Feb. 13–16, 2024
Denver, Colorado

Electronic Materials and Applications 2024 (EMA 2024)

www.ceramics.org/ema2024

Organized by ACerS Electronics and Basic Science Divisions

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The American Ceramic Society
ceramics.org

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Organized by ACerS Electronics and Basic Science Divisions

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ABSTRACT SUBMISSION INSTRUCTIONS

- Visit www.ceramics.org/ema2024 for more information and to review session topics.
- Select "Submit Abstract" to be directed to the abstract submission website, or visit https://ema2024.abstractcentral.com

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

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Introduction

Electronic Materials and Applications 2024 (EMA 2024) is an international conference focused on electroceramic materials and their applications in electronic, electrochemical, electromechanical, magnetic, dielectric, and optical components, devices, and systems. Jointly programmed by the Electronics Division and Basic Science Division of The American Ceramic Society, EMA 2024 will take place at the Hilton Denver City Center, Feb. 13–16, 2024.

EMA 2024 is designed for scientists, engineers, and students interested in basic science, engineering, and applications of electroceramic materials. Participants from around the world in academia, industry, and national laboratories exchange information and ideas on the latest developments in theory, experimental investigation, and applications of electroceramic materials.

Students are highly encouraged to participate in the meeting. Prizes will be awarded for the best oral and poster student presentations. Students who wish to participate in the competition should opt in during the abstract submission process. In addition, there will be networking events as well as career development activities for students and young professionals.

The technical program includes plenary talks, invited lectures, contributed papers, poster presentations, and open discussions. EMA 2024 features symposia focused on dielectric, piezoelectric, pyroelectric, magnetoelectronic, magnetic, (multi)ferroic, quantum, relaxor, optoelectronic, and photonic materials; complex oxide thin films, heterostructures, and nanocomposites; semiconductors; superconductors; high-entropy oxides; materials for batteries; and materials for advanced microelectronics, next-generation computing devices, and 5G/6G applications. Other symposia emphasize broader themes covering processing, microstructure evolution, and integration; additive manufacturing; structure–property relationships; effects of surfaces and interfaces on processing, transport, and properties; point defects, dislocations, and grain boundaries; in-situ/operando characterization; computational design of electroceramics; and machine learning for novel materials.

EMA includes several networking opportunities to facilitate collaborations for scientific and technical advances related to materials, components, devices, and systems. The Basic Science Division will host a tutorial session in addition to the regular conference programming. The grand finale of the meeting will again be the symposium Failure: The Greatest Teacher. We invite anyone interested to submit a brief abstract for this educational and engaging event that concludes the meeting.

Please join us in Denver, Colorado, to participate in this unique experience!

S1- Characterization of Structure- Property Relationships in Functional Ceramics

Probing structure–property relationships in functional ceramics demands an integrated approach combining complementary experimental probes (e.g., light, X-ray, electron, neutron) with theory and simulation. Spatially and temporally resolved multiscale state-of-the-art scattering, imaging, and/or spectroscopy techniques can capture dynamic material structure, composition, and microstructure under external stimuli (e.g., electric/magnetic fields, stress/strain fields), which are necessary to answer many open questions in this field.

This symposium bridges the Basic Science and Electronics Divisions, focusing on rapidly developing experimental techniques, big-data analysis, and modeling approaches to answer open structure–property relationship questions in functional ceramic materials and demonstrate use cases of these methods.

The symposium will demonstrate new characterization techniques and stimulate new research questions and collaborations. Methods for approaching challenging material problems spanning from functional interfaces to structural ordering will be featured. Contributions integrating novel applications of computational tools to predict and interpret scattering, diffraction, and microscopy data are also welcome.

Proposed sessions

- Advances in scattering, imaging, and analytical techniques
- Integrating machine learning into the structural measurement workflow
- Advances in connecting local and global structure to properties
- Addressing open questions in functional ceramics

Organizers

Hadas Sternlicht, University of California, Berkeley, Lawrence Berkeley National Laboratory, USA, *HSternlicht@lbl.gov*
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S2 - Advanced Microelectronics of Structure–Property Relationships in

This symposium focuses on recent advances and developments in advanced microelectronics for next-generation device applications. Topics of interest include devices in memory and data storage, quantum information science, neuromorphic computing, flexible electronics, and optoelectronics. Contributions that connect device design/fabrication, defects, and interface to structure and device performance are of particular interest.

The goal is to create an international and interdisciplinary forum for researchers from industry, academia, and national laboratories to exchange ideas and foster collaboration. Broad areas of interest include the use of modeling and simulation to predict device properties, and the role of defects, interface, and synthesis/fabrication process on device performance. Specific devices of interest are memory and data storage devices based on spintronics and ferroelectrics, memristive devices, neuromorphic systems, transistors, detectors, and flexible electronics.

Proposed sessions

- Theory, modeling, and first principles calculations of devices performance and properties
- Role of defects, interface, and synthesis/fabrication process on device properties
- Ohmic and Schottky contacts for devices
- Memristive switching and performance
- Memory and data storage devices based on spintronics and ferroelectrics
- Emergent devices for novel computing such as neuromorphic computing
- Next generation quantum information devices
- Dielectrics and ferroelectrics for device applications (e.g., gate dielectric and energy storage)
- High-performance thin film and 2D (e.g., van der Waals heterostructures) transistors and devices
- Flexible electronics

Organizers

Aiping Chen, Los Alamos National Laboratory, USA, *apchen@lanl.gov*
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Tom Harris, Sandia National Laboratories, USA
Weiwei Li, Nanjing University of Aeronautics and Astronautics, China

S3 - Advanced Electronic Materials: Processing, Structures, Properties, and Applications

This symposium brings together materials and engineering researchers to present the latest advances in electronic materials, including synthesis/processing as well as microstructure analysis and characterization of dielectric, piezoelectric, pyroelectric, and ferroelectric properties in the form of bulk ceramics, single crystals, glasses, and multilayers. These materials have tremendous impact on a variety of technologies, including ultrasonic transducers, memories, MEMS devices, actuators, sensors, and tunable microwave devices. Other topics of interest include nanoscale domain phenomena, defect chemistry, structure–property relationships, and electric-field-induced phase transitions.

Proposed sessions

- Advanced electronic materials, including ferroelectric, piezoelectric, dielectric, electrostrictive, electrocaloric, and pyroelectric materials
- Materials design, new materials and structures, and their emerging applications
- Performance, reliability, and fatigue of ferroelectrics and related devices

Organizers

Eric Patterson, U.S. Naval Research Laboratory, USA, *eric.patterson@nrl.navy.mil*
Satoshi Wada, University of Yamanashi, Japan
Shujun Zhang, University of Wollongong, Australia

S4 - Complex Oxide Thin Films and Heterostructures: From Synthesis to Strain/Interface-engineered Emergent Properties

This symposium covers recent advances in oxide thin films, heterostructures, and nanocomposites. Topics include epitaxy of complex oxides, strain–stabilization, heterointerface engineering, emergent interfacial properties, new materials, field tunable responses, advanced characterizations, device applications, and extensions to performance limits. Contributions that connect advances in synthesis science to structure and property trends are of particular interest, as are those which link theoretical/computational and experimental efforts.

The goal is to create an international and interdisciplinary forum for scientists, engineers, and researchers from industry, academia, and national laboratories to exchange ideas and foster collaboration. Broad areas of interest include the theoretical understanding and design of material properties using first principles-based methods to enhance and inform synthesis; stabilization of new structures and useful functionality through strain and heterointerface engineering within multilayers and vertically aligned nanocomposites; emergent properties in high-entropy complex oxides; understanding the relationship between process space and equilibrium defect chemistry; strain-induced defects and interfacial microstructure and their relationships to material properties; and device fabrication and applications in, for example, energy harvesting, memories, and sensors. Specific properties of interest are magnetic, electronic, electrochemical, and photonic responses, as well as thermal transport phenomena, including strong correlation and quantum-confinement effects.

Proposed sessions

- Theory, modeling, and first principles calculations of complex oxides and their heterostructures with focuses on strain and interface
- Controlled synthesis of epitaxial thin films and nanocomposites, including heterostructures, superlattices, and vertically aligned nanocomposites for functional properties
- Synthesis and properties of high-entropy complex oxides
- Strain, microstructures, and functionality tuning in superlattices, vertical nanocomposites, and high-entropy complex oxides
- Phenomena arising from strain couplings and interface couplings, including quantum phases and topological states and their control via external stimuli
- Characterizations of strain, defects, and interfaces
- Strain- and interface-controlled device performance in energy harvesting, memories, and sensors, among others

Organizers

Hyoungjeen Jeen, Pusan National University, South Korea, *hjeen@pusan.ac.kr*
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Judith L. MacManus-Driscoll, University of Cambridge, UK
Aiping Chen, Los Alamos National Laboratory, USA
Elizabeth Paisley, Sandia National Laboratories, USA
Weiwei Li, Nanjing University of Aeronautics and Astronautics, China
Yingge Du, Pacific Northwest National Laboratory, USA

S5 - Controlling Grain Boundary Structure, Chemistry, and their Network as a Function of Material Processing

Electronic and mechanical properties that control the function of ceramic devices, like capacitors and sensors, are highly dependent on the structure and chemistry of grains, grain boundaries, and the subsequently formed grain boundary network. The atomic structure, bonding configuration, defect distribution, segregation behavior of these boundaries, and the overall microstructure of the system are altered by material processing techniques. Developing a fundamental understanding of the effect of processing techniques on modifying these internal interfaces and, in turn, impacting the microstructure of ceramic materials is needed to tailor their properties and optimize their application in device technology.

This symposium explores fundamental research into the modifications of internal interfacial structure and composition as well as microstructure evolution in functional materials as it relates to processing techniques. These processing techniques include sintering, electric fields, high-temperature and cryogenic applications, and gas environments.

Proposed sessions

- Interface structure and chemistry
- Atomic structure, chemistry, bonding configuration
- Defect and segregation behavior
- In-situ microscopy evaluation
- Microstructure evolution
- Grain growth and mobility
- Nanocrystalline ceramics
- Material properties
- Processing parameters
- Mechanical and electric fields (e.g., SPS, FAST, HIP)
- Extreme temperatures (e.g., cold sintering, SPS)
- Environments (e.g., oxygen, hydrogen)

Organizers

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Amanda Krause, Carnegie Mellon University, USA, *amandakr@andrew.cmu.edu*
Hadas Sternlicht, University of California, Berkeley, Lawrence Berkeley National Laboratory, *hsternlicht@lbl.gov*

S6 - Interfacial Transitions in Polycrystalline Materials

The presence of internal interfaces can have a dramatic effect on materials properties. This symposium brings together both experimentalists and computational scientists who are interested in exploring grain-boundary “phase” (complexion) transitions and their impact on boundary kinetics (e.g., mobility, diffusivity, complexion nucleation) and associated thermomechanical properties (e.g., hardness, thermal conductivity). A list of current topics would include, but is not limited to, thermodynamic descriptions, complexion diagrams, complexion nucleation mechanisms, experimental characterization of complexions, complexion modeling, the impact of complexion transitions on materials properties, and complexion engineering.

Proposed sessions

- Complexion modeling
- Complexion engineering
- Complexions and thermomechanical properties

Organizers

Jeffery Rickman, Lehigh University, USA, *jmr6@lehigh.edu*

S7 - Defects and Transport in Ceramics

This symposium highlights experimental and computational research aimed at understanding point defect equilibria and kinetics in ceramic materials. Defect chemistry governs conductivity and impacts interfacial reaction kinetics in electronic, ionic, and mixed-conducting ceramics. These materials are important for numerous applications, including solid-state batteries, memristors, dielectrics, solid oxide fuel/electrolysis cells, catalysts, and sensors. Many operate under extreme electrochemical conditions to gain higher energy, power density, and novel properties. In addition, defect transport is intimately related to microstructure evolution and many material degradation phenomena. We encourage symposium contributions that help establish a greater understanding of our ability to predict, design, and control defects to enhance ceramic properties and performance, including under extreme far-from-equilibrium conditions. This symposium furthermore includes the influence of dislocations and grain boundaries as higher-dimensional defects.

Proposed sessions

- Predictive bulk and interfacial point defect energetics and equilibria from density functional theory, molecular dynamics, and other computational methods
- Structure and stability of defects and defect complexes via in-situ measurement (e.g., EPR, TSDC, EXAFS)
- Defect-mediated transport & reaction kinetics, including concerted/cooperative effects, via advanced in-situ and ex-situ measurement (e.g., QENS, NMR, isotope-APT)
- High-throughput, screening, and combinatorial methods applied to the study of defect equilibria and point defect-mediated properties
- Point defect segregation to or depletion from dislocations, surfaces, grain boundaries, and interfaces
- Defect mobility and transport behavior, including under operando or in extreme environments (e.g., temperature, chemical reactions, stress, high E-fields, irradiation)
- Defect-mediated properties (e.g., conductivity, surface oxygen or proton exchange kinetics, optical absorption, grain growth, creep, magnetism, ferroelectric imprint, dielectric degradation)
- Impact of dislocations and grain boundaries on ceramic functional properties

Organizers

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S8 - Data-Driven and Model-Supported Structure–Property Relationships in Complex Electroceramics

Modeling combined with experimental data has been increasingly employed to better understand structure–property relationships in various branches of ceramic science and engineering. In particular, exciting results have been unveiled in the field of ferroic materials, which are useful to develop the next generation of energy harvesting and storage, sensors, and actuators. Often these are both chemically and structurally complex systems, thereby understanding the role of differently charged substituents, their distribution in the lattice, and the arrangement of phases or of polar order/disorder on multiple length scale is of paramount importance to optimize their performance. Recent contributions in the field of materials genomics, for example, with the use of high-throughput density functional theory and artificial intelligence-based optimization, have shown their strength in uncovering new or overseen structure–property relationships and in designing new materials with improved functionalities. In addition, the use of finite element modeling and phase field modeling is also important to better understand the electrical response of ferroic ceramics.

This symposium targets the use of data-driven and modeling methods combined with experimental data to rapidly uncover the structure–property relationships in complex, disordered solids, including (but not limited to) ceramic relaxors and superparaelectrics, nanostructured metallic oxides, and semiconductors. Specifically, the interplay of local structure, chemistry, configurational entropy, ergodic–nonergodic behavior, and instabilities induced by substitution and electric polarization on multiple length scales and how it impacts macroscopic properties relevant for applications (energy storage, electromechanical, and electrocaloric applications, among others) is a topic we look for. Importantly, we welcome contributions involving advanced nano- to microscale characterization methods in synergy with multiscale modeling, providing key insights to better understanding the structure–property relationships in complex and disordered solids.

Proposed sessions

- Theoretical foundations of data-driven models
- Local structure and properties of complex electroceramics
- Model-supported advanced nano- and microscale characterization methods
- Real-world applications

Organizers

Antonio Feteira, Sheffield Hallam University, UK, a.feteira@shu.ac.uk
Marco Deluca, Materials Center Leoben Forschung GmbH, Leoben, Austria
Prasanna V. Balachandran, University of Virginia, USA
Jiri Hlinka, Institute of Physics, Academy of Sciences of the Czech Republic, Czech Republic

S9 - Machine Learning and Automated Synthesis/Characterization for Novel Materials

Typically, materials research involves repeated cycles of conception, design, synthesis, and characterization, which rely on human scientists for data analysis, decision-making, and manual operation of scientific tools, resulting in long timelines for new materials development. An emerging topic is combining machine learning, tool automation, and human knowledge/physical hypotheses to realize autonomous experiments, where machine learning models are used to analyze data, refine theories/hypotheses, and make decisions for future experiments. As such, an iterative loop of experiments can be carried out without human intervention and accelerate the discovery of new materials and physics.

This symposium covers topics related to the applications of machine learning in materials research, including autonomous experiments, high-throughput synthesis and characterization, and algorithms developments for materials science. This symposium aims to bring together researchers across the materials science and machine learning communities to foster and accelerate the development of novel materials and fundamental knowledge.

Proposed sessions

- Data-driven discovery of materials and physics
- Autonomous research
- High-throughput experiments
- Computer-assisted experiment automation
- Data-driven modeling and analysis
- Embed physics in machine learning
- Knowledge extraction and model interpretation
- Experiment planning and workflow design

Organizers

Yongtao Liu, Oak Ridge National Laboratory, USA, *liuy3@ornl.gov*
Mahshid Ahmadi; Affiliation: University of Tennessee, USA
Jason Hattrick-Simpers; Affiliation: University of Toronto, Canada
Jian Lin; Affiliation: University of Missouri, USA

S10 - Fundamental Mechanisms in Materials for Next-Generation Computing Devices

Typically, materials research involves repeated cycles of conception, design, synthesis, and characterization, which rely on human scientists for data analysis, decision-making, and manual operation of scientific tools, resulting in long timelines for new materials development. An emerging topic is combining machine learning, tool automation, and human knowledge/physical hypotheses to realize autonomous experiments, where machine learning models are used to analyze data, refine theories/hypotheses, and make decisions for future experiments. As such, an iterative loop of experiments can be carried out without human intervention and accelerate the discovery of new materials and physics.

This symposium covers topics related to the applications of machine learning in materials research, including autonomous experiments, high-throughput synthesis and characterization, and algorithms developments for materials science. This symposium aims to bring together researchers across the materials science and machine learning communities to foster and accelerate the development of novel materials and fundamental knowledge.

Proposed sessions

- Phase transitions in 2D materials and devices
- CMOS compatible ferroelectric materials and devices
- Fundamental materials needs for emerging computing paradigms
- Electrochemical and reservoir memory and computing devices
- Scalable modeling and computation for switching phenomena
- Applications of machine learning in device modeling and characterization
- Co-design of materials, devices, and systems
- Advanced characterization techniques

Organizers

Petro Maksymovych, Oak Ridge National Laboratory, USA, *maksymovychp@ornl.gov*
Yiyang Li, University of Michigan, USA

S11 – In-situ/Operando Characterization of Nanomaterials

The advancement of new technologies in recent decades has enabled a variety of new in-situ/operando techniques to study the materials behavior and microstructure evolutions in real time. The external stimulus can be in many forms, including heating or cooling, mechanical stress, light exposure, electric or/and magnetic fields, reactive gas or liquid environments, and ion irradiation, for example. By capturing the real-time materials evolutions under certain external stimulus using in-situ/operando characterization techniques, we can understand the functionality and device operation mechanisms fundamentally in their proposed working environments, which undoubtedly facilitate the development of novel material systems and devices for various technological applications.

This symposium focuses on the recent progress and development of using in-situ/operando techniques to characterize functional and structural materials and devices. These techniques use photon, electron, neutron, and X-ray to probe materials and devices, including but not limited to transmission electron microscopy, X-ray and neutron diffraction/reflectivity, atomic force microscopy, and synchrotron techniques.

Proposed sessions

- In operando study of advanced functional materials, including transition metal oxides, graphene, transition metal dichalcogenides, and halide perovskites
- Study of electronic materials such as Mott insulators, dielectrics, ionics, ferroics, semiconductors, and superconductors using advanced characterization techniques
- In operando study of device performances and behaviors including batteries, fuel cells, solar cells, memristors, and memory devices
- Study of nanomaterial-based catalysts at reactive environments
- Real-time investigation of mechanical properties in structural materials
- Advances in developing in-situ characterization techniques related to electron microscopy, X-ray, and neutron characterization techniques

Organizers

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S12 - Magnetic and Superconducting Materials: From Basic Science to Applications

The ever-growing field of magnetic materials enables countless technologies, including information storage, sensing, transportation, communications, and biomedical applications. Additionally, superconductivity and magnetism and their correlation to spin, charge, and orbital order parameters are dominant topics in quantum material research. To bridge the gap between fundamental research and device performance/applications for magnetic and superconducting materials requires approaches that transect multiple disciplines and require a collaborative approach.

This symposium covers a broad range of topics related to magnetism, including superconductivity; the magnetic materials synthesis, characterization, and applications thereof; plus other topics of magnetic materials. Specific topics include superconducting magnetic materials, synthesis and characterization of nanomaterials and composites, modeling at multiple length scales, microwave or mm-wave materials, spintronics devices, magneto-ionics, magnetocalorics, and rare-earth-free permanent magnets. Relevant work spanning theory, synthesis, and characterization of new materials and phenomena is welcomed for submission to this symposium. The goal is to create an interdisciplinary forum where stakeholders from academia, industry, and national laboratories can discuss cutting-edge research to foster new collaborations to further advance the field of magnetism.

Proposed sessions

Superconducting and related magnetic materials

- Low dimensional, correlated magnetic materials
- Theory and advanced characterization of superconductivity
- Tailoring superconducting magnetic properties for applications
- Superconducting devices: from nanoscale to large-scale applications

Other magnetic materials

- Nanomaterials and composites, skyrmions and other topological phenomenon, 2D magnetic materials
- Multiscale modeling of magnetism: first principles calculations, phase-field modeling, micromagnetics simulations, finite element analysis, high-throughput evaluation of materials (both computationally and experimentally)
- High-frequency magnetic phenomena: spintronics, microwave materials, ultrafast switching, and other magnetization dynamics

- Sustainability in magnetics research: rare-earth-free permanent magnets, materials recycling, and other novel synthesis processes from waste products, low-temperature or other energy-efficient processing methods, green technologies
- Novel applications of magnetic materials: magnetoelectrics, magneto-ionic transport, magnetocalorics, hybrid magnonics, magnetoresistance, quantum magnetic phenomena

Organizers

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Margo Staruch, U.S. Naval Research Laboratory, USA
Jennifer Andrew, University of Florida, USA
Connor Smith, U.S. Naval Academy, USA
Lauren Garten, Georgia Tech, USA
Jiamian Hu, University of Wisconsin, USA
Mike Susner, Air Force Research Laboratory, USA
Timothy Haugen, Air Force Research Laboratory, USA
Gang Wang, Institute of Physics, Chinese Academy of Sciences, China

S13 - Frontiers in Ferroic oxides: Synthesis, Properties, and Applications

Ferroic oxides exhibit rich physics and great potential for applications in next-generation devices. Significant research efforts over the past decades have created unprecedented advances in the study of these materials. Recent breakthroughs in materials synthesis, characterization, theory and modeling, and device fabrication have led to emerging materials in the form of bulk crystals, thin films, heterostructures, and nanomembranes, as well as emergent phenomena, including but not limited to exotic topological structures, magnetoelectricity, magnetoelectronics, and quantum magnetism. These advancements have attracted worldwide interest and opened up a new era toward understanding fundamental ferroic phenomena.

This symposium will focus on the interdisciplinary topics related to the physics, materials science, and engineering within the field of ferroic oxides. The goal of this symposium is to bring together scientific experts and young scientists with an interest in ferroic materials to advance the fundamental understanding, develop modern experimental techniques, and explore new devices and applications.

Proposed sessions

- Advanced synthesis and characterization techniques for ferroic oxides
- Low-dimension ferroic oxides
- Heavy transition metal oxides
- Multiscale theory and modeling of ferroicity
- Electrical control of magnetism and spin textures
- Ferroic materials for novel devices
- Spin-orbit electronics

Organizers

Jian Liu, University of Tennessee, USA, *jianliu@utk.edu*
Ruijuan Xu, North Carolina State University, USA
Gang Cao, University of Colorado-Boulder, USA

S14 - Emerging Semiconductor Materials and Interfaces

This symposium will focus on the recent advances in new semiconductors and heterostructures for advancing the state-of-the-art in a wide range of devices, from power, RF, and logic to optoelectronics and photonics. Materials of interest for this symposium will include wide bandgap and ultrawide bandgap semiconductors, 2D materials, and inorganic perovskites. The symposium will include synthesis, characterization, and high-throughput computational materials screening of these materials. The symposium will provide an interdisciplinary forum for researchers with expertise in diverse materials platforms to interact with each other, which will lead to cross pollination of new ideas.

Proposed sessions

- WBG and UWBG materials: synthesis, characterization, theory
- 2D materials: synthesis, characterization, theory
- Inorganic perovskites: synthesis, characterization, theory
- Other

Organizers

Hari Nair, Cornell University, USA, *hn277@cornell.edu*
Sang-Hoon Bae, Washington University in Saint Louis, USA
Nidhin Kurian Kalarickal, Arizona State University, USA

S15 - Electronics Materials for 5G/6G Applications

Right now, there is a worldwide race to implement millimeter-wave (mmWave) technologies for the sixth and fifth generation (5G/6G) communication systems and win a piece of the $5.6T telecommunications gross revenue. New technologies spanning the space between analog and digital electronics require innovations in materials science and measurement to facilitate commerce in the mmWave regime. Novel materials can help manufacturers tackle the 5G/6G challenges by accessing fundamental physics, including phase transitions, controlling loss, enhancing transport, and physical models, among others. In this symposium, we kickoff a discussion between worldwide experts from academia, government labs, and industry to identify how ceramics can help. Presentations and discussions are expected to address technical challenges and insights across a wide range of topics, ranging from materials-by-design to proof-of-concept device development, all of which are relevant to a diverse application space. The broader impacts of this symposium will facilitate innovations in mmWave technology.

Proposed sessions

- 5G/6G metrology
- 5G/6G devices
- Materials growth and design

Organizers

Nate Orloff, National Institute of Standards and Technology, USA; orloff@nist.gov
Rick Ubic, Boise State University, USA
Geoff Brennecka, Colorado School of Mines, USA

S16 - New Frontiers and Science in Additive Manufacturing of Ceramic Materials

Additive manufacturing (AM, or 3D printing) has emerged as a set of novel ceramic manufacturing processes with the advantages of design freedom, flexibility, high customization, and waste minimization. Various AM processes have been developed for structural and functional ceramic materials, including binder jetting, stereolithography, ink jet printing, selective laser sintering, and fused deposition modeling, which have provided new opportunities to overcome the limitations of traditional ceramic manufacturing processes, such as the long processing time and difficulty to fabricate structures with complex geometries.

This special symposium will provide an international forum to foster technical discussions of the fundamental mechanisms related to processing–microstructure–property relationship during AM of ceramic-based materials. With the recent advances in powder processing, in-situ process monitoring, in-situ and ex-situ characterization tools, nondestructive evaluation and testing, and qualification and certification, we will develop a better understanding of the physical mechanisms controlling the unique microstructures, defect formation, and physical and chemical properties of additively manufactured ceramics.

Proposed sessions

- New approaches for AM processes of ceramics and ceramic matrix composites
- Novel techniques to prepare ceramic powders for AM
- Multiscale computational modeling and data-driven process optimization
- In-situ and ex-situ characterization of, for example, phase transformation, textures, and defects using synchrotron X-ray, neutron diffraction, and electron microscopy
- Mechanical, thermal, electrical, magnetic, and optical properties
- New applications of additively manufactured ceramics

Organizers

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Fei Peng, Clemson University, USA
Matjaz Spreitzer, University of Ljubljana, Slovenia
Mina Yoon, Oak Ridge National Laboratory, USA
Klaus van Benthem, University of California, Davis, USA
Amanda Krause, Carnegie Mellon University, USA

S17 - Electronic and Ionic Materials in Battery Energy Storage

The continued advance of batteries for both mobile and stationary applications hinges on the scientifically informed innovation of key electronic and ionic materials across the entire battery assembly. Understanding the fundamental material properties and dynamic, multiscale electrochemical phenomena that govern battery performance is key to the innovation and design of the next generation of safe, cost-effective, and high-performance batteries. We are soliciting abstracts that describe innovative electronic and ionic materials advances for a wide range of battery chemistries, including lithium-ion, non-lithium (e.g., sodium, zinc, potassium, magnesium, calcium), redox flow, metal-air, solid state, and other emerging systems. We are interested in fundamental experimental investigations of electronic and ionic phenomena, computational modeling and predictions of battery behavior, advanced characterization techniques, and assessments of battery performance in half-and full-cell testing. The symposium will emphasize energy storage, in contrast to energy generation (e.g., fuel cells or hydrogen production) and of particular interest are topics around non-lithium-ion chemistries or large-scale, long-duration energy storage.

Proposed sessions

- Electrodes (anodes and cathodes)
- Solid-state ion conductors
- Interfaces
- Current collectors/electrode supports
- Next-generation electrolytes
- Separatorss

Organizers

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Jon Ihlefeld, University of Virginia, USA
Hua Zhou, Argonne National Lab, USA
Claire Xiong, Boise State University, USA

S18 - Structure and Function in High-Entropy, Entropy-Stabilized, and Related Oxides

Compositionally complex oxides, including high-entropy and entropy-stabilized, have unique structure–property combinations compared to their enthalpy-stabilized analogs. Leveraging configurational entropy, these materials cover a broad and more flexible compositional space than many functional oxides, providing a path for reduced dependence on expensive and toxic materials with the equivalent, or superior, properties.

One barrier to fundamental and applied advances in these materials is the complexity of their structure–property relationships and potential lack of thermodynamic equilibrium, including interdependence of properties, structure, composition, and processing. Further, important structural features span several length scales, including local distortions (e.g., Jahn-Teller distortions), short-range order, strain, and nanoscale chemical segregation. This hierarchical structure and compositional complexity also increase computational costs, requiring advanced approaches to predicting and understanding structure and function in these exciting ceramics.

This symposium aims to provide a platform for interdisciplinary experts to highlight advances of compositionally complex oxides spanning properties, processing, structural characterization, and computation.

Proposed sessions

- ESOs in energy storage
- Characterization and quantification of structure and properties
- Understanding and predicting structure and properties through computation and data science
- Other

Organizers

Megan Butala, University of Florida, USA, mbutala@ufl.edu
Juan Nino, University of Florida, USA, jnino@mse.ufl.edu
Valentino (Tino) Cooper, Oak Ridge National Laboratory, USA, coopervr@ornl.gov

S19 - Failure: The Greatest Teacher

The vast majority of scientific literature and conference talks report positive results, but there is a lot to be learned from negative results and missteps as well. Do not miss this opportunity to hear recognized leaders in the field discuss failure and perhaps recount some of their most spectacular learning experiences during a frank and friendly discussion in a relaxed atmosphere. Speakers and audience alike are encouraged to check their egos at the door for this event that has turned into an EMA highlight.

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- Characterization and quantification of structure and properties
- Understanding and predicting structure and properties through computation and data science
- Other

Organizers

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