



call for papers

Abstracts due by September 9, 2015

January 20-22 | DoubleTree by Hilton Orlando at Sea World® | Orlando, Florida USA

# ELECTRONIC MATERIALS AND APPLICATIONS 2016

Electronic Materials and Applications 2016 addresses emerging needs, opportunities and key challenges in the field of electronic materials and applications. Technical presentations highlight advancements in materials and devices for electronics, sensors, energy generation and storage, photovoltaics, and LEDs.

[ceramics.org/ema2016](http://ceramics.org/ema2016)



# ELECTRONIC MATERIALS

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## INTRODUCTION

Electronic Materials and Applications 2016 is an international conference focused on electroceramic materials and their applications in electronic, 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 2016 will take place at the DoubleTree by Hilton Orlando at Sea World® January 20–22, 2016.

EMA 2016 is designed for researchers, engineers, technologists, and students interested in basic science, engineering, and applications of electroceramic materials. Speakers include an international mix of university, industrial, and federal laboratory participants to exchange information and ideas on latest developments in theory, experimental investigation and applications of electroceramic materials. Students are highly encouraged to attend and participate in a special symposium that features awards for best oral and poster presentations.

The technical program includes plenary talks, invited lectures, contributed papers, poster presentations, and open discussions. EMA 2016 features symposia focused on ferroics and multiferroics; dielectrics; sintering and grain growth; piezoelectrics; thermoelectrics; and superconductors. Other symposia emphasize broader themes covering structure, interfaces and novel characterization methods; doping, defects and nanoscale phenomena; layered oxide and related materials; thin film synthesis and integration science; nanocomposites; and computational design of electronic materials.

The meeting includes several networking opportunities to facilitate collaborations for scientific and technical advances related to materials, components, devices, and systems. A separate, student-run symposium, sponsored by the ACerS President's Council of Student Advisors, will feature undergraduate and graduate student research and provide development and networking opportunities for our next generation of scientists.

We are pleased to build on the previous successes of this conference series in providing a distinctive forum to address emerging needs, opportunities, and key challenges in the field of electronic materials and applications. We anticipate this meeting will continue 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!



## DOUBLETREE by HILTON ORLANDO AT SEA WORLD®

10100 International Drive, Orlando, FL 32821  
407-352-1100 / 800-327-0363

### Rate:

Single/double/triple/quad – \$149.00

## ORGANIZING COMMITTEE



Gibbons

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Chatain

**Dominique Chatain**, Basic Science Division  
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## 2014-2015 OFFICERS

### Basic Science Division

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**John Blendell**  
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## CONFIRMED PLENARY SPEAKERS



Schlom

**Darrell Schlom**, Cornell University, USA

Title: *Oxide Materials for Electronics*



Warren

**James Warren**, National Institute of Standards and Technology

Title: *The Materials Genome Initiative, Data, and Open Science.*



Detzel

**Thomas Detzel**, Infineon Technologies Austria AG

Title: *Power Semiconductors*

## SPONSORS



## SYMPOSIA

### S1. Multiferroic Materials and Multilayer Ferroic Heterostructures: Properties and Applications

This symposium will provide an international, interdisciplinary forum for scientists and engineers from academia, industry, and national laboratories interested in research, characterization, development, manufacturing, design, and applications of multiferroic materials and multilayer ferroic heterostructures. The symposium covers a wide spectrum of research activities, from basic science to technological applications. Additionally, this symposium will unite researchers from a broad range of disciplines to discuss current state-of-the-art, physics, engineering, and future challenges of multicomponent, multifunctional materials. Organizers seek papers focusing on understanding such materials systems utilizing theoretical, experimental and/or novel sophisticated characterization methods. The relationship between materials growth, microstructure, and the relation between microstructure and physical properties will be highlighted. Emphasis will also be devoted to applications of these materials in sensors/actuators, energy harvesting, and solid-state heating/cooling.

#### Proposed Sessions

- Transport properties of multilayer multiferroics
- Multiferroic thin film growth, materials design, and processing
- Interfaces in multilayered ferroic heterostructures, functionally-graded ferroics, artificial multiferroics
- Structure: defects and doping; the relationship between materials growth, microstructure, and physical properties
- Theory and modeling of multiferroics
- Technological applications ranging from medicine to aerospace industry: tunable high dielectric materials for high frequency applications; microelectro-mechanical systems (MEMS); sensors, transducers, and nonlinear optical devices; vibration damping, actuators, artificial muscles, self assembled actuators and devices

#### Symposium Organizers

- **Melanie Cole**, U.S. Army Research Laboratory, USA; [melanie.w.cole.civ@mailmil](mailto:melanie.w.cole.civ@mailmil)
- **S. Pamir Alpay**, University of Connecticut, USA
- **Ichiro Takeuchi**, University of Maryland, USA
- **Timothy Haugan**, U.S. Air Force Research Laboratory, USA

### ABSTRACT SUBMISSION INSTRUCTIONS

Visit [www.ceramics.org/ema2016](http://www.ceramics.org/ema2016) to review session topics. Select "Submit Abstract" to access the Abstract Central website. If you have questions, please contact **Marilyn Stoltz** at [mstoltz@ceramics.org](mailto:mstoltz@ceramics.org) or 614-794-5868.

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## S2. Functional Materials: Synthesis Science, Properties, and Integration

This symposium will bring together researchers from academia, government laboratories, and industry to discuss the links bridging synthesis science, properties, and integration of functional crystalline materials. Advances in mechanisms of material preparation and integration that lead to new materials discovery, new property opportunities, and extensions to performance limits are of particular interest. The topic is motivated by the recent National Academies Report—*Frontiers in Crystalline Matter: From Discovery to Technology*—which identifies the need to reinvigorate activities that focus on material growth, and to elevate the community's recognition for synthesis. Topics of interest for this symposium include: (1) advances in thin film, single crystal, and 2-D layer synthesis, particularly those that access challenging processing windows, stabilize new phases, or create structures far from equilibrium; (2) advances in substrate design that extend thermal, chemical, and mechanical stability, and provide new opportunities for epitaxy; (3) synthesis methods monitored by in situ probes improve crystal growth understanding; and (4) integrating functional materials with base-metals, semiconductors, 2-D materials, nanostructures, and sophisticated device platforms.

The spectrum of materials systems considered is broad intentionally, but related by common attention to advanced synthesis and process flows, and to the property and performance opportunities they create. This combination will also bridge the functional electronic materials communities (e.g., epitaxy, transparent conductors, piezoelectrics, energy storage, memories, etc.) with the vacuum science, semiconductor processing, characterization, and integration industry for highest impact and knowledge sharing.

### Proposed Sessions

- Refined synthesis routes to enable and advance properties
- Controlling crystal growth morphology (within the structure zone model)
- Controlling phase distribution in crystals, films, and nanolayers
- Managing growth with volatile species
- Advances in synthesis science that regulate point defects
- Theory and modeling to enhance and inform synthesis
- Integrating functional oxides with conventional semiconductors
- Thin-film memory and piezoelectric materials
- Novel substrates and electrodes
- Crystal growth at temperature extremes, near  $T_{\text{room}}$  and approaching  $T_{\text{melt}}$
- In situ thin film characterization to guide materials synthesis

### Symposium Organizers

- **Jon-Paul Maria**, North Carolina State University, USA: [jpmaria@ncsu.edu](mailto:jpmaria@ncsu.edu)
- Jon Ihlefeld, Sandia National Laboratories, USA
- Ronald Polcawich, U.S. Army Research Laboratory, USA

## S3. Use of Thermal Energy for Electrical Power Generation and Refrigeration: Fundamental Science, Materials Development and Devices

Thermal energy has been used in a variety of ways in electrical power generation and refrigeration under both transport and equilibrium conditions. This symposium targets technologies that use thermal energy and the fundamental science that enables it. Specific technologies of interest include thermoelectrics, thermophotovoltaics, electro-, magneto- and baro-caloric systems, Stirling and thermoacoustic engines. The challenges to implementation or improvement have been materials specific. The approaches of interest include novel material development, measurement standardization, bonding, ceramic processing, crystal chemistry, modeling, nanostructured materials, devices, and others.

The symposium also aims to include the basic science underlying behavior of such materials. Fundamental physics include phonon transport and interactions in solids, in nanosystems, and across interfaces. Abstracts are encouraged on topics including, but not limited to, coherent phonon transport, non-local phonon conduction around interfaces, phonon interference, the interplay between material structures and intrinsic phonon scattering mechanisms, and how these processes relate to the thermal conduction mechanisms in solids and across interfaces.

This symposium encourages contributions on topics outside the technologies summarized above that take advantage of thermal energy for electrical power and refrigeration. This symposium is a forum for discussing defect chemistry, conductivity, thermal conductivity optimization, caloric effects and applications for novel conversion systems. It aims to increase interaction between communities that normally work separately.

### Proposed Sessions

- Theory and applications of thermoelectrics and related phenomena
- Theory and applications of caloric effects and Stirling engines
- Thermophotovoltaics and emerging thermal devices
- Fundamental physics of phonon transport
- Materials development, defect structure control and analysis
- Low dimensional materials and crystal chemistry approaches
- Nanoscale scattering effects
- Defects and defect chemistry and their effects on electrical and thermal conductivity

### Symposium Organizers

- **Alp Sehirlioglu**, Case Western Reserve University, USA; [alp.sehirlioglu@case.edu](mailto:alp.sehirlioglu@case.edu)
- David Singh, Oak Ridge National Laboratory, USA
- Antoine Maignan, CrisMat, France
- Winnie Wong-Ng, NIST, USA
- Anke Weidenkaff, University of Stuttgart, Germany
- Patrick Hopkins, University of Virginia, USA
- Edward P. Gorzkowski, Naval Research Laboratory, USA

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## S4. Ion-conducting Ceramics

Ion-conducting membranes 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 development of robust, highly functional ion conducting ceramics. This symposium will bring together researchers from academia, government labs, and industry to 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.

### Proposed Sessions

- Novel ion-conducting materials
- Influences of ceramic processing on ion conduction
- Cation-conducting ceramics for energy storage
- Oxygen conductors
- Membranes for chemical separations
- Computational studies in ion-transport ceramics

### Symposium Organizers

- **Jon Ihlefeld**, Sandia National Laboratories, USA; jihlefe@sandia.gov
- Frank Chen, University of South Carolina, USA
- Jeff Sakamoto, University of Michigan, USA
- Erik Spoerke, Sandia National Laboratories, USA
- Hui (Claire) Xiong, Boise State University, USA

## S5. Multifunctional Nanocomposites

This symposium provides a platform to present and discuss recent advances in the growth, characterization, design, property prediction, and study of interface phenomena in nanocomposite oxide thin films. Topics include identification of materials design strategies to discover novel phenomena in this class of materials and theoretical prediction of material properties using first-principle calculation methods; synthesis of multilayer oxide thin films and vertically aligned nanocomposites; structure, defect, and interface characterization and their relationship to material properties; and device fabrication for energy harvesting, memories, actuators, sensors, optical, electronic and optoelectronic applications. Specific areas of interest are magnetic, electric and photonic properties as well as electronic and thermal transport phenomena of oxide thin films, vertical nanocomposites, lateral multilayers and structures with quantum-confinement.

### Proposed Sessions

- Synthesis and growth of nanocomposite oxide thin films including heterostructures, layered structures, superlattices, and vertically aligned nanocomposites
- Influence of growth, stoichiometry, doping, strain and microstructure on properties of nanostructured oxide thin films and vertical aligned nanocomposites
- Microstructures and defects characterization

- Strain, microstructures and functionality tuning in vertical aligned nanocomposites
- Novel phenomena arising from structural distortion, charge redistribution, as well as spin and orbital order rearrangement in proximity to the oxide interface
- Theory, modeling, and first-principles calculations of nanoscale phenomena in functional oxide thin films
- Functionalities including ferroelectric, dielectric, magnetic, magnetoelectric and photonic properties as well as electronic and thermal transport characteristics of single-phase and nanocomposite oxide thin films
- Device fabrication of oxide thin films and nanocomposites for energy harvesting, memories, actuators, sensors, optical, electronic, and optoelectronic applications

### Symposium Organizers

- **Roman Engel-Herbert**, Pennsylvania State University, USA; rue2@psu.edu
- Aiping Chen, Los Alamos National Laboratory, USA
- Judith L. MacManus-Driscoll, University of Cambridge, UK
- James Rondinelli, Northwestern University, USA
- Bharat Jalan, University of Minnesota, USA
- Junwoo Son, Pohang University of Science and Technology, South Korea
- Oliver Bierwagen, Paul Drude Institute for Solid State Electronics, Germany

## STUDENT AWARDS AND COMPETITION:

The EMA 2016 conference follows its established tradition of strongly supporting undergraduate and graduate student participation.

- Six awards with cash prizes will be given at EMA 2016 for best student presentations and posters.
- Shortly after the abstract submission deadline, the meeting's top abstracts with student presenters will be selected. Finalists will have the option of presenting in their original symposium and/or as part of special lunchtime sessions on Wednesday and Thursday highlighting the work of top students. Only presentations during the lunch sessions will be judged for cash awards, which will be given out at the conference banquet on Thursday evening.

## FAILURE: THE GREATEST TEACHER

The vast majority of scientific literature and conference talks report positive results, but there's a lot to be learned from negative results and missteps as well. After the "successful" part of the meeting closes, come 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. If you would like to speak at this symposium, please contact Geoff Brenneka (gbrennec@mines.edu).

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## S6. Computational Design of Electronic Materials

Given the pressing requirements for new high-performance electronic materials to meet important application needs, computational methods are required to understand unusual phenomena and to design new classes of materials. Computational exploration of properties of novel materials has potential to mitigate costs, risks, and time involved in preparing and testing potentially useful materials, and could yield valuable insights into the fundamental factors underlying material behavior. Moreover, such computational design efforts form the core of the Materials Genome Initiative. This symposium will bring together materials scientists and engineers from academia, industry, and national laboratories to discuss the current state-of-the-art (and future outlook) within various types of materials modeling and incorporated experiments and materials informatics efforts, aimed primarily at electronic materials.

### Proposed Sessions

- Materials by design: computational and/or experimental emerging strategies for searching, designing, and discovering new electronic materials
- High-throughput data generation and screening via first principles and other computations
- Modeling at different (and across) scales (first principles, force fields, phase field, etc.)
- Novel phenomena at interfaces and heterostructures: interface driven functional materials
- Low-dimensional systems (quantum dots, nanowires, graphene, and related systems)
- Theoretical challenges and development of accurate description of defects and interface properties
- Electronic and/or thermal transport in electronic materials and low-dimensional structures

### Symposium Organizers

- **Mina Yoon**, Oak Ridge National Laboratory, USA; myoon@ornl.gov
- **Wolfgang Windl**, Ohio State University, USA
- **Ghanshyam Pilania**, Los Alamos National Laboratory, USA
- **James Rondinelli**, Northwestern University, USA
- **Emmanouil Kioupakis**, University of Michigan, USA

## S7. Processing and Microstructure of Functional Ceramics: Sintering, Grain Growth and Their Impact on Materials Properties

Materials processing is important for functional ceramics applications, such as sensors, ferroelectric actuators, dielectrics, and oxygen as well as lithium-ion conductors. In these technologies, grain boundaries have a strong impact on device performance. Possible influences of processing and microstructure arise, e.g., from local defect redistribution, space charges, mechanical stresses, and anisotropy of transport processes at grain boundaries. These effects and their interplay with materials properties need to be understood on a fundamental level in order to optimize materials for given applications.

This symposium aims to bring together researchers working on all aspects of bulk functional ceramics processing, microstructure, and its evolution and relationship to materials properties. The focus is on perovskite materials (e.g. BaTiO<sub>3</sub>, BKT, KNN, SrTiO<sub>3</sub>, LLTO, BSCF), but other functional ceramics are considered (e.g. spinel, ZnO, CeO<sub>2</sub>, ZrO<sub>2</sub>, TiO<sub>2</sub>), also.

### Proposed Sessions

- Sintering techniques of functional ceramics: conventional sintering and field-assisted sintering
- Grain growth and abnormal grain growth
- Effects of nonstoichiometry
- Defects, space charge, and their interplay with microstructure evolution
- Transport along and across grain boundaries

### Symposium Organizers

- **Wolfgang Rheinheimer**, Karlsruhe Institute of Technology, Germany; wolfgang.rheinheimer@kit.edu
- **Michael Hoffmann**, Karlsruhe Institute of Technology, Germany

## S8. Interface Structure, Orientation, and Composition: Influence on Properties and Kinetics

Interface properties and kinetics can be controlled by structure, composition and orientation at atomistic, mesoscopic, and microscopic scales. Chemical adsorption, local structure, orientation, and microscopic shape (faceting) of interfaces have been observed to change with thermodynamic parameters (chemical potential, temperature, etc.), but the influence of these features on interface motion (grain growth, coarsening, sintering) and properties (grain boundary diffusion, electric and ionic or thermal conductivity, wetting) has not been fully correlated with the observed transitions. This symposium will examine both structure of interfaces over a variety of thermodynamic variables and influence of interface transitions on properties and kinetics.

### Proposed Sessions

- Interface structure and composition
  - Atomistic structures
  - Simulations
- Observations
  - Microscale structures
- Segregation
- Adsorption
- Interfacial energies
  - Mesoscale structures
- Facetting
- Reconstructions
- Interface motion
  - Grain growth
  - Faceting
  - Triple junction effects
- Interface properties
  - Electrical / Ionic
  - Thermal
  - Optical

### Symposium Organizers

- **Dominique Chatain**, CINaM, France; chatain@cinam.univ-mrs.fr
- **Wayne Kaplan**, Technion, Israel

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- John Blendell, Purdue University, USA
- Carol Handwerker, Purdue University, USA

## S9. Recent Developments in Superconducting Materials and Applications

Recently, significant progress has been made worldwide in both application and fundamental understanding of high-temperature superconductors (HTS). For example, HTS (such as cuprates) wires and tapes have been commercially produced; advances continue to be made in fabrication and application of superconducting  $MgB_2$ ; and discovery of iron-based superconductors has set off an intense search for new superconductors with even higher transition temperature. However, challenges remain to increase overall current carrying ability for applications and to correlate interplay between structure, magnetism, and superconductivity in these superconductors on micro-, meso-, and nanoscales for understanding the superconductivity mechanism. This symposium will cover recent developments in processing of superconducting materials, improved flux-pinning via structural and defect optimization, recent advances in discovery of new superconductors, and progress in understanding unconventional superconductivity. Development and status of applications, and associated materials science drivers and issues will also be addressed.

### Proposed Sessions

- Issues related to the fabrication of low-cost and high-performance second generation coated conductors
- Flux-pinning engineering in thick HTS films via structural and defect optimization
- Processing and properties of cuprates,  $MgB_2$ , and iron-based superconductors
- New superconducting materials and phenomena
- Characterization of structural, magnetic, and superconducting properties
- Electronic structure and superconductivity mechanism
- AC-losses
- Applications and related material issues including wire properties

### Symposium Organizers

- **Gang Wang**, Institute of Physics, Chinese Academy of Sciences, China; gangwang@aphy.iphy.ac.cn
- Xingjiang Zhou, Institute of Physics, Chinese Academy of Sciences, China
- Tim Haugan, Air Force Research Laboratory, USA
- Haiyan Wang, Texas A&M University, USA

## S10. Emerging Functionalities in Layered-oxide and Related Materials

Layered variations of oxide materials, such as binary compounds and clay-like structures, not only usually inherit the functional traits of their parents, but also possess multiple additional channels for property modification and fine-tuning. The realm of current and prospective applications of these materials includes — but is not exhausted by — electronics, sensors, catalysts, and molecular sieves. Furthermore, plentiful opportunities for cross-pollination and fusion, as well as design of novel functionalities exist by virtue of straightforward incorporation of slabs with different structure and chemical identity into the same, layered geometry. However, synthesis and processing of such complex interfacial compounds present a variety

of serious new challenges, compared to their “mundane” nonlayered counterparts. This symposium will bring together experts from academia, industry, and national laboratories to discuss the current state-of-the-art (and future directions) in theoretical modeling, synthesis, characterization and processing of functional layered oxides, with a primary focus on electronic materials and their applications.

### Proposed Sessions

- Synthesis, characterization, and processing of new layered materials
- Soft-chemistry related material synthesis and transformation approaches
- Chemistry and physics within interlayer galleries, including ionic and molecular defects, intercalation, and diffusion
- Microstructures and nanostructures in layered materials
- Theoretical modeling and design of materials with new functionalities across length scales
- Device applications based on electronic and other functionalities, including molecular sensing, capture, and release

### Symposium Organizers

- **Serge M. Nakhmanson**, University of Connecticut, USA; smn@ims.uconn.edu
- Bharat Jalan, University of Minnesota, USA
- Edward Gorzkowski, U.S. Naval Research Laboratory, USA

## S11. Advanced Electronic Materials: Processing, Structures, Properties and Applications

This symposium brings together materials and engineering researchers from academia and industry to present the latest advances in electronic materials, including synthesis/processing, and characterization of dielectric, piezoelectric, pyroelectric and ferroelectric materials in bulk ceramics and single crystals. These materials have tremendous impact on a variety of technologies, including ultrasonic transducers, memories, high-energy storage, energy harvesting, actuators, sensors, and tunable microwave devices. Other topics of interest are (but not limited to) nanoscale domain phenomena, defect chemistry, structure–property relationships, electrocaloric and electric-field-induced phase transitions.

### Proposed Sessions

- Advanced electronic materials, including ferroelectric, piezoelectric, dielectric, electrostrictive, pyroelectric, electrocaloric, and flexoelectric materials
- Materials design, new materials and structures, and emerging applications
- Characterization of materials, crystal structure, phase transitions, as well as electrical, mechanical, electromechanical, and other functional properties
- Energy storage, conversion and harvesting materials, and device structures
- Lead-free piezoelectrics
- Reliability of electronic materials and devices

### Symposium Organizers

- **Shujun Zhang**, The Pennsylvania State University, USA; soz1@psu.edu
- Xiaoli Tan, Iowa State University, USA
- Kyle Webber, Technische Universität Darmstadt, Germany
- Satoshi Wada, University of Yamanashi, Japan

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