January 23 – 25, 2019 | DoubleTree by Hilton Orlando at Sea World Conference Hotel | Orlando, FL, USA

# ELECTRONIC MATERIALS AND APPLICATIONS 2019 (EMA 2019)

ORGANIZED BY THE ACERS ELECTRONICS AND BASIC SCIENCE DIVISIONS

## CALL FOR PAPERS

Abstracts deadline
September 5, 2018

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# Electronic Materials and Applications 2019 (EMA 2019)

## Organized by the ACerS Electronics and Basic Science Divisions

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## ABSTRACT SUBMISSION INSTRUCTIONS

- Visit **ceramics.org/ema2019** to review session topics.
- Select "Submit Abstract" to be directed to the Abstract Central website. Abstract title and text character limit (including spaces) is 1,500 characters.

If you have questions, please contact **Marilyn Stoltz** at **mstoltz@ceramics.org** or +1 614-794-5868.

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## INTRODUCTION

The 2019 Electronic Materials and Applications Conference is an international meeting focused on electronic and electroceramic materials and their applications in electronic, electromechanical, magnetic, dielectric, and optical components, devices, and systems. Jointly programmed by the Electronics and Basic Science divisions of The American Ceramic Society, EMA 2019 will take place at the DoubleTree by Hilton Orlando at Sea World® January 23-25, 2019

EMA 2019 is designed for researchers, engineers, technologists, and students interested in basic science, engineering, and applications of electronic and ceramic materials. Speakers include an international mix of university, industrial, and federal laboratory participants exchanging information and ideas on the latest developments in theory, experimental investigation and applications of electronic materials and ceramics. Students are especially encouraged to participate in the meeting with prizes awarded for the best oral and poster student presentations.

The technical program includes plenary talks, invited lectures, contributed papers, poster presentations, and open discussions. EMA 2019 features symposia focused on advanced characterization methods; processing, properties, and applications of advanced electronic materials; ferroic oxides; complex oxide films; mesoscale properties of electronic materials; complex oxide and chalcogenide semiconductors; superconducting and magnetic materials; structure-property relationships in relaxors; ion conductors; basic science and electronic applications in microstructure evolution; materials for 5G telecommunications; thermal transport; and material design.

EMA 2019 includes several networking opportunities to facilitate collaborations for scientific and technical advances related to materials, components, devices, and systems. Special lunchtime sessions will be geared toward students and young professionals. The grand finale of the meeting will again be the popular "Failure: The Greatest Teacher" where established researchers discuss the great ideas that they've had that did not work out for one reason or another.

We are pleased to build upon the success of this conference series by again providing a distinctive forum to address emerging needs, opportunities, and key challenges in the field of electronic materials and applications. This meeting continues to highlight the most recent scientific advances and technological innovations in the field, and to facilitate the interactions and collaborations that will help shape its future.

**Please join us in Orlando, Florida to participate in this unique experience!**

## OFFICIAL NEWS SOURCES

American Ceramic Society bulletin — emerging ceramics & glass technology

CeramicTechToday — From the American Ceramic Society

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## ORGANIZING COMMITTEE


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## TECHNICAL PROGRAM

### S1: Characterization of Structure-Property Relationships in Functional Ceramics

Probing structure-property relationships in functional ceramics demands an integrated approach that combines multimodal experimental approaches (light, X-ray, electron, neutron etc.) with theory and simulation. State-of-the-art characterization techniques that address multiple dimensions (2D, 3D, and beyond), are multiscale (both spatially and temporally), and can capture dynamic material responses under external stimuli (electric and magnetic fields, stress and strain fields etc.) are necessary to answer many open questions in this field.

This symposium is intended to provide a bridge between the Basic Science and Electronics divisions of EMA 2019. Half of the symposium will focus on rapidly developing experimental techniques best suited for characterizing functional ceramics, while the other half will focus on the use of these techniques, together with existing experimental and modelling approaches, to answer open structure-property questions. Materials of interest include, but are not limited to: Energy storage materials, ferroics and multiferroics (ferroelectrics, electrocalorics, magnetoelectrics, relaxors), flexoelectrics, optical materials, etc. The symposium is aimed at exposing scientists to new characterization techniques and unfamiliar research questions to bring about new ideas and new collaborations. Methods for approaching the challenging material problems spanning functional interfaces, short range structural orders, and long-range crystallinity will be featured. One of the sessions will focus on the work of early career researchers (untenured or newly tenured).

**Proposed sessions**

– Imaging and analytical techniques
– Addressing open questions in functional ceramics

**Symposium organizers:**

- **David W. McComb**, The Ohio State University, USA, mccomb.29@osu.edu
- Abhijit Pramanick, City University of Hong Kong, Hong Kong, apramani@cityu.edu.hk
- Julian Walker, The Pennsylvania State University, USA, jxw512@psu.edu
- Arno Merkle, XRE, Belgium, arno.merkle@xre.be
- Hugh Simons, Technical University of Denmark, Denmark, husimo@fysik.dtu.dk

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## Organized by the ACerS Electronics and Basic Science Divisions

### S2: 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, and pyroelectric materials
– Materials design, new materials and structures, and their emerging applications
– Reliability and fatigue of ferroelectrics and related devices

**Symposium organizers**

- **Shujun Zhang**, University of Wollongong, Australia; shujun@uow.edu.au
- Xiaoli Tan, Iowa State University, USA
- Kyle Webber, Friedrich-Alexander Universität Erlangen-Nürnberg, Germany
- Satoshi Wada, University of Yamanashi, Japan

### S3: Frontiers in Ferroic Oxides: Synthesis, Structure, Properties, and Applications

Complex oxides offer an extremely wide range of properties not observed in conventional metals or compound semiconductors. In these correlated materials, new emergent phenomena may arise at intrinsic homointerfaces such as domain walls. This symposium will focus on the interdisciplinary topics related to the physics, materials science, and engineering within the field of ferroic oxides, domains, and domain walls. The topical list for this symposium reflects the materials needs and challenges within the field, with emphasis on synthesis, ferroic domain/domain wall architecture-property correlations, and exploratory devices. The speakers will span the breadth of these interdisciplinary topics in order to accelerate the understanding and development of materials and heterostructures to enable new functionalities for (multi)ferroic oxides.

**Proposed sessions**

– Magnetic, ferroelectric, and multiferroic films and ceramics
– Synthesis of ferroic oxides
– Structure and defects, structure-property relationships
– Domain and domain walls
– Theory and modeling: Domain structure and evolution
– Materials integration and applications: Rewritable electronics using domain walls, computational devices, sensors, transducers, actuators, medical devices

**Symposium organizers**

- **John Heron**, University of Michigan, USA, jtheron@umich.edu
- Morgan Trassin, ETH Zurich, Switzerland, morgan.trassin@mat.ethz.ch
- Jinxing Zhang, Beijing Normal University, China, jxzhang@bnu.edu.cn

### S4: Complex Oxide Thin Film Materials Discovery: From Synthesis to Strain/Interface Engineered Emergent Properties

This symposium seeks recent advances in complex oxide thin films, heterostructures, and nanocomposites. Topics of interest include strain-stabilization, interface engineering for heterostructures, emergent interfacial properties, new materials discovery, field tunable responses, device applications, and advanced measurement/characterization methods. Contributions that connect synthesis science to structure and property trends are of particular interest, as are those which link computational and experimental efforts. Broad areas of interest include: Theoretical understanding and design of material properties using first principles based methods; stabilizing new structures and useful functionality through strain and heterointerface engineering within multilayers and vertically aligned nanocomposites; 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 energy harvesting, memories, sensors, etc. Specific properties of interest are magnetic, electronic, ionic and photonic responses, as well as thermal transport phenomena, including correlation and quantum-confinement effects.

**Proposed sessions**

– Theory, modeling and first principles calculations of complex oxide thin films and heterostructures with focuses on strain and interface
– Controlled synthesis of lateral and vertical heteroepitaxial thin films and nanocomposites including heterostructures, superlattices, and vertically aligned nanocomposites
– Synthesis and properties of high entropy complex oxides
– The effects of film growth conditions on strain, interface and functional properties
– New materials/structures enabled via controlled synthesis
– Characterizations of strain, defects and interface
– Strain relaxation and its correlation to functional properties
– Strain, microstructures and functionality tuning in lateral and vertical nanocomposites
– Phenomena arising from strain couplings and interface couplings, including quantum phases and topological states
– Interface phenomena induced by charge redistribution, magnetic, electronic and orbital reconstructions, intermixing, structural distortion, etc.
– Control of interface phenomena via external stimuli such as electric and magnetic fields, and light
– Strain and interface controlled device performance in energy harvesting, memories, sensors, etc.

**Symposium organizers**

- **Aiping Chen**, Los Alamos National Laboratory, USA, apchen@lanl.gov
- Elizabeth Paisley, Sandia National Laboratories, USA, eapaisl@sandia.gov
- Hyoungjeen Jeen, Pusan National University, South Korea, eapaisl@sandia.gov
- Jon-Paul Maria, The Pennsylvania State University, USA, jpm133@psu.edu
- James Rondinelli, Northwestern University, USA, jrondinelli@northwestern.edu
- Sean Smith, Sandia National Laboratories, USA, ssmith5@sandia.gov
- Judith L. MacManus-Driscoll, University of Cambridge, UK, jld35@cam.ac.uk

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- Roman Engel-Herbert, The Pennsylvania State University, USA, rue2@psu.edu
- Junwoo Son, Pohang University of Science and Technology, South Korea, jwson@postech.ac.kr

## S5: Mesoscale Phenomena in Ferroic Nanostructures: Beyond the Thin-Film Paradigm

Mesoscopic phenomena span length scales that are considerably larger than atomic-bond distances, but small enough that classical continuum physics with materials properties and behavior averaged over many domains, or regions 10–100 nm in size, does not apply. The involved physical processes belong to a region bridging quantum mechanical and macroscopic continuum materials descriptions, which makes them critically important for the design, modeling, growth and characterization of ferroic nanostructures. Many such systems exhibit intriguing behavior with nontrivial dependence of their elastic, polar and magnetic degrees of freedom—including domain pattern formation and evolution—on shape, size and morphology. Additional interesting effects may involve the influence of layering, composition variation, and ionic diffusion. This symposium will discuss the current state-of-the-art (and future directions) in theoretical modeling, synthesis, characterization, processing and applciations of ferroic nanostructures, with a primary focus on the influence of shape, size, morphology and interaction strength on their properties and functional behavior.

**Proposed Sessions**

– Synthesis, characterization and processing
– Chemistry and physics of ferroics at mesoscale
– Nano to micro to macro: Size dependence of ferroic behavior and properties
– Multiscale modeling of mesoscopic phenomena
– Applications involving electronic, thermal, optical and other functionalities

**Symposium organizers**

- **Edward Gorzkowski**, Naval Research Laboratory, USA, edward.gorzkowski@nrl.navy.mil
- Serge M. Nakhmanson, University of Connecticut, USA, serge.nakhmanson@uconn.edu
- Seungbum Hong, Korean Advanced Institute of Science and Technology, South Korea, seungbum@kaist.ac.kr

## S6: Complex Oxide and Chalcogenide Semiconductors: Research and Applications

Many technologies that power the information age are based on covalent semiconductors. Despite this success, harnessing phenomena such as magnetism, superconductivity, metal-insulator transitions, ferroelectricity, etc. (and coupled combinations thereof) for future applications requires a thorough understanding of electronic materials with varying degrees of ionicity. This symposium will discuss the status and the outlook for research and applications of emerging complex oxide and chalcogenide materials broadly, with a specific emphasis on the common challenges and opportunities in complex oxides and chalcogenides. Heterostructures combining oxides and chalcogenides also exhibit particularly intriguing properties and will be a focus of the symposium. Topics to be covered include a wide range of studies from theory, materials synthesis, and characterization, to devices and applications.

**Proposed sessions**

– Theoretical methods
– Synthesis and characterization techniques
– Oxide/chalcogenide heterostructures
– Low dimensional systems
– Physical and chemical properties
– Emerging materials
– Applications in next-generation technology

**Symposium organizers**

- **Ryan Comes**, Auburn University, USA, ryan.comes@auburn.edu
- Matthew Brahlek, The Pennsylvania State University, USA, mbrahlek@gmail.com
- Anderson Janotti, University of Delaware, USA, janotti@udel.edu
- Rafael Jaramillo, Massachusetts Institute of Technology, USA, rjaramil@mit.edu
- Steven Spurgeon, Pacific Northwest National Lab, USA, Steven.spurgeon@pnnl.gov

## S7: Superconducting and Magnetic Materials: From Basic Science to Applications

The discovery and subsequent applications of magnetic and superconducting materials has been a topic of much research spanning the scale from large-scale energy applications at one end to quantum computing at the other. From a fundamental perspective, the elucidation of the fundamental physics underlying these materials through highly advanced characterization techniques is of extreme interest. From the perspective of applications, the tailoring of the structure-property relationships through defect engineering and doping will full harness the capabilities of these materials. Of additional importance is meso-scale engineering for the development of these materials for devices (e.g. superconducting wires, magnetocalorics, grain boundary engineering, etc.).

This symposium will cover recent developments in the discovery, characterization, and applications of superconducting and magnetic materials. Focus will be paid to new discovery paradigms, advanced characterization and theory of correlated properties, and the engineering of these materials for applications ranging from nanoscale to large-scale.

**Proposed sessions**

– New superconducting and magnetic materials
– 2D correlated materials: Synthesis, characterization, and tailoring of properties
– Characterization and theory of structural, magnetic, and superconducting properties
– Tailoring magnetic and superconducting properties for applications
– Device fabrication: Nanoscale to industrial

**Symposium organizers**

- **Gang Wang**, Institute of Physics, Chinese Academy of Sciences, China, gangwang@iphy.ac.cn
- Michael Susner, Air Force Research Laboratory, USA, mike.susner@gmail.com
- Timothy Haugan, Air Force Research Laboratory, USA, tjhaugan@hotmail.com
- Haiyan Wang, Purdue University, USA, hwang00@purdue.edu
- Charles Rong, U.S. Army Research Laboratory, USA, cr12102000mail@gmail.com

### S8: Structure-Property Relationships in Relaxor Ceramics

Relaxor materials are finding increasing application in fields like telecommunications, energy storage, sensors and actuators. Although it is universally accepted that relaxor behavior occurs in chemically-substituted systems, the range of phenomena leading to relaxor behavior is very broad and still unclear. In particular, the role of differently charged substituents, their distribution in the lattice, and the arrangement of polar order/disorder on multiple length scale needs to be uncovered. The combination of advanced nano to micro-scale characterization methods in synergy with multiscale modeling (from ab initio to molecular dynamics) can be expected to deliver key insights to better understand the structure-property relationships in relaxors. This symposium targets specifically the interplay of local structure, chemistry and instabilities induced by substitution and electric polarization on multiple length scales, and how it impacts macroscopic properties relevant for application. Both lead-based and lead-free perovskite relaxors will be addressed, together with relaxors in non-perovskite crystalline forms.

**Proposed sessions**

– Local structure of relaxors: From polar nanoregions to dipolar glass behavior
– Multiscale modeling of relaxors
– Advanced nano and micro-scale characterization methods for relaxors
– Perovskite relaxors
– Non-perovskite relaxors
– Applications of relaxors

**Symposium organizers**

- **Marco Deluca**, Materials Center Leoben Forschung GmbH, Austria, marco.deluca@mcl.at
- Prasanna V. Balachandran, University of Virginia, USA, pvb5e@virginia.edu
- Antonio Feteira, Sheffield Hallam University, UK, A.Feteira@shu.ac.uk
- Jiri Hlinka, Institute of Physics, Academy of Sciences of the Czech Republic, Czech Republic, hlinka@fzu.cz

### S9: Ion-Conducting Ceramics

Ion-conducting ceramics are expected to be vital components of an increasingly demanding global energy future. New technologies ranging from clean energy production to electrical energy storage and chemical separations will require the development of robust, highly functional ion-conducting ceramics. This symposium will discuss critical properties-process-performance relationships central to the effective development of ion-conducting ceramics. Presentations and discussions are expected to address technical challenges and insights across a wide range of length scales (atomic to macroscopic), address both cation and anion conductors, and consider a variety of ion-conducting materials relevant to a diverse application space. This symposium welcomes relevant presentations and contributions from experimental work, theory and modeling, and advanced characterization of these technologically interesting and important materials.

**Proposed sessions**

– Influences of synthesis and processing conditions on ion conduction
– Cation conducting ceramics for energy storage
– Solid state batteries
– Oxygen conductors
– Ionic liquid gating in ceramics
– Membranes for chemical separations
– Computational studies in ion-transport ceramics

**Symposium organizers**

- **Yingge Du**, Pacific Northwest National Laboratory, USA, Yingge.Du@pnnl.gov
- Hui(Claire) Xiong, Boise State University, USA, clairexiong@boisestate.edu
- Fanglin (Frank) Chen, University of South Carolina, USA, chenfa@cec.sc.edu
- Erik Spoerke, Sandia National Laboratory, USA, edspoer@sandia.gov

### S10: Current Challenges in Microstructural Evolution: From Basic Science to Electronic Applications

Interfaces play a key role in achieving best performance of solar cells, sensors, ferroelectric actuators, and dielectrics, as well as oxygen and lithium-ion conductors. Tailoring the materials microstructure, grain boundary structure, local defect distribution, space charges, texture and the anisotropy of transport processes at interfaces enables new applications for energy harvesting and storage. The microstructure formation during the fabrication processes and the corresponding structure-property relations need to be understood on a fundamental level to optimize a material for best performance.

This symposium covers both the fundamental understanding of functional materials and their application to current challenges in material science. Besides studies of interfaces, the focus will be on applying basic science to current challenges in material science such as perovskite solar cells and field assisted sintering technologies.

**Proposed sessions**

– Interface structure and properties
– Microstructure evolution
– Ferroelectric materials for solar cell applications

**Symposium organizers**

- **Wolfgang Rheinheimer**, Purdue University, USA, rheinheimer@purdue.edu
- Alexander Colsmann, Karlsruhe Institute of Technology, Germany, alexander.colsmann@kit.edu
- Holger Röhm, Karlsruhe Institute of Technology, Germany, holger.roehm@kit.edu
- Tobias Leonhard, Karlsruhe Institute of Technology, Germany tobias.leonhard@kit.edu

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## S11: Electronic Materials Applications in 5G Telecommunications

Right now, there is a worldwide race to implement millimeter-wave (mmWave) technologies for 5th Generation (5G) 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 material science and measurement to facilitate commerce in the mmWave regime. Novel materials can help manufacturers tackle the 5G challenges by accessing fundamental physics including phase transitions, controlling loss, enhancing transport, physical models, etc. In this symposium, we kick off a discussion 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**

- Invited panel: What is 5G and how can materials help?
- The millimeter-wave race: Industry
- Materials-by-design for telecommunications applications
- 5G materials synthesis
- Metrology and characterization of materials
- Microwave and millimeter-wave devices

**Symposium organizers**

- **Nate Orloff**, National Institute of Standards and Technology, USA; orloff@nist.gov
- Geoff Brennecka, Colorado School of Mines, USA; geoff.brennecka@mines.edu
- Ling Cai, Corning Inc., USA; CaiL@corning.com
- Turan Birol, University of Minnesota, USA; tbirol@umn.edu

## S12: Thermal Transport in Functional Materials and Devices

Thermal energy in electronic materials and their associated devices can be either an unwanted byproduct or a technological enabler, depending on the application (e.g., microelectronics versus pyroelectrics). Thermal conductivity, heat capacity, and thermal diffusivity must be optimized for device performance according to the type of device. Consequently, a fundamental understanding of the thermal transport properties, heat storage characteristics, and thermo-electronic property coupling are critical to many electronic materials and devices. This symposium explores the basic science of thermal properties in electronic materials with a focus on enabling electronic devices and applications. Relevant topics include carrier transport and multi-carrier interactions in solids, nanosystems, and across interfaces. This symposium also encourages contributions on technological aspects of the use and control of thermal energy (e.g., refrigeration). This symposium aims to increase interactions between the thermal sciences and materials research communities, as well as those designing electronic devices by enabling discussions about the interdependencies between defect chemistry/microstructure and the resultant thermophysical properties, property optimization, caloric effects, interface engineering, heat exchange, and related applications.

**Proposed sessions**

- Fundamentals of thermal transport within materials and across interfaces
- Materials development and structure-thermal property relationships
- Thermal transport in low-dimensional materials/systems (2D transition metal dichalcogenides, electron/hole gases, topological insulators, etc.)
- Computational methods for material and device optimization
- Dynamic thermal properties of materials and applications
- Thermal management and metrology of electronic devices (transistors, diodes, lasers, etc.)
- Materials for thermal management in extreme environments

**Symposium organizers**

- **Brian M. Foley**, Georgia Institute of Technology, USA brian.m.foley@gatech.edu
- Brian F. Donovan, United States Naval Academy, USA, bdonovan@usna.edu

## S13: From Basic Science to Agile Design of Functional Materials: Aligned Computational and Experimental Approaches and Materials Informatics

Given the pressing requirements for new high-performance electronic materials to meet important application needs, both computational and experimental approaches are required to understand unusual phenomena and to design new classes of materials. The collaborative effort between the two disciplines allows for exploring novel material properties quickly, with the potential to mitigate the cost, risk, and operation time, for taking materials from research to manufacturing. Further, it could yield valuable insights into the fundamental factors underlying materials behavior. This symposium looks at the current state-of-the-art (and future outlook) methods within a broad range of materials modeling, experiments, and materials informatics-driven efforts, aimed primarily at electronic materials.

**Proposed sessions:**

- Materials by design: Computational/experimental emerging strategies for searching, designing, and discovering new electronic materials
- High-throughput computational/experimental screening, data mining, and machine learning, and materials informatics
- Novel phenomena at interfaces and heterostructures: Interface driven functional materials (such as novel quantum materials and perovskites) and experimental synthesis challenges and modeling
- Multiscale modeling (first principles, force fields, phase field, etc.) and computational tool for energy storage and conversion
- Novel quantum materials (such as topological insulators, Weyl semimetals, quantum anomalous Hall insulators, and quantum magnets)
- Functional (hybrid) perovskite materials for various applications, solar cells, and optical devices
- Low-dimensional electronic materials (quantum dots, nanowires, 2D materials, and related systems)

**Symposium organizers**

- **Mina Yoon**, Center for Nanophase Materials Science, Oak Ridge National Laboratory, USA, myoon@ornl.gov
- Lan Li, Boise State University, USA, lanli@boisestate.edu
- Peilin Liao, Purdue University, USA, lpl@purdue.edu