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Engineering Ceramics Division
The American Ceramic Society

CALL FOR PAPERS

International Conference & Exposition on

ADVANCED CERAMICS AND COMPOSITES

JANUARY 28 – FEBRUARY 2, 2024

Hilton Daytona Beach Resort and Ocean Center
Daytona Beach, Florida, USA

Abstracts due on September 4, 2023

www.ceramics.org/icacc2024

ORGANIZED BY: THE ENGINEERING CERAMICS DIVISION OF THE AMERICAN CERAMIC SOCIETY

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Welcome

Jie Zhang
Institute of Metal Research, CAS
Program Chair, ICACC 2024

The 48th International Conference & Exposition on Advanced Ceramics & Composites (ICACC 2024) will be held from Jan. 28–Feb. 2, 2024, in Daytona Beach, Fla. It is a great honor to chair this conference, which has a strong history of being one of the best international meetings on advanced structural and functional ceramics, composites, and other emerging ceramic materials and technologies.

The American Ceramic Society's Engineering Ceramics Division (ECD) has organized this esteemed event since 1977. Over the years, the conference has experienced tremendous growth, worldwide interest, and active participation from ceramic researchers and developers from the national and global technical community.

This year, the technical program consists of nineteen Symposia, five Focused Sessions, and one Special Focused Session, and the 13th Global Young Investigator Forum. These technical sessions, consisting of both oral and poster presentations, will provide an open forum for scientists, researchers, and engineers from all over the world to present and exchange findings on recent advances on various aspects related to ceramic science and technology.

The technical program encompasses diverse areas of ceramics and advanced composites, with particular emphasis on the current trends in the research, development, engineering, and application of advanced ceramics. The well-established nineteen Symposia at this conference include Mechanical Behavior of Ceramics and Composites, Advanced Ceramic Coatings, Solid Oxide Cells, Protective Ceramics, Bioceramics, Materials for Rechargeable Energy Storage, Nanomaterials for Sustainable Energy and Health Applications, Advanced Processing and Manufacturing Technologies, Porous Ceramics, Modeling and Design, Production Root Technologies, Nanolaminated Ternary Carbides/Nitrides, Nucelar Materials, Optical Materials, Additive Manufacturing, Geopolymers, Photonics, Ultrahigh-Temperature Ceramics, and Molecular-level Processing and Chemical Engineering.

Additionally, there will be five Focused Sessions, including a new topic concerning High-Voltage Materials, as well as topics carried over from 2023 on Bioinspiration and Green Processing, Thermoelectric and Thermionic Energy Conversion, Chemical Sensors, and Ceramic/Carbon Reinforced Polymers. The Special Focused Session on Diversity, Entrepreneurship, and Commercialization will be organized to recognize the ECD Jubilee Global Diversity Awardees, along with other invited speakers who will present their contributions and showcase some of the recent developments in entrepreneurship and commercialization in the field of ceramics science and engineering. Building on successful interactions and excitement generated in the first 12 years, the 13th Global Young Investigator Forum will be organized and facilitated by a group of our young researchers.

The ECD Executive Committee and volunteer organizers sincerely hope you will join us at this annual conference for a stimulating and enjoyable ICACC 2024.

We look forward to seeing you in Daytona Beach, Fla., in January 2024.

Tentative Schedule of Events

SUNDAY, JANUARY 28, 2024

Conference Registration	2:00 - 7:00pm
Member and Publication Center	2:00 - 7:00pm
Speaker Ready Room	2:00 - 7:00pm
Welcome Reception	5:30 - 7:00pm

MONDAY, JANUARY 29, 2024

Conference Registration	7:00am - 6:00pm
Member and Publication Center	7:00am - 6:00pm
Speaker Ready Room	8:00am - 4:00pm
Opening Awards Ceremony & Plenary Session	8:30am - Noon
Companion Coffee	9:00 - 10:30am
Coffee Break	10:10 - 10:40am
Lunch On Own	Noon - 1:20pm
Concurrent Technical Sessions	1:30 - 6:10pm
Coffee Break	3:00 - 3:20pm

TUESDAY, JANUARY 30, 2024

Conference Registration	7:30am - 6:00pm
Member and Publication Center	7:30am - 6:00pm
Speaker Ready Room	8:00am - 4:00pm
Concurrent Technical Sessions	8:30am - Noon
Coffee Break	10:00 - 10:20am
Exhibitor Set-up	Noon - 4:00pm
Lunch On Own	Noon - 1:20pm
Concurrent Technical Sessions	1:30 - 5:30pm
Coffee Break	3:00 - 3:20pm
Poster Session A Set-up	3:00 - 4:30pm
Exhibits & Poster Session A, Including Reception	5:00 - 8:00pm

WEDNESDAY, JANUARY 31, 2024

Conference Registration	7:30am - 5:30pm
Member and Publication Center	7:30am - 5:30pm
Speaker Ready Room	8:00am - 4:00pm
Concurrent Technical Sessions	8:30am - Noon
Coffee Break	10:00 - 10:20am
Lunch On Own	Noon - 1:20pm
Concurrent Technical Sessions	1:30 - 5:30pm
Coffee Break	3:00 - 3:20pm
Poster Session B Set-up	3:00 - 4:30pm
Exhibits & Poster Session A, Including Reception	5:00 - 7:30pm

THURSDAY, FEBRUARY 1, 2024

Conference Registration	7:30am - 5:30pm
Member and Publication Center	7:30am - 5:30pm
Speaker Ready Room	8:00am - 4:00pm
Concurrent Technical Sessions	8:30am - Noon
Coffee Break	10:00 - 10:20am
Lunch On Own	Noon - 1:20pm
Concurrent Technical Sessions	1:30 - 5:30pm
Coffee Break	3:00 - 3:20pm
Lasrt Night Reception	5:30 - 6:30pm

FRIDAY, FEBRUARY 2, 2024

Conference Registration	8:00am - Noon
Concurrent Technical Sessions	8:30 - 11:40am
Coffee Break	10:00 - 10:20am

HILTON DAYTONA BEACH RESORT

100 North Atlantic Avenue, Daytona Beach, FL 32118 ■ Phone: 1-386-254-8200

Rates: One to four occupants: $189 USD ■ US government employee: Prevailing rate

Make reservations on line under Hotel and Travel link at www.ceramics.org/icacc2024 or reserve by telephone. mention The American Ceramic Society to obtain the special rate. Room rates are effective until January 1, 2024 and are based on availability.

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ABSTRACT SUBMISSION INSTRUCTIONS

- **Visit www.ceramics.org/icacc2024 to review session topics.**
- **Select "Submit Abstract" to be directed to the Abstract Central website.**

Abstract title plus text total character limit (including spaces) is 1,500 characters.

If you have questions, please contact Karen McCurdy at kmccurdy@ceramics.org or +1-614-794-5866

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SYMPOSIUM 1

Mechanical Behavior and Performance of Advanced Ceramics & Composites

Advanced structural ceramics, cermets, and ceramic matrix composites are enabling materials for applications in various industries, such as energy generation (e.g., concentrated solar power, nuclear) and energy storage, extreme environment, space, transportation, medicine, microelectronics, and optical systems. High mechanical reliability is a key issue for their ultimate use in short- to very long-term applications. Identification and quantification of failure mechanisms by fracture, creep, fatigue, and/or irreversible deformation are essential, as well as their correlation with structure, processing, and exposure to severe service conditions. Extreme environments and challenging applications of ceramic materials have necessitated new approaches for sustainable manufacturing and characterization. The development of novel methods to advance and accelerate computationally driven materials characterization and validate structure–property relationship multiscale models is needed to improve prediction of material behavior and lower costs.

This symposium solicits abstracts related to the diverse aspects of mechanical behavior of ceramics and composites and their correlations with processing and component performance and reliability.

PROPOSED SESSION TOPICS

- Mechanical characterization of ceramics and composites, techniques and equipment
- Small-scale testing and in-situ characterization using photons and neutrons
- Fracture mechanics, failure analysis and fractography
- Environmental effects, thermomechanical creep, fatigue performance, and tribology
- Design, reliability, and life prediction modeling of devices and components
- Novel computational approaches to enhance performance and characterization
- Processing–microstructure–mechanical properties correlation
- Role of fibers, matrices, coatings, and interfaces in mechanical behavior
- Functionally graded materials and multilayer ceramic systems
- Manufacturing and testing of joined and integrated components and structures
- Ceramics for energy generation, turbines, and environmental applications
- Ceramics for concentrated solar–thermal power and industrial process heat
- Correlation of resource-efficient processing of ceramics and ceramic matrix composites with their performance

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SYMPOSIUM 2

Advanced Ceramic Coatings for Structural, Environmental, and Functional Applications

Research and development in the field of high-performance ceramic coating systems is a key to current and future technologies. Ceramic coatings extend the lifetime or even enable operation of engineered materials in harsh environments. Advanced gas turbine engine components made of ceramic matrix composites, intermetallics, or superalloys promise higher energy efficiency due to increasing operation temperatures. Advanced thermal and environmental barrier coatings (T/EBC) are mandatory to protect components against the synergistic attack of heat, combustion atmosphere, and inorganic, CMAS-type aerosols. Oxidation protection provided by ceramic coatings is a key issue for nonoxide, ultrahigh-temperature ceramics and composites to be used in reusable spacecraft or hypersonic vehicles. Protection of metal components against oxidation, corrosion, erosion, and wear by innovative ceramic coatings is also a central building block for many other technologies. Functional ceramic coatings are essential for many renewable energy applications.

This symposium addresses processing, microstructure, performance, and durability of advanced ceramic coatings. New materials, innovative processing technologies, advanced characterization methods, and thermodynamic modeling are particularly emphasized. Material scientists and engineers from around the world are invited to present and discuss cutting-edge ceramic coating science and technology.

PROPOSED SESSION TOPICS

- Thermal and environmental barrier coatings for ceramic matrix composites, intermetallics, and alloys
- CMAS-type degradation of T/EBC: Fundamentals, modeling, and mitigation strategies
- Ceramic coatings for protection against oxidation, corrosion, erosion, and wear
- Ceramic coatings for renewable energy applications
- Processing of ceramic coatings (thermal spraying, PVD, CVD, aerosol deposition, sintering)
- Microstructure–property relationships
- Advanced destructive and nondestructive characterization methods
- Modeling and simulation

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SYMPOSIUM 3

21st International Symposium on Solid Oxide Cells (SOC): Materials, Science, and Technology

Solid oxide cells (SOCs) offer great potential for clean and efficient power generation from a wide variety of fuels, ranging from hydrocarbons to renewables, and for highly efficient conversion of electricity to hydrogen or synthesis gas via electrolysis. Durable electrochemical energy conversion in SOC is only possible by proper material choice and processing, cells stacking technology, and stack module design. Application of SOC in scalable systems for power, heat, hydrogen, and synthetic gas generation requires serious consideration of the stack operating window, operating environment, contaminants sources/levels, and customer specifications to realize competitive solutions.

This symposium provides an excellent platform for academia and industry to present and discuss novel solutions for materials, components design, mechanical robustness, durability, system layouts, and exchange their experience in application of SOCs in different areas. The goal of the symposium is not only the exchange of recent results by experienced and young scientists but also extensive discussion of unsolved problems and development directions.

PROPOSED SESSION TOPICS

- Electrolytes: oxygen ion, proton, and mixed conductors; conduction mechanisms
- Electrode materials and microstructural engineering: electrode processes, defect chemistry, characterization, accelerated testing, and lifetime prediction
- Ceramic and metallic interconnects: materials development and properties, coatings, accelerated testing, and lifetime prediction
- Sealing and brazing technology: material development and characterization, designs and approaches, interactions with sealing materials
- Novel processing and design for cells, stacks, reformers, burners, and other system components
- Mechanical and thermomechanical properties of materials and components up to high temperatures
- Surface and interfacial reactions: electrochemical transport and electrode poisoning, catalytic degradation, carbon fouling
- Simulation: electrode performance and degradation, distribution of temperature, current density and mechanical stresses in cells and stacks, system layout, stationary and dynamic system operation
- High-temperature electrolysis: steam, steam and CO2, chemical process engineering utilizing SOEC
- System design and demonstration

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SYMPOSIUM 4

Protective Ceramics — Fundamental Challenges and New Developments

Ceramic and glass materials possess qualities that make them useful for applications involving high-velocity impact. Fundamentally, such intense events are governed by momentum transfer moderated by high-rate inelastic material behavior and failure. Understanding material behavior and failure under these conditions is highly challenging due to the nonlinear, nonuniform, coupled interactions between dynamic stresses and the inherent multi-scale material structure, from atomic defects to processing flaws. These variables can lead to the initiation and growth of a multitude of inelastic deformation mechanisms, such as phase transformations, dislocations, twinning, stacking faults, microcracking, fracture, and others, resulting in fragmentation of the solid body. By identifying and understanding underlying mechanisms, their consequences, and processing–structure–property relationships, material behavior can be controlled.

This symposium is focused on the fundamental challenges and new developments associated with the topics listed below. In addition, special sessions on: (1) ultrahard ceramics, (2) high-throughput experimentation and data-driven techniques, and (3) dynamic behavior are planned. Presentations addressing these topics and those listed below are welcomed.

PROPOSED SESSION TOPICS

- Traditional and emerging ceramic and glass science and engineering
- Conventional, reactive, novel, and emerging synthesis and processing
- Processing of hierarchically structured bodies
- Materials-by-design and process modeling
- Microstructure characterization and advanced methods
- High-rate and dynamic behavior, including underlying mechanisms
- Quasi-static mechanical properties
- Constitutive modeling

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SYMPOSIUM 5

Next-Generation Bioceramics and Biocomposites

The last few decades have witnessed significant progress in the use of ceramics for biomedical applications, with anticipated benefits in clinical diagnosis and treatment. In addition to conventional ceramic fabrication technologies, biomimetic processes are also being adopted to develop bio-inspired materials and inorganic–organic hybrids. The advent of nanotechnology and additive manufacturing has further increased the spectrum of applications of bioceramics and biocomposites.

This symposium will provide a platform to stimulate discussion among active researchers from academia/national labs, medical device manufacturers, entrepreneurs, and clinicians who are involved in the development and use of bioceramics.

PROPOSED SESSION TOPICS

- Porous bioceramics (joint with Symposium 9)
- Additive manufacturing of bioceramics
- Biomineralization and tissue–material interactions
- Bioactive and resorbable ceramics and composites
- Bio-inspired, bio-synthetic, and biomimetic ceramics and composites
- Self-assembled bioceramics
- Ceramics for drug and gene delivery
- Ceramics and composites with antimicrobial/antiviral properties
- In vitro and in vivo biocompatibility of bioceramics
- Mechanical properties of bioceramics and biocomposites
- Orthopedic and dental applications of bioceramics and composites
- Nanostructured bioceramics (joint with Symposium 7)
- Magnetic nanoceramics and composites for biomedical applications
- Light-emitting nanoceramics for bioimaging, sensing, and therapy
- Ceramic biosensors

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SYMPOSIUM 6

Advanced Materials and Technologies for Rechargeable Energy Storage

The significant increases in demand of world energy consumption as well as clean and efficient energy resources have prompted imperative searches for new materials and technologies. The intermittent nature of the renewable power generation technologies will require new solutions for efficient and reliable energy storage. This symposium will focus on the advanced engineered ceramics and technologies that could help the global community to achieve the stated goals. For example, state-of-the-art materials and technologies for energy storage, improvements in materials design, electrodes architecture, electrolytes, separators, and cell chemistries. These examples are key factors to extend the life, enhance the safety, and lower the cost of rechargeable batteries, which are regarded as the most efficient energy storage systems for portable electronics, renewable energy storage, smart grid, and transportation applications. A deeper understanding of the battery materials–property relationship, electrode/electrolyte interface phenomena, and cell failure mechanisms is critically needed to face these challenges. The search for advanced high-capacity electrode materials, solid electrolytes, and the implementation of the very challenging all-solid-state batteries, lithium batteries, lithium–sulfur, metal–air batteries, beyond lithium technologies including sodium batteries, and Mg/Ca/Al-based batteries will be necessary to overcome the energy density shortfall and safety issues in currently commercial batteries.

This symposium will focus on crystal chemistry, structural analysis, materials processing, powder metallurgy, sintering, transport properties, structural and mechanical characterization, new testing methods, cost/performance and reliability issues, commercialization, market prospects, and recyclability related to batteries and supercapacitors..

PROPOSED SESSION TOPICS

- Solid electrolytes for batteries
- All-solid-state batteries
- Advanced anode and cathode materials for lithium batteries
- Materials design, screening, and electrode architectures for lithium batteries
- Diagnostics and materials characterization for lithium batteries
- Electrode/electrolyte interface characterization for lithium batteries
- Applications focused lithium batteries
- Lithium–sulphur battery technology
- Sodium batteries, potassium batteries, magnesium batteries, and calcium batteries
- Materials of capacitive energy storage (super-capacitors)
- Recycling of battery materials
- Stationary rechargeable batteries for grid, solar, and wind technologies

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SYMPOSIUM 7

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18th International Symposium on Functional Nanomaterials and Thin Films for Sustainable Energy, Environmental, and Health Applications

Functional nanomaterials with intrinsically new and tailored properties are key elements for developing sustainable solutions for energy, environment, and health. This symposium will focus on new materials, energy technologies, and devices based on inorganic, hybrid, and composite materials. Particular emphasis will be given to novel synthesis approaches, surface functionalization, and heterostructuring of nanoparticles, nanowires, and nanoscopic films, fundamentally new properties, and energy-efficient materials synthesis. Functional surfaces fabricated using emerging processing techniques, such as jet printing and 3D printing, are also within the scope of the symposium. Applications of nanostructures in photocatalysis, energy, sensing, and biomedical applications that combine advanced processing with conceptual advancement will form the major thrust areas. Contributions related to energy applications such as photovoltaics (perovskite materials), batteries, fuel cells, thermoelectric materials, water splitting, and carbon dioxide conversion, as well as transparent conductors and challenges related to the large-scale production and integration of functional and structural nanomaterials are highly desired.

PROPOSED SESSION TOPICS

- Synthesis, functionalization, and assembly of inorganic and hybrid nanostructures
- Nanomaterials for energy conversion, storage, and catalysis
- Metal oxide nanostructures for sensing, batteries, and water-splitting applications
- Nanomaterials for thermoelectrics, photocatalysis, electrocatalysis, and solar hydrogen
- Nanotoxicity, bioimaging, drug-delivery, and tissue engineering with tailored nanobioconjugates
- Carbon nanostructures, 2D materials, and metal chalcogenides
- Functional coatings and innovative thin film techniques (e.g., ALD, PECVD)
- Industrial production and application of nanomaterials and coatings
- Computational methods in the design of tailored nanostructured materials
- Interfacial materials and multimaterial heterostructures and nanocomposites

SYMPOSIUM 8

18th International Symposium on Advanced Processing and Manufacturing Technologies for Structural and Multifunctional Materials and Systems (APMT18)

The properties and performance of structural and multifunctional materials largely depend on their processing and manufacturing routes. Manufacturing processes carefully designed with sufficient understanding of forming and sintering behaviors lead to reliable performance of components and products of large size and complex shapes. On the other hand, recently developed processing and fabrication techniques of ceramic materials and systems give us unique properties that cannot be achieved through conventional routes.

This symposium aims to discuss global advances in the research and development of advanced processing and manufacturing technologies for a wide variety of nonoxide- and oxide-based structural ceramics, fiber-reinforced and particulate composites, and multifunctional materials, as well as their components and devices. Current advances and state-of-the-art techniques in various ecofriendly processing approaches will be also covered.

PROPOSED SESSION TOPICS

- Novel forming and sintering technologies, near-net shaping
- Rapid prototyping, 3D printing, patterning, templates, and self-assembly
- Advanced composite manufacturing technologies, hybrid processes
- Microwave processing, SPS, flash sintering, high pressure assisted sintering
- Advanced powder synthesis and processing
- Aqueous synthesis, colloidal processing, bio-inspired synthesis and processing
- Polymer-based processing
- Design-oriented manufacturing and processing
- Joining, integration, machining, repair, and refurbishment technologies
- Green manufacturing, global environmental issues and standards

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SYMPOSIUM 9

Porous Ceramics: Novel Developments and Applications

Porous materials are essential components in many applications, including but not limited to thermal insulation, catalysts, catalyst supports, filters, adsorbers, sensors, and lightweight components. These materials contain pore sizes from the nanometers to millimeters, and they can have textured to random porosity or hierarchical porosity and be based on various pore architectures, such as foams, honeycombs, fiber networks, and bioinspired structures. They can be produced using a variety of manufacturing approaches, from direct foaming to replication of a porous scaffold, from the use of sacrificial fillers to additive manufacturing. Due to these characteristics, porous materials are extensively used in environmental, energy, biological, and other applications.

This symposium aims to bring together the scientific community to share recent advances in the formation, characterization, properties, and modeling of porous ceramic, carbon, glass, and glass-ceramic components for multifaceted applications. It will be the ideal showcase for the research activities of the many groups involved in the development and use of porous materials, including but not limited to the areas of ceramics, chemistry, mechanics, fluid dynamics, modeling and simulation, and application engineering.

PROPOSED SESSION TOPICS

- Innovations in processing methods and synthesis of porous ceramics
- Structure and properties of porous ceramics
- Novel characterization tools and software for porous structures
- Computational techniques in porous ceramics
- Machine learning and artificial intelligence for porous ceramics
- Mechanical behavior of porous ceramics
- Hierarchical, microporous, and mesoporous ceramics
- Gas separation ceramic membranes
- Engineered porous architectures enabled by additive manufacturing technologies
- Porous ceramics for environmental, energy, biological, and functional applications

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SYMPOSIUM 10

Modeling and Design of Ceramics and Composites

Recent progress in computational materials science has significantly enhanced the efficiency with which the understanding of fundamental phenomena, the improvement of materials performance, the optimization of processing, the discovery of new materials, and the design of structural components can be achieved.

This symposium will focus on the high-throughput design and characterization, informatics and machine learning, and modeling of ceramics and composites with different approaches in both computational research and experimental measurements across the length and time scales so as to further optimize their behavior and facilitate the design of new ceramics and composites with tailored properties. A broader perspective is desired, including the interest related to ceramic genome, virtual materials design, informatics, and machine learning for new innovative materials and thermostructures; integrated materials computational engineering; prediction of the structure and properties of crystals, glasses, and defects; modeling materials behavior under extreme/harsh environments; application of novel simulation methods for materials processing and performance; simulation of novel ceramics for functional applications; and the modeling of surfaces, interfaces, and grain boundaries at multiple scales..

PROPOSED SESSION TOPICS

- High-throughput design and characterization
- Informatics and machine learning
- Multiscale modeling of processing, microstructure, and performance
- Modeling of structure and property of ceramics and composites
- Modeling defects and amorphous matter
- Modeling of surfaces, interfaces, and grain boundaries at multiple scales

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Advanced Materials and Innovative Processing Ideas for Production Root Technologies

Production root technologies refers to a collection of six production technologies including casting, molding, forming, welding, heat treatment, and surface treatment. Production root technologies involve both materials and process technologies that are hidden behind products and do not frequently appear outward. However, they are very important and greatly influence material performance. As the functions of products become more complex and robust, the importance of these production root technologies is concurrently growing. Production root technologies have an inherent interdisciplinary nature, inevitably including a broad spectrum of skills from starting materials all the way up to component manufacturing and module integration. As demand increases for sustainable energy, especially by employing novel materials, composites, and/or functional (e.g., energy scavenging, storage and saving) techniques, the interdisciplinary approach plays an even greater role.

This symposium is designed to provide an opportunity for the world's leading scientists and engineers from many fields to exchange ideas and to build new collaborations in the fields of production root technologies. Many successful stories and noteworthy examples of transforming dangerous, dirty, and difficult aspects of production root technologies into automatic, clean, and easy form will also be recognized and shared.

PROPOSED SESSION TOPICS

- Starting materials: mining, particles, bulk, and functional materials and precursors
- Sustainable energy concepts and applications
- Coating, forming, and shaping processes for industrial applications
- Recycling and reuse processes
- New concepts and emerging root technologies for enhanced product performance

SYMPOSIUM 12

Design and Applications of Nanolaminated Ternary Transition Metal Carbides/Nitrides (MAX Phases) and Borides (MAB Phases), Their Solid Solutions and 2D Counterparts (MXenes, MBenes)

The MAX and MAB phases are thermodynamically stable nanolaminates of early transition metal carbides/nitrides and borides, respectively. The MAX and MAB phases are hexagonal solids with an inherently nanolayered crystal structure that is responsible for an unusual and unique combination of metal-like and ceramic-like properties, such as machinability, damage tolerance, electrical and thermal conductivity, thermal shock resistance, oxidation and corrosion resistance, radiation tolerance, and high-temperature stiffness. This unique set of properties makes the MAX and MAB phases appealing candidate materials for diverse potential industrial applications, especially under extreme service environments. Relatively recently, it was also demonstrated that it is possible to selectively remove the metallic A layers from the MAX and MAB crystal structures, exfoliating the MX and MB nanolaminates to form the respective 2D solids (MXenes and MBenes). Notwithstanding their recent discovery, the 2D MXenes and MBenes combine excellent electrical conductivity with tunable surface functionality, holding great promise for a range of innovative functional applications.

This symposium focuses on the design, processing, structure–property relationships, thermal, electrical, optoelectronic, and mechanical properties, thermodynamic stability, oxidation and corrosion resistance, and radiation tolerance of these nanolaminated compounds, as well as on the potential applications of both their 3D and 2D forms. In addition, exploratory research on further expanding the chemistry of ternary compounds is also welcome.

PROPOSED SESSION TOPICS

- Design of novel compositions and manufacturing methods
- Methods for improving damage tolerance, oxidation and corrosion resistance, electromagnetic interference, and thermal shock resistance
- Novel applications and device fabrication (electrochemical energy storage, biosensors, etc.) of 2D MXenes and MBenes
- Study of electronic, optical, plasmonic, and thermoelectric properties
- Theoretical calculations to predict thermodynamically stable 3D MAX and MAB phases, 2D MXenes and MBenes, and solid solutions with desired properties
- Nuclear applications of the MAX and MAB phases

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SYMPOSIUM 13

Development and Applications of Advanced Ceramics and Composites for Nuclear Fission and Fusion Energy Systems

The future safety and sustainability of nuclear energy systems based on fission and fusion technologies are strongly correlated to the development and application of advanced materials capable of withstanding the ever-increasingly harsh environments of a nuclear reactor core.

This symposium will bring together scientists and engineers to discuss opportunities and needs in key enabling materials for application in nuclear energy systems. These topics will include the most up-to-date science and state-of-the-art technologies, ranging from materials design and development, processing, and performance under relevant nuclear environments. Also included will be discussions on prospects and perspectives related to commercial development and qualification and licensing requirements. The symposium is cosponsored by the ACerS Energy Materials and Systems Division.

PROPOSED SESSION TOPICS

- Material technologies for accident-tolerant fuel cladding and core structures for light water reactors
- Ceramic fuel materials, technologies, and characterization
- Graphite and carbon materials for nuclear applications
- High temperature ceramics for space reactor applications
- New materials and containment for neutron moderators, reflectors, and shielding
- Processing and characterization of novel ceramics and composites for nuclear systems
- Ceramics and ceramic-based composites in nuclear fusion; blanket structural and functional materials, advanced plasma-facing material, and ceramic breeder
- Joining and coating technologies for reactor components
- Chemical compatibility and corrosion
- Radiation damage, defect production, evolutions, and interactions
- Advanced characterization techniques and methods
- Fuel, cladding, assembly, and core evolutions and performance modeling
- Test methods, codes and standards, design methodology, and material qualifications

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SYMPOSIUM 14

Crystalline Materials for Electrical, Optical, and Medical Applications

This session will provide a forum for the presentation and discussion of recent research and development activities on crystalline materials. The session will cover all aspects, from basic research and material characterization through physicochemical aspects of growth, synthesis, and deposition techniques to the technological development of industrialized materials. For this purpose, world-wide experts in the different topics will be invited to introduce their most recent activities. The broad scope of the session assures a wide overview of the state-of-the-art issues on crystalline materials, aiming to stimulate interdisciplinary discussions and collaborations in a wide range of fields.

PROPOSED SESSION TOPICS

- Semiconductors for LEDand LD, power device, sensor
- Optical materials for laser, nonlinear optics, optical isolator, phosphor
- Scintillators for X-ray, gamma-ray, and neutron detection
- Piezo-, ferro-, and magneto-electric materials
- Transparent ceramics and nanocrystals
- Phase diagrams, defect chemistry, crystalline quality

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SYMPOSIUM 15

8th International Symposium on Additive Manufacturing and 3D Printing Technologies

Additive manufacturing and 3D-printing technologies are globally recognized as novel fabrication processes for advanced materials and components with multifunctional structures. These technologies offer tremendous potential for design innovations and customization, complex part fabrication, rapid prototyping, and distributed digital manufacturing. In this approach, 3D models are designed and created according to theoretical concepts using computer software, and 2D cross sections are created by slicing operations automatically. In direct writing processes, paste materials with ceramic and/or metal particles dispersed in binder system are fused from nozzles moving freely in three dimensions to create composite structures. In laser-based approaches, high resolution laser beams are scanned on a spread ceramic powder bed with or without resin binders to form solid planes of 2D cross sections. Various functional components of dielectric lattices to control electromagnetic waves, biomaterials components for medical applications, and ceramics electrode with large surface area could also be developed. Large-scale structural components for aerospace and other high-temperature applications can be fabricated with internal cooling path networks formed without casting molds. Using smart additive manufacturing, it is possible to design for function and not for manufacturing. However, each technique needs special design adjustments to boost products' efficiency and multi-functionality.

This symposium focuses on superiority of design, efficient processing, and perspicuous evaluations in the additive manufacturing and 3D-printing processes. In addition, various topics related to starting materials, characterization tools, NDE and in-situ monitoring of processes, qualification and certification, cost, and applications will be discussed.

PROPOSED SESSION TOPICS

- Laminated object manufacturing and green tape stacking
- Powder bed fusion and selective laser melting and sintering
- Material extrusion and fused deposition modeling
- Binder jetting processes
- Vat photopolymerization and substrate stereolithography
- Direct writing and ink jet printing technologies
- Multimaterial and hybrid printing techniques
- Design with or for additive manufacturing
- Materials and process characterization tools
- Qualifications, certifications, standards, and property databases
- Applications of additively manufactured materials and components

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SYMPOSIUM 16

Symposium 16: Geopolymers, Inorganic Polymers, and Sustainable Construction Materials

Refractory inorganic polymers can be made at ambient temperatures and pressures from a powder and a liquid to form a paste of low viscosity. These materials, called "geopolymers," include alkali metakaolin-based, aluminosilicates, silicoaluminate phosphates, or stoichiometric geopolymers (which convert to single phase ceramics upon heating), as well as other chemically bonded, inorganic compounds. The use of biological materials as starting compounds or as reinforcements in composites demonstrates the ecofriendly and sustainable nature of these materials. The geopolymer "glue" is refractory up to 1,000°C, whereupon it converts to a ceramic or a ceramic plus glass. Novel potential applications of such composites include fire- and corrosion-resistant coatings; thermal insulation; porous materials; structural ceramic composites containing ceramic, metal, organic, or biological reinforcements; ceramic coatings of tailorable thermal expansions; nanozeolites or porous geopolymers for liquid and water purification; as well as infrastructure and construction materials. The nanoparticulate nature of geopolymers also provides a low-energy processing route to ultrarefractory ceramic powders or versatile forming methods, including 4D printing.

PROPOSED SESSION TOPICS

- Synthesis, processing, microstructure
- Mechanical properties, thermal shock resistance
- Composites
- Alkali-based geopolymers
- Acid-based phosphate geopolymers
- Other inorganic geopolymer analogues
- Geopolymer-derived processing routes
- Conversion to ceramics
- Use of waste materials to make geopolymers
- Coatings (fire resistant, acid resistant, tailorable thermal expansion)
- Waste encapsulation
- Nuclear radiation shielding
- Sustainable materials
- Novel applications

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SYMPOSIUM 17

Advanced Ceramic Materials and Processing for Photonics and Energy

In the past few years, significant progress has been reported on the synthesis and structural, physical, and chemical characterization of ceramic nanostructures that exhibit size-dependent properties and on novel glass-based materials for optical lasers and amplifiers. Nanomaterials have been widely studied and are leading to fundamental new discoveries as well as applications in photovoltaics, optical sources, electroceramics, multiferroic materials, catalysis, and solar hydrogen.

This symposium focuses on all ceramic materials with application potential as functional materials, with particular consideration given to the capability to tailor and control material properties via surface and structural modifications. The session also includes novel optical glass-based and glass-ceramic materials with new functionalities, new emission wavelengths, and with an overview toward integration with other classes of materials (e.g., polymers, metals). New nanotechnology tools and technological procedures for the development of new functional devices integrating bottom-up and top-down technologies will be also considered..

PROPOSED SESSION TOPICS

- Multifunctional materials
- Advanced and nanostructured materials for photonics, electronics, and sensing
- Advanced and nanostructured materials for photovoltaics and solar fuels
- Advanced glass-based and glass-ceramic materials for laser sources and nonlinear applications

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SYMPOSIUM 18

Ultrahigh-Temperature Ceramics

Ultrahigh-temperature ceramics (UHTCs) are materials of interest for use in extreme environments that are beyond the capabilities of other materials. Some proposed applications for UHTCs include scramjet engine components, leading edges and thermal protection systems for hypersonic vehicles, plasma facing materials in nuclear fusion reactors, solar power concentrators, fuel forms in nuclear fission reactors, and others. Challenges that exist for UHTCS and limit near-term use include thermal and chemical stability in extreme environments, the ability to be formed into complex shapes, thermal shock resistance, irradiation resistance, and damage tolerance. For such extreme environment applications, advances in the understanding of structure–property relations and performance are needed.

This symposium will focus on design, processing, processing–microstructure–property relationships, thermal and mechanical properties, oxidation resistance, machining, joining, and thermal and chemical stability of UHTCs and UHTC composites, both from fundamental and application-oriented perspectives.

PROPOSED SESSION TOPICS

- Novel processing methods for bulk, coatings, thin films, fibers, and/or composites
- Precursors for powders, coatings, and matrix or fibers of composites
- Processing–microstructure–property relationships of existing or new systems
- Bulk ceramics, thin films, coatings, fibers, and composites
- Entropy engineering and compositionally complex UHTCs
- Super-hard UHTCs
- Characterization methods and lifetime assessments
- Methods for improving damage tolerance, oxidation behavior, and thermal shock resistance
- Response in extreme environments (e.g., irradiation, ultrahigh-temperature)
- Simulation and theory for predicting stability or behavior under extreme environments

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SYMPOSIUM 19

Molecular-level Processing and Chemical Engineering of Functional Materials

Materials synthesis based on the use of molecular precursors has been recognized as a powerful way to access compounds with controlled and adjustable compositions, crystal structures, morphologies, and consequently property profiles. Thus, a careful design of suitable molecular precursors as well as an extensive knowledge about their (thermal) conversion into desired functional materials are of crucial importance for providing improved rational preparative concepts toward tailor-made (multi)functional structures. Molecular synthesis techniques toward functional materials are highly attractive because they can be performed with highly efficient atom economy, which allows access to well-defined chemical and phase compositions as well as to unique morphologies and (metastable) phases.

This symposium intends to conceptually unite materials chemists, ceramists, and materials engineers for developing new concepts and pathways for synthesis, net-shaping, and device integration of functional materials. Whereas the conventional top-down methods are preferred due to their simplicity and to some extent predictable nature, they operate mostly in the thermodynamical regimes and are less suited for synthesizing multicomponent and hybrid (organic–inorganic) materials. Despite the well-known benefits of molecular-level processing of inorganic solids, a major challenge lies in the limited insight into molecule-to-material transformations and the fact that many of the molecular precursors are commercially not available. During this symposium, the role of precursor chemistry and additives in solution such as sol-gel, solvothermal, electrospinning, microwave, chemical vapor deposition (CVD), and atomic layer deposition (ALD) techniques will be critically analyzed. Specific emphasis will be laid on materials manufacturing strategies, such as 3D printing and chemically controlled assembly and purpose-driven modification of materials. Nonconventional synthesis and analytical methods enabling in-situ diagnostics and mechanistic insights into nucleation, growth, and self-assembly are in particular focus. Emphasizing the need of new and smart chemical processing methods to obtain specific material compositions that can integrate the advancements in materials processing techniques with the existing knowledge base of materials chemistry will also be a part of this symposium. The industrial potential of chemically processed materials will be analyzed and discussed concerning their simplicity, scalability, and cost-effectiveness. Moreover, aspects related to the potential of using molecular precursor synthesis concepts toward circular economy, wasteless processes, and effective materials recycling will also be considered and critically discussed.

PROPOSED SESSION TOPICS

- Precursor chemistry: Structural and thermal transformations
- Chemically processed nanostructures and on-surface nanochemistry
- 2D materials and their chemical functionalization
- Solution-processing of nanomaterials for optical, catalytic, and sensing applications
- Molecular precursor approaches for vapor-phase synthesis (ALD, CVD) of materials
- In-situ studies on nucleation and growth of solid-state phases in solution and gas phases
- Smart chemistry for functionalization of nanostructures
- Chemical approaches to new processing methods, such as 3D printing
- Scaled-up production of precursor-derived materials
- Materials integration and device applications

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FOCUSED SESSION 1

Bioinspiration, Green Processing, and Related Technologies of Advanced Materials

During billions of years of evolution and natural selection, living organisms can efficiently and accurately produce complex and multifunctional materials under environmentally benign conditions, such as biomineralization and photosynthesis. Taking inspirations from the structure–function relationships and the structure-forming processes of these biological materials, numerous advanced materials with novel structures and functions have been fabricated and many new fabrication techniques have also been developed. In addition, green processing and related technologies exhibit flexibility for materials design to impart various functions for diverse applications.

This focused session aims to provide a forum for researchers, students, and entrepreneurs to present and discuss their recent scientific results on a wide variety of topics related to the science and engineering issues associated with bioinspired and green processing of advanced materials. A particular emphasis will be placed on the fundamental issues related to advancing our understanding and utilization of processes inspired by living organisms to fabricate materials with new structures and functions, current progress and challenges, and future directions in green processing and related technologies.

PROPOSED SESSION TOPICS

- Biomineralization, photosynthesis, and other bioprocesses
- Aqueous synthesis, colloidal processing, and bottom-up assembly
- Advanced computational modeling methods
- Advances in bioinspired materials and related applications
- Advances in fabrication techniques for bioinspired materials
- Low-temperature sintering of ceramics
- Green processing for energy conversion and storage materials and systems
- Green processing for environmental sustainability
- Future directions of bioinspired materials, green processing and technologies

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FOCUSED SESSION 2

Advanced Materials for Thermoelectric and Thermionic Energy Conversion

Thermoelectric power generation relies on a thermally induced electrical current in an all-solid-state device. Thermionic energy conversion also relies on a temperature gradient to generate an electrical current, but the materials research and device applications are still underdeveloped compared with those in thermoelectrics. In both heat-to-electricity direct energy conversion technologies, the useful power and the power conversion efficiency depend on transport of charge carriers (electrons or holes) and propagation of lattice vibrations (phonons) in the materials involved. Broader applications of thermoelectric and thermionic devices can be expected if new materials can be developed and assembled to meet the requirements reliably under a variety of environments and duty loads. Deeper insight into mechanisms by novel theoretical concepts and advanced manufacturing techniques is needed to realize a breakthrough in thermoelectric as well as thermionic materials and devices, which enables far greater figure of merit and higher power factor than those of currently available counterparts. Computational sciences also afford researchers tools and methods to guide in design, performance, and evaluation of nontraditional thermoelectric and thermionic materials and devices.

This focused session aims to convene leading global field experts to engage in ceramic technology-centered dialogues to address critical issues in the development of thermoelectric and thermionic energy conversion materials and devices. Researchers and scientists in thermoelectrics and thermionics and related fields are cordially invited to participate in this symposium.

PROPOSED SESSION TOPICS

- Ceramic technology-centered materials development in thermoelectric and thermionic energy conversion
- Novel thermoelectric and thermionic materials with high power factors and/or high figures of merit
- Organic thermoelectric materials and organic–inorganic hybrid systems
- Flexible thermoelectric materials and devices
- Porous thermoelectric and thermionic materials
- Electronic and phononic band structure engineering, nanostructure engineering, superlattice structures and 2D thermoelectric and thermionic materials
- Thermal stability and mechanical properties of thermoelectric and thermionic materials and reliability of devices
- Electrical and thermal contact resistivity and their interplay with joining of thermoelectric and thermionic materials
- Thermodynamics and solid-state defect chemistry of thermoelectric and thermionic materials
- Theoretical and experimental approaches to thermal and electrical transport mechanisms in thermoelectric and thermionic materials
- Design of new thermoelectric and thermionic materials using density functional theory or other first principles computational methods
- Innovative processing routes for thermoelectric and thermionic materials
- Advanced manufacturing technologies for thermoelectric and thermionic devices and modules
- Miniaturized and integrated thermoelectric and thermionic devices
- System-level applications of advanced thermoelectric devices and modules in electrical power generation (i.e.. thermogenerators), sensor technology, and heating and cooling

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FOCUSED SESSION 3

Nanostructures and Low-Dimensional Materials for Chemical Sensors

A self-contained analytical device called a chemical sensor can provide information about the chemical composition of a liquid or gas phase. This device generates a measurable physical signal that is related to the concentration of a specific chemical species, or analyte. The functioning of a chemical sensor involves two main steps: recognition and transduction. In the recognition step, analyte molecules selectively interact with receptor molecules or sites in the recognition element, causing a physical parameter to change. An integrated transducer reports this variation as an output signal. If a chemical sensor uses biological recognition material, it is called a biosensor. Chemical sensors have various applications in fields such as medicine, industry, agriculture, and the military. Chemical sensors also play an important role in the development of Internet of Things solutions, and advancements in nanomaterials and microelectromechanical technology will contribute to further progress in chemical sensor development.

This focused session aims to present the most complete and reliable information on recent progress and prospects of high-performance chemical sensors that use nanostructures of inorganic, organic, and inorganic–organic hybrid materials, as well as low-dimensional materials like quantum dots, 2D materials, nanowires, and nanotubes. The session also welcomes abstracts related to theoretical calculations and modeling for chemical sensing and the newest applications of chemical sensors.

PROPOSED SESSION TOPICS

- Chemical sensors using nanostructures
- Chemical sensors based on 0D, 1D, and 2D materials
- Synthesis of nanostructures for sensitive chemical sensing
- Modification of nanomaterials for selective sensing
- New applications of chemical sensors
- Operando studies on chemical sensing mechanism
- Sensor array, e-nose, and e-tongue
- Theoretical calculations on chemical sensing

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FOCUSED SESSION 4

Ceramic/Carbon Reinforced Polymers

This focused session will cover ceramic- and/or carbon-reinforced polymer composites used in a wide range of industrial applications, including energy, environment, biological, space, transportation, building, and sport. It aims to bring together the technical community to share recent advances in experimental or simulation approaches for the fabrication, processing, characterization, properties, and modeling of ceramics and ceramics- and/or carbon-reinforced polymers. The role of inorganic phases in the composites, which are composed of textured or random fillers or fibers on the scale of nanometers to millimeters, is to provide various functionalities, such as mechanical, thermal, biological, insulation, electric, chemical resistant, and wear properties. This focused session will be the ideal showcase for the research activities of many groups involved in the development of ceramic- and/or carbon-reinforced polymers and composites and their recycling technology, including but not limited to the areas of ceramics, plastics, their interface chemistry, mechanics, modeling, and simulation and engineering applications.

PROPOSED SESSION TOPICS

- Innovative processing of ceramics and ceramic- and/or carbon-reinforced polymers
- Novel process and characterization technology of fiber, filler, matrix, and composites
- Mechanical behavior: Fracture, fatigue, deformation, and machine processing of ceramic- and/or carbon-reinforced polymers and composites
- Big data, informatics, computing, simulation, modeling, and theoretical approaches in ceramic- and/or carbon-reinforced polymers and composites
- Environmental, infrastructure, energy, biological, space, transportation, building, and sport applications
- Innovation for integration of ceramics and composites
- The role of composites in multimaterial systems
- Thermoplastics based composites
- Composite recycling technology

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FOCUSED SESSION 5

High-Voltage Materials for Advanced Electrical Applications

High-voltage electrified systems for aerospace and terrestrial applications are getting a lot of attention due to their importance in enabling the next generation of high-power technologies for aircraft and space exploration where lightweight, compactness, and high-speed power transmission are critical. Electrified systems require the development of novel lightweight multifunctional materials to lower the specific weight of power cables' insulation and conductor architectures. An improvement from state-of-the-art in conductor and electrical insulation is a step forward in that advancement of the technology. Carbon fibers and other carbon nanomaterials, which exhibit conductivities similar to or better than copper, have been considered to lower the specific weight of the electrical conductor. While the polymers used in state-of-the-art electrical insulation materials are not enough to achieve the performance required for these applications, the addition of ceramic fillers are being studied to improve their performance. Moreover, the developed materials systems needed to function properly at high voltages while withstanding extreme missions' electrical, chemical, thermal, and mechanical loading profiles. This situation necessitate developing relevant high-voltage test methods combined with identification, quantification, and modeling of durability and failure mechanisms of high-voltage materials and components. In addition, the developed test capabilities should be used to measure the developed materials electrical properties, such as ampacity, electrical conductivity, and breakdown voltage; mechanical properties, including stiffness, strength, and fatigue durability; and thermal properties, including thermal conductivity and upper temperature capability.

This focused session solicits abstracts related to the development and processing of lightweight electrical conductors, electrical insulation, and hybrid materials, as well as their testing in extreme environments, characterization, and performance. Although this solicitation is for aerospace applications, it is also beneficial to terrestrial applications.

PROPOSED SESSION TOPICS

- Development of lightweight durable conductors with metals and/or nanomaterials or carbon inclusions
- Electrical insulation development, using ceramic fillers in polymer and other novel materials and methods
- Ceramic candidates to improve electrical insulation performance
- Lifecycle characterization of high-voltage power transmission components
- Processing of high-voltage electrical component materials to form reliable electrical insulation and conductors
- Development of techniques to test, characterize, and design components in aerospace conditions at high voltages
- Identification, quantification, and modeling of durability and failure mechanisms of high-voltage materials
- Modeling the electrical performance of conductors and insulations in extreme environments

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13TH ANNUAL

Global Young Investigator Forum

The Global Young Investigators Forum (GYIF) aims to bring together students, postdoctoral researchers, young professionals, and early career faculty from around the world to showcase their research and promote scientific discussions to identify and tackle emerging global challenges at the forefront of ceramic science and engineering research. The GYIF dedicated symposium and poster session are a platform to support networking among young professionals, fostering global cooperation to approach current and future challenges in ceramic science and technology. The Global Young Investigator Award laureate will deliver the opening keynote lecture of the symposium. All GYIF participants will be invited to attend a private luncheon hosted by the president of The American Ceramic Society. The American Ceramic Society will also provide complimentary student registration for a select number of eligible students GYIF presenters.

PROPOSED SESSION TOPICS

- Fabrication, characterization, and modeling of advanced ceramics, ceramic-based composites, and coatings for energy, environmental, and functional applications
- Novel ceramic processing methods and synthesis routes, including new precursors for functional ceramics
- Additive manufacturing of ceramics and ceramic-based composites
- Nondestructive testing and advanced real time monitoring techniques and methods
- Advanced and nanostructured ceramics for sensors and actuators, energy generation, energy storage, catalysis, functional surfaces, and biomedical applications
- Career development in science, technology, engineering, mathematics, and medicine, including building collaborative networks, research projects, as well as supporting diversity and promoting sustainability in the field of ceramics

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SPECIAL FOCUSED SESSION ON

Diversity, Entrepreneurship, and Commercialization

This special focused session will recognize Jubilee Global Diversity Awardees—exceptional early- to mid-career women and/or underrepresented minorities (based on race, ethnicity, nationality, and/or geographic location) in the area of ceramic science and engineering who will be recognized and invited to present their contributions. In addition, this special focused session will focus on entrepreneurship and commercialization, as well as how diversity can play a role in such endeavors. As a background, entrepreneurship has become an important tool for job creation. More particularly, entrepreneurial process is a highly rewarding process, which revolves around freedom of thoughts, originality, risk-taking and recognizing gaps in the market, proactiveness, and competitive aggressiveness.

PROPOSED SESSION TOPICS

- Jubilee Global Diversity Awardees invited presentations
- Designing a successful start-up, for example, business strategy and business idea generation
- Assembling a focused team for a successful venture
- Reallocating different resources for the same, for example, human resource management
- Promoting problem-solving and creative and out-of-the-box thinking
- Impact of diversity on ideation and entrepreneurial endeavors
- Creating saleable products from research results
- Methods and tools for fostering and retaining broad diversity in science, technology, engineering, and mathematics, with a main focus on ceramic science

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