo¹, A. Kohyama⁴, A. Hasegawa⁵; ¹Kyoto University, Japan, ²Oak Ridge National Laboratory, USA, ³Hiroshima University, Japan, ⁴Muroran Institute of Technology, Japan, ⁵Tohoku University, Japan

17:00 - 17:15

S10-007 Evaluation of Fracture Resistance of Advanced SiC/SiC Composites after Neutron Irradiation

K. Ozawa¹, Y. Katoh¹, T. Nozawa², T. Hinoki³, L. L. Snead¹; ¹Oak Ridge National Laboratory, USA, ²JAEA, Japan, ³Kyoto University, Japan

17:15 - 17:30

S10-008 Dimensional Stability of SiC Irradiated under Applied Stress

S. Kondo, T. Koyanagi, T. Hinoki; ¹Kyoto University, Japan

17:30 - 17:45

S10-009 Ion-Irradiation Effect on Microstructural Evolutions and High-Temperature Behaviours of Advanced SiC Fibers

K. Shimoda¹, C. Colin¹, H. Kishimoto², S. Doriot¹, L. Chaffron¹; ¹Commissariat à l'Énergie Atomique de Saclay, France, ²Muroran Institute Technology, Japan

17:45 - 18:00

S10-010 A First Principles Study of Frenkel Pairs Recombinations in Silicon Carbide Leading to the Formation of Antisites

G. Roma, J.-P. Crocombette; CEA, France

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Room: 1001

9:00 - 10:30: Characterization

Chairs: Charles Henager (Pacific Northwest National Laboratory, USA) and Ji-jung Kai (National Tsing Hua University, Taiwan)

9:00 - 9:15

S10-011 Study on Fracture Behavior of 2D-C/C Composite for Application to Control Rod of Very High Temperature Reactor

J. Sumta¹, I. Fujita¹, T. Shibata¹, T. Makita², T. Takagi³, E. Kunimoto⁴, K. Sawa¹, J.-Y. Park⁵; ¹Japan Atomic Energy Agency, Japan, ²Tokai Carbon Co., Ltd., Japan, ³Ibiden Co., Ltd., Japan, ⁴Toyo Tanso Co., Ltd., Japan, ⁵Korea Atomic Energy Research Institute, Korea

9:15 - 9:30

S10-012 Tensile, Compressive and In-Plane/Inter-Laminar Shear Failure Behavior of CVI- and NITE-SiC/SiC Composites

T. Nozawa¹, Y. Choi², T. Hinoki³, H. Kishimoto⁴, A. Kohyama⁴, H. Tanigawa¹; ¹Japan Atomic Energy Agency, Japan, ²Hiroshima University, Japan, ³Kyoto University, Japan, ⁴Muroran Institute of Technology, Japan

9:30 - 9:45

S10-013 Mechanical and Thermal Properties of $Y_2Ti_2O_7$ Ceramics

L. F. He, J. Shirahata, K. Kayamura, M. Takeda, T. Nakayama, T. Suzuki, H. Suematsu, K. Niihara; Nagaoka University of Technology, Japan

9:45 - 10:00

S10-014 SiC Metallic Transmutant Production in Fusion Systems

M. E. Sawan¹, Y. Katoh²; ¹University of Wisconsin-Madison, USA, ²Oak Ridge National Laboratory, USA

10:00 - 10:15

S10-015 Correlation of Microstructure and Compressive Strength of C/C Composite Using X-ray Tomography

J. Sumita¹, T. Shibata¹, E. Kunimoto², M. Yamaji², T. Konishi², K. Sawa¹; ¹Japan Atomic Energy Agency, Japan, ²Toyo Tanso Co., Ltd., Japan,

10:15 - 10:30

S10-016 In-situ Observation of Fracture Behavior on Nano Structure in NITE SiC/SiC Composite by HVEM

T. Shibayama¹, G. Matsuo¹, K. Hamada¹, S. Watanabe¹, H. Kishimoto²; ¹Hokkaido University, Japan, ²Muroran Institute of Technology, Japan

10:30 - 10:45 Break

10:45 - 11:45: Material Design and Synthesis

Chairs: Monica Ferraris (Politecnico di Torino, Italy) and Tamaki Shibayama (Hokkaido University, Japan)

10:45 - 11:15

S10-017 Development and Test of SiCf/SiC Compact Intermediate Heat Exchanger for High Temperature (Invited)

S. Konishi, Y. Yamamoto, K. Noborio, Y. Takeuchi, T. Hinoki; Kyoto University, Japan

11:15 - 11:30

S10-018 Fabrication of SiC Continuous Fiber-Reinforced SiC Composite Using Electrophoretic Deposition and Hot-Pressing

T. Yano, K. Yoshida; Tokyo Institute of Technology, Japan

11:30 - 11:45

S10-019 Silicon Carbide – Processing and Interactions in a TBM Environment

A. K. Suri, R. K. Fotedar, A. Mukherjee, N. Krishnamurthy; Bhabha Atomic Research Centre, India

14:15 - 16:00: Overview for Generation IV CMC R&D

Chairs: Akira Kohyama (Muroran Institute of Technology, Japan) and
Sehila Gonzalez de Vicente (European Fusion Development Agreement, Germany)

14:15 - 14:45

S10-020 R&Ds on Application of Carbon-Carbon Composite to HTGR/VHTR (Invited)

M. Eto¹, T. Konishi¹, T. Shibata², J. Sumita²; ¹Toyo Tanso Co., Ltd., Japan, ²Japan Atomic Energy Agency, Japan

14:45 - 15:15

S10-021 Potential Applications of SiC-based CMC in Advanced Nuclear Energy (Invited)

S. M. Dong, B. Lu, Y. S. Ding, X. Y. Zhang, P. He, L. Gao, Z. Wang; Chinese Academy of Sciences, China

15:15 - 15:45

S10-022 Overview of SiC- and C-based Materials R&D for Next Generation Nuclear Applications in Korea (Invited)

J. Y. Park, C. H. Jung, W.-J. Kim; Korea Atomic Energy Research Institute, Korea

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15:45 - 16:00

S10-023 Ceramic Composite for High Temperature Gas-cooled Reactors

Y. Katoh¹, L. L. Snead¹, T. D. Burchell¹, W. E. Windes², R. J. Shnavski³, S. T. Gonczy⁴; ¹Oak Ridge National Laboratory, USA, ²Idaho National Laboratory, USA, ³Hypertherm High-Temperature Composites, Inc., USA, ⁴Gateway Materials Technology, Inc., USA

16:00 - 16:15 Break

16:15 - 18:15: Joining and Coating

Chairs: Kazuhiro Sawa (Japan Atomic Energy Agency, Japan) and Dong Shaoming (Shanghai Institute of Ceramics, China)

16:15 - 16:30

S10-024 Joining SiC Ceramics and Composites for Nuclear Applications

M. Ferraris, V. Casalegno, S. Han, S. Rizzo, M. Salvo, A. Ventrella; Politecnico di Torino, Italy

16:30 - 16:45

S10-025 Silicon Carbide Joining Research and Development in U.S. Fusion Program: Status and Recent Achievements

C. H. Henager Jr.¹, Y. Katoh², T. Hinoki³, M. Ferraris⁴, R. J. Shnavski⁵; ¹Pacific Northwest National Laboratory, USA, ²Oak Ridge National Laboratory, USA, ³Kyoto University, Japan, ⁴Politecnico di Torino, Italy, ⁵Hypertherm High-Temperature Composites, Inc., USA

16:45 - 17:00

S10-026 Development of Joining Technique for Compact Intermediate Heat Exchanger Using NITE-SiC/SiC Composites

Y.-H. Park, T. Hinoki, S. Konishi; Kyoto University, Japan

17:00 - 17:15

S10-027 Diffusion Bonding Technology of Tungsten and SiC/SiC Composites for Nuclear Applications

H. Kishimoto¹, T. Abe¹, T. Shibayama², A. Kohyama¹; ¹Muroran Institute of Technology, Japan, ²Hokkaido University, Japan

17:15 - 17:30

S10-028 Joining of SiC and SiC/SiC Composite to F82H Steel

Z. Zhong^{1,2}, T. Hinoki²; ¹National Institute of Materials Science, Japan, ²Kyoto University, Japan

17:30 - 17:45

S10-029 Thermodynamic and Experimental Study on the Chemical Vapor Deposition of Zirconium Carbide Coatings

Q. Liu, L. Zhang, Y. Wang, L. Cheng; Northwestern Polytechnical University, China

17:45 - 18:00

S10-030 Silicon Carbide Coating on Metallic Substrates – Methods, Properties and Environmental Effects

N. Krishnamurthy, S. Ramanathan, A. K. Suri; Bhabha Atomic Research Centre, India

18:00 - 18:15

S10-031 Fabrication and Characterization of Dip-Coated Silicon Carbide Coatings

K. Ramadurai¹, P. T. Rao¹, P. K. Mollick, D. Sathiyamoorthy^{1,2}; ¹Vashi Complex, India, ²Homi Bhabha National Institute, India

Poster Session

Monday, November 15

Room: Event Hall

12:00 - 14:00

S10-P001 SiC/SiC and W/SiC/SiC Composite Heater by NITE-method for IFMIF and Fission Reactor Irradiation Rigs

T. Abe¹, H. Kishimoto¹, J.-S. Park^{1,2}, H.-C. Jung², A. Kohyama^{1,2}; ¹Muroran Institute of Technology, Japan, ²Institute of Energy Science and Technology, Co.Ltd., Japan

S10-P002 Thermal Insulator of Porous SiC/SiC Composites for Fusion Blanket System

K. Satori¹, H. Kishimoto², J.-S. Park^{1,2}, H.-C. Jung², Y.-H. Park³, Y.-J. Lee³, T. Hinoki³, A. Kohyama^{1,2}; ¹Muroran Institute of Technology, Japan, ²Institute of Energy Science and Technology, Co.Ltd., Japan, ³Kyoto University, Japan

S10-P003 Proposal for a New Brazing Alloy and a Single-step Technique for Joining CFC Composites to Copper

M. Ferraris¹, M. Salvo¹, V. Casalegno¹, T. Koppitz², G. Pintsuk²; ¹Materials Science and Chemical Engineering Department- Politecnico di Torino, Italy, ²EURATOM Association, Germany

S10-P004 Metallurgical and Mechanical Joining of RAFM Steel and SiC/SiC Composite for Fusion System

T. Ono¹, H. Kishimoto¹, J.-S. Park^{1,2}, H.-C. Jung², A. Kohyama^{1,2}; ¹Muroran Institute of Technology, Japan, ²Institute of Energy Science and Technology, Co. Ltd., Japan

S10-P005 Fracture Toughness Evaluation of Neutron-irradiated Ceramics

M. Watanabe¹, T. Shikama¹, Y. Tachi²; ¹Tohoku University, Japan, ²Japan Atomic Energy Agency, Japan

S10-P006 Influence of Fiber Weave on Proportional Limit Stress of SiC/SiC Composites

K. Toyoshima¹, T. Hinoki¹, A. Sato², H. Nonaka²; ¹Kyoto University, Japan, ²Gunze Limited, Japan

S10-P007 Influence of Grain Size on Thermal Conductivity of SiC Ceramics

Y. Lee, Y. Park, T. Hinoki; Kyoto University, Japan

S10-P008 Microstructure and Mechanical Property of SiC_r/SiC and C_r/SiC Composites

S. P. Lee¹, K. S. Cho¹, J. K. Lee¹, D. S. Bae¹, J. H. Byun³; ¹Donggeui University, Korea, ²Korea Institute of Materials Science, Korea

S10-P009 Indentation Fracture Toughness of Silicon Carbide after Neutron Irradiation and Helium Implantation

S. Nogami, A. Hasegawa; Tohoku University, Japan

S10-P010 The Microstructure Evolution of C-C Composite and Energy Storage of Nuclear Grade Graphite in Simulated Very High Temperature Gas Cooled Reactor

S.-C. Tsai, Y.-T. Hsieh, F.-R. Chen, J.-J. Kai; National Tsing-Hua University, Taiwan

S10-P011 Microstructure and Property Changes of SiC Fibers under Thermal and Ion Irradiation Environments

K. Hayakawa¹, H. Kishimoto¹, J.-S. Park^{1,2}, H.-C. Jung², A. Kohyama^{1,2}; ¹Muroran Institute of Technology, Japan, ²Institute of Energy Science and Technology, Co.Ltd., Japan

S10-P012 Microstructure Evolution of Single Crystal SiC and Hi-Niclon Type-S SiC Composite under Ion Irradiation at Elevated Temperatures

C. H. Chen, Z. R. He, J. J. Kai, F. R. Chen; National Tsing Hua University, Taiwan

S10-P013 Irradiation Effects on Interfacial Stress in SiC/SiC Composites through Differential Swelling

T. Koyanagi, S. Kondo, T. Hinoki; Kyoto University, Japan

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- S10-P014 Effect of Ion Irradiation on the Crack Deflection Pattern at the PyC Interface in SiC/SiC Composites**
M. Kanamoto, T. Koyanagi, S. Kondo, T. Hinoki; Kyoto University Japan
- S10-P015 The Research of Rising Efficiency of Porous Ceramic Pellets in Catalytic Ozonation of Dey Wastewater Treatment**
L. Yin, Y. Zheng; Nanjing University, China
- S10-P016 Characterization of Aminopropyltriethoxysilane-functionalized Polycaprolactone-Montmorillonite Beads for Heavy Metal Biosorption**
E. Magdaluyo Jr., E. Dayhon, M. delos Angeles, R. J. dela Cruz, L. de Sales-Papa, P. A. de Yro, E. dela Pena, L. J. Diaz; University of the Philippines, Philippines
- S10-P017 Characterization and Cadmium Ion-Removing Property of Adsorbents Synthesized from Inorganic Wastes**
K. Ooishi, K. Ogino, H. Nishioka, Y. Muramatsu; University of Hyogo, Japan
- S10-P018 Preparation of Calcium Silicate Hydrate Gels/Diatomaceous Earth Composites by Hydrothermal Process**
H. Maeda, E. H. Ishida; Tohoku University, Japan
- S10-P019 Leaching Behavior of Magnesium-Zinc-Phosphate Glasses for Nuclear Waste Immobilization**
T. Imai¹, T. Okura¹, H. Monma²; ¹Kogakuin University, Japan, ²Hosei University, Japan
- S10-P020 Adsorption of Hydrocarbons on Modified Nanoclays**
M. Sharafimasoo¹, S. Bazgir¹, M. Tamizifar², A. Nemati³, M. Validi¹; ¹Islamic Azad University, Iran, ²University of Science and Technology, Iran, ³Sharif University of Technology, Iran
- S10-P021 Precision of the Eutectic Points Determination by the Isopleths**
V. Lutsyk^{1,2}, O. Sumkina¹, V. Savinov¹; ¹RAS, Russia, ²Buryat State University, Russia
- S10-P022 Crystal Structure Analysis of Single Phase Lithium Titanate with Added Li by Neutron Powder Diffraction**
K. Mukai¹, K. Sasaki¹, K. Omoto², T. Hashimoto³, K. Nomura⁴, H. Kageyama⁴, T. Hoshino⁵, T. Terai¹, M. Yashima²; ¹The University of Tokyo, Japan, ²Tokyo Institute of Technology, Japan, ³Nihon University, Japan, ⁴National Institute of Advanced Industrial Science and Technology, Japan, ⁵Japan Atomic Energy Agency, Japan
- S10-P023 Synthesis of Cs-titanosilicate with Pollucite Structure for Cs-stabilization**
I. Yanase, T. Takahashi, M. Tomizawa, H. Kobayashi; Saitama University, Japan
- S10-P024 Novel Ceramic Foam Composites Infiltrated with Refractory Metal**
E. J. Faierson, K. V. Logan; Virginia Tech, USA