Electronic Materials and Applications 2013

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Electronic Materials and Applications 2013

INTRODUCTION

Electronic Materials and Applications 2013, jointly programmed by the Electronics and the Basic Science Divisions of The American Ceramic Society, is the fourth in a series of annual international meetings. The 2013 meeting encompasses energy generation and storage, photovoltaics and LED's, MEMS/NEMS, superconductors, thermoelectrics, data storage, sensors, actuators, and other functional and nanostructured materials. The meeting will provide leaders and experts in the field of electronic ceramics the opportunity to discuss fundamental and technological challenges in these areas.

The conference features plenary lectures by notables, including Ramamoorthy Ramesh, Director, SunShot Initiative, DOE and Professor, University of California, Berkeley; Kitt Reinhardt, Program Manager, Air Force Office of Scientific Research; and Rainer Waser, Director, Institute of Solid State Research, at HGF Research Center, Germany. The technical program will include invited lectures, contributed papers, poster presentations, and roundtables on emerging topics. Naturally, participants include an international mix of industrial, university, and federal laboratory organizers and researchers. For students there is also the opportunity to participate in a special student-run symposia.

We are pleased to provide this opportunity to focus on electronic materials and applications in 2013, building on the previous success of this conference series as well as the ever-expanding network of scientists in this field. With a continuing goal of fostering interconnections and collaborations, we expect this meeting will facilitate both the presentation, and development, of new ideas crucial for future electronic materials, with ultimate applications ranging from consumer devices to solutions to grand challenges. Please join us in Orlando in January for this unique experience.

ORGANIZING COMMITTEE


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CONFIRMED PLENARY SPEAKERS

Ramamoorthy Ramesh, Director, SunShot Initiative, DOE; Professor, University of California, Berkeley
Kitt Reinhardt, Program Manager, Air Force Office of Scientific Research
Rainer Waser, Director, Institute of Solid State Research, at HGF Research Center, Germany

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HOTEL INFORMATION

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Rate: Single/double/triple/quad–$149.00
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S1: Functional and Multifunctional Electroceramics for Energy Storage, Conversion, and Harvesting, Detectors, Senors, Frequency Agile Components, Packaging, Interconnects and Other Commercial Opportunities

This symposium brings together material scientists, engineers, researchers and technologists from academia, government and industry to present the latest advances in functional and multifunctional electroceramics and their commercial opportunities. Ferroelectric, pyroelectric, piezoelectric and lead-free piezoelectric, paraelectric, dielectric, flexoelectric, magnetostrictive, ferroelectric-thermoelectrics, oxide superconductors and other materials in the form of bulk, thin and thick films, composites, single crystals, homo- and hetero-epitaxial films and multilayers, MEMS and NEMS as well as material and device modeling will be discussed toward enabling technologies. Energy technologies, materials and devices, related to storage, conversion, and harvesting are of interest. Detectors, sensors and other component technologies that provide narrow-band, multi-band, broadband or that provide frequency agile opportunities are of interest. Other commercial opportunities including but not limited to packaging and interconnect technologies are of interest. Within this symposium it is anticipated that topics from fundamental material science such as interface and nanoscale domain phenomena through macroscale device and system level criteria and engineering and reliability will be discussed.

Proposed Symposium Topics:

- Ferroelectric, pyroelectric, piezoelectric, paraelectric, dielectric, magnetorestricitive, ferroelectric-thermoelectrics, oxide superconductors, Mott insulators and other materials including composites and nano-composites
- Microwave Dielectrics, Metamaterials, and Frequency Tunable Devices
- Material Design, New Materials and Their Applications
- Characterization of materials, interfaces, as well as electrical, mechanical, electro-mechanical and other material properties
- Nanoscale Phenomena in Dielectric, Ferroelectric and Piezoelectric Materials
- Piezoelectric and Lead-free Piezoelectric Materials, Devices and Applications
- Electromechanical Phenomena and Applications in NEMS and MEMS Devices
- Integrated Homo-, Hetero-epitaxial Single and Multi-Layer Films and Device Structures
- Energy Storage, Conversion and Harvesting Materials and Device Structures.

Symposium Organizers

- **Steven C. Tidrow**, The University of Texas – Pan American, USA, sctidrow@utpa.edu
- **Clive Randall**, Pennsylvania State University, USA
- **Shashank Priya**, Virginia Polytechnic Institute and State University, USA

S2: 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 the research, characterization, development, manufacturing, design, and applications of multiferroic materials and multilayer ferroic heterostructures. The purpose of this symposium is to cover a wide spectrum of research activities, from the basic science to technological applications. Additionally, this symposium will serve to unite researchers from a broad range of disciplines to discuss the current state-of-the-art, physics, engineering, and future challenges of multicomponent multifunctional materials. Papers focusing on the understanding of such materials systems utilizing theoretical, experimental and/or novel sophisticated characterization methods are an important theme. 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 Symposium Topics:

- Dielectric, piezoelectric, pyroelectric, electrocaloric, magnetoelectric, magnetostrictive, electrostrictive, and other ferroic properties
- Transport properties of multilayer multiferroics
- Thin film growth, materials design, processing, and integration
- Interfaces in multilayered ferroic heterostructures, functionally graded ferroics
- Multiferroics
- Structure: defects and doping; the relationship between materials growth, microstructure, and the relation between microstructure and physical properties
- Theory and modeling
- Technological applications

Symposium Organizers

- **Melanie W. Cole**, U.S. Army Research Laboratory, USA, melanie.w.cole.civ@mail.mil
- **Ichiro Takeuchi**, University of Maryland, USA
- **Valanoor Nagarajan**, The University of New South Wales, Australia
- **S. Pamir Alpay**, University of Connecticut, USA
- **Joseph V. Mantese**, United Technologies Research Center, USA

ABSTRACT SUBMISSION INSTRUCTIONS

Visit **www.ceramics.org/ema2013** to review the session topics and select the "Submit Abstract" hyperlink to be directed to the Abstract Central website. If you have questions, please contact Marilyn Stoltz at **mstoltz@ceramics.org** or 614-794-5868.

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S3: Structure of Emerging Perovskite Oxides: Bridging Length Scales and Unifying Experiment and Theory

Pb-based oxides have been plagued with ever-increasing environmental and health concerns. As a result, numerous research groups around the globe have contributed to a resurgence in Pb-free materials development. The principles understood in Pb-based compositions, namely those associated with the morphotropic phase boundary (MPB), have guided the inquiry toward new solid solutions between components containing Na, K, Bi, and Ba. Some principles of MPBs that have been argued to strongly influence properties include monoclinic structural distortions, nanodomain structures, co-existing ferroelectric phases, domain wall contributions, etc. These physical phenomena span length scales, making a single characterization technique difficult to completely and conclusively determine the structure and structural origin of the properties. Moreover, experimental results need to be interpreted through (and further inform) theoretical models. The challenges in structural and phase determination transcend single research groups and necessitate cooperation of experts in numerous fields. This symposium is a forum for these researchers to disseminate their results and develop new integrated approaches.

Symposium Organizers

- **Jacob L. Jones**, University of Florida, USA, jjones@mse.ufl.edu
- **David Cann**, Oregon State University, USA
- **Dragan Damjanovic**, EPFL, Switzerland
- **Julia Glaum**, UNSW, Australia
- **Simon R Phillpot**, University of Florida, USA
- **Matthew Suchomel**, Argonne National Laboratory, USA
- **Xiaoli Tan**, Iowa State University, USA
- **Yu Wang**, Michigan Tech, USA

S4: LEDs and Photovoltaics—Beyond the Light: Common Challenges and Opportunities

In today's Green Economy, there are two seemingly unrelated markets whose maturing technologies are each centered around semiconductors and light. Photovoltaics and LEDs: One generates electricity by efficiently capturing (sun)light, and the other generates light by efficiently consuming electricity. Both technologies have similar challenges to overcome before widespread adoption will take place. Yet there has been little dialog between the two fields. This Symposium attempts to draw these two technical disciplines together in an effort to attack similar problems from alternative points of view. The greatest challenge in common is Cost. This challenge could be overcome in both disciplines, for example, with the development of highly efficient semiconductors (>60%), high light extraction/absorption of the substrate/chip/optical systems, better optical coupling, and high-speed, low-cost manufacturing. Another challenge in common is Reliability. This challenge can be addressed by development of environmentally stable materials and encapsulants, better thermal management, and reliable thermal and electrical interconnects.

Proposed Symposium Topics:

- Efficient semiconductor materials—traditional (Si, GaN) and non-traditional
- Transparent conductive electrodes
- Transparent, thermally conductive encapsulants
- Thermal management (substrates, die-attach, TIMs, cooling, etc.)
- Environmental Stability & Lifetime
- Optical coupling I: structured surfaces and high index materials
- Optical coupling II: novel light extraction and absorption
- Low cost, high speed manufacturing

Symposium Organizer

- **Adam M. Scotch**, OSRAM SYLVANIA, USA, adam.scotch@sylvania.com

S5: Structure and Properties of Interfaces in Electronic Materials

Interfaces can be the controlling microstructural feature in many electronic applications and are becoming increasingly important as the scale of electronic system decreases. A fundamental understanding of the role of interfaces at the nanoscale is needed to enable increased performance. This symposium will bring together simulations and measurements of the properties and performance of interfaces (grain boundaries, phase boundaries and surfaces) to address the thermodynamic and kinetic effects that control the structure and performance of electronic systems.

Proposed Symposium Topics:

- Thermodynamics of interfaces
- Transport at interfaces
- Structure and composition of interfaces

Symposium Organizers

- **John Blendell**, Purdue University, USA, blendell@purdue.edu
- **R. Edwin García**, Purdue University, USA
- **Shen Dillon**, University of Illinois, USA
- **Erik D. Spoerke**, Sandia National Laboratories, USA

S6: Thermoelectrics: Defect Chemistry, Doping and Nanoscale Effects

In order to be useful, widespread energy scavenging materials, thermoelectrics must be composed of nontoxic and abundant elements, be stable in air to high temperatures, and display simultaneous large thermopower and low thermal conductivity. A wide variety of ceramic science may be applied to control conductivity and to decrease phonon-related thermal transport. Nanostructuring approaches have been adopted in traditional selenide and telluride thermoelectric materials, and are now being extended to novel thermoelectrics. Methods including nanoscale grains, embedded nanoinclusions, interfacial nanocoatings, and lamellar/multilayer structuring have all been utilized for significant thermoelectric property improvements. Similar efforts have recently been proposed for oxide materials, where control of oxygen vacancies, crystal chemistry, and electronically compensating charge carriers have led to ZT values exceeding 0.7. This symposium is a forum for discussing defect chemistry, conductivity, thermal conductivity optimization and applications for novel thermoelectrics.

Proposed Symposium Topics:

- Theory and applications
- Thermoelectric silicides
- Thermoelectric oxides
- Novel materials
- Low dimensional materials and crystal chemistry approaches
- Nanoscale scattering effects
- Thermophotovoltaics and emerging thermal devices

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Symposium Organizer
- **Alp Sehirlioglu**, Case Western Reserve University, USA, alp.sehirlioglu@case.edu
- **Anke Weidenkaff**, EMPA, Switzerland
- **Jon Ihlefeld**, Sandia National Laboratories, USA
- **Antoine Maignan**, CRISMAT Laboratory, France

S7: Production Quality Ferroelectric Thin Films and Devices

This symposium is targeted at bringing together the industrial leaders in the area of ferroelectric thin film processing. Targeted application areas include ferroelectric random access memory, inkjet printing, sensors, and other MEMS applications. Topics for discussion include all types of thin film manufacturing techniques, repeatability and reproducibility at the manufacturing scale, uniformity controls, contamination controls, defect density, electrical characterization, device design, device characterization.

Proposed Symposium Topics:
- Ferroelectric and Piezoelectric Thin Film Deposition
- Electrical and Electromechanical Testing and Characterization
- Reliability and Repeatability Assessment
- Etching and Patterning
- Device Fabrication and Processing

Symposium Organizers
- **Ronald G. Polcawich**, US Army Research Laboratory, USA, ronald.g.polcawich.civ@mail.mil
- **Glen Fox**, Fox Materials Consulting, USA
- **Geoff Brennecka**, Sandia National Laboratories, USA

S8: Advances in Memory Devices

A range of future data storage solutions are under development worldwide, including phase change, flash, ferroelectric, resistive, magnetic, spintronic, and optical systems. These implement a range of ceramic materials, including semiconductors, glasses, perovskites, ferroics, and multifunctionals. The benefits and limitations for each balance often-competing requirements in terms of data density, power consumption, speed, and reliability, with cost, manufacturability, and scalability also necessarily important. Toward overcoming challenges to extend and improve current memory technologies, this symposium will feature presentations on new materials, designs, and fabrication methods, along with those emphasizing advances in characterization, modeling, and operating conditions. Contributions will focus on improving ultimate device performance, extending current technologies, decreasing energy consumption, and common challenges and solutions across memory platforms..

Proposed Symposium Topics:
- Resistive memories
- Charge storage systems
- Ferroelectrics
- Thermal storage
- Optical and Magnetic devices
- Common Challenges and Solutions

Symposium Organizers
- **Bryan D. Huey**, University of Connecticut, USA, bhuey@ims.uconn.edu
- **Glen Fox**, Fox Materials Consulting, USA

S9: Thin Film Integration and Processing Science

This symposium will bring together researchers from academia, government labs, and industry to focus on the profound role of processing and integration science on structure-property relations in thin ceramic and metallic (both polycrystalline and epitaxial) films. Of interest for this symposium are advances in thin film processes that enable integration with non-traditional substrates, processing methods that facilitate epitaxy, and tailoring processing methods to achieve bulk-like responses under limited thermal budgets. Specific materials systems discussed are intentionally broad in an effort to bridge communities (e.g. ferroelectrics, transparent conductors, battery materials) for highest impact and knowledge sharing. Topics of interest include (but are not limited to) integration of oxides with polymers, advanced substrate preparation methods, utilizing and controlling strain to enhance properties, and achieving bulk-like properties in thin films.

Proposed Symposium Topics:
- Novel Substrate Materials
- Low Temperature Processing
- Strain Engineering for Enhanced Performance
- Controlling Epitaxial Growth Morphology
- Controlling Phase Assemblage
- *In-situ* Characterization

Symposium Organizers
- **Brady J. Gibbons**, Oregon State University, USA, brady.gibbons@oregonstate.edu
- **Jon Ihlefeld**, Sandia National Laboratories, USA
- **Jon-Paul Maria**, North Carolina State University, USA

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S10: Ceramic Composites for Defense Applications

This symposium brings together researchers from academia, government labs, and industry to present the latest advances in fabrication, modeling and characterization of ceramic composites for defense applications. These composites can have an impact on a variety of applications, including tunable microwave devices, sonar transducers, high-energy-density capacitors, piezoelectrics, energy harvesting, actuators and sensors.

Symposium Organizer

- **Edward P. Gorzkowski**, Naval Research Laboratory, USA, gorzkowsk@anvil.nrl.navy.mil

S11: Sustainable, Low Critical Material Use and Green Materials Processing Technologies

Development of low-carbon, low-critical materials use, energy-efficient, and environmentally-benign technologies is an emerging issue for both economic competitiveness of manufacturing and sustainable energy generation and use. This symposium is a forum for materials issues related to both improved materials manufacturing and new energy efficiency and energy generation technology development. Improved materials manufacturing, or green processing, includes use of more environmentally-benign and/or lower energy use manufacturing methods, which provide benefits in reduced cost, waste generation, and environmental compliance. Electronic ceramics also play an important role in clean energy generation, environmental remediation, and energy efficiency technologies. Redox-active materials enable multiple atmospheric effects including reduction of atmospheric pollution, carbon sequestration, and artificial solar thermal photosynthesis. Electronic ceramics also enable advances in building energy efficiency through moderation of heat gain and loss (electrochromics and photochromics), photovoltaics (transparent conductive oxides), and novel energy storage methods. Topics include development of novel energy and environmental technologies, waste minimization, substitutions for rare or critical substances, and advanced process development.

Proposed Symposium Topics:

- Energy efficient manufacturing, building, transportation, & lighting
- Identification of and replacements for critical materials (rare earth metals, indium, lithium, and others)
- Green manufacturing methods
- Ceramic-based carbon sequestration
- Synthetic photosynthesis
- Carbon-neutral energy generation

Symposium Organizers

- **Paul Clem**, Sandia National Laboratories, USA, pgclem@sandia.gov
- **Stephan Krohns**, University of Augsburg, Germany

S12: Recent Developments in High Temperature Superconductivity

Recently, significant progress has been made world-wide in both fabrication and fundamental understanding of high-temperature superconductors (HTS). For example, high-temperature superconductor (such as cuprates) wires and tapes have been commercially produced; advances are continued to be made in fabrication and application of superconducting MgB_2; and the iron arsenide family of superconductors has set off an intense search for new superconductors with even higher transition temperatures and lower anisotropies. However, challenges remain to increase the overall current carrying ability for applications and to correlate the interplay between structure, magnetism, and superconductivity in these superconductors on a micro-, meso-, and nano-scales for fundamental understanding of the mechanism of superconductivity. This symposium will cover recent development in the processing of superconducting materials, improved flux-pinning via structural and defect optimization, and recent advances in the discovery of new superconducting materials.

Proposed Symposium Topics:

- 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 cuprate, MgB_2, and iron arsenide superconductors
- New superconducting materials and phenomena
- Characterization of structural and superconducting properties
- AC-losses in coated conductors and MgB_2 as well as Bi-based materials

Symposium Organizers

- **Haiyan Wang**, Texas A&M University, USA, wangh@ece.tamu.edu
- **Timothy J. Haugan**, The Air Force Research Laboratory, USA
- **Quanxi Jia**, Los Alamos National Laboratory, USA

S13: Body Energy Harvesting for Intelligent Systems

As computers become increasingly smaller and more powerful, futurists predict that intelligent, miniature robotic implants will be able to provide humans with synthetic organs, blood cell replacements, and even brain function enhancements. One major problem to overcome before this becomes reality is how to power such devices. Right now, all biomedical organ assisting devices run on external batteries and energy sources. Their miniaturized, implanted successors will need to be able to function using the body's own energy sources, e.g. ATP, mechanical, pH gradients or cell potentials and many more. This concept is described as body energy harvesting for intelligent systems This session plans to bring together industry leaders and researchers in the field studying the fundamentals of body energy harvesting via a wide range of processes. It will also address the current state of the art like piezomaterials and many other implanted or implantable devices for energy harvesting as well as scavengers for wearable electronics or sensors.

Proposed Symposium Topics:

- Biomechanical and Piezoelectric Energy Harvesting
- Catalytic or Membrane Harvesting
- Other sources of energy harvesting (chemical gradients of implants, electromagnetic fields and more)

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Symposium Organizers
- **Wolfgang Sigmund**, University of Florida, USA and Hanyang University, Republic of Korea, wsigm@mse.ufl.edu; sigmund@hanyang.ac.kr
- **Seungbum Hong**, Argonne National Laboratory, USA

S14: Nanoscale Electronic Materials and Devices

Nanomaterials and fabrication techniques enable better control of the electronic, thermal, mechanical and magnetic properties of nanoelectronic devices. Layered semiconductor and oxide heterostructures can be used to engineer specific physical material properties. The rich interplay between self-organized structure and individual material properties in oxide heterostructures is observed in their multiferroic properties. Semiconductor nanowires and carbon-based materials impact both energy related technologies such as thermoelectrics and photovoltaics and new sensor techniques. New tools can characterize the electronic and structural properties of nanoscale devices. In this symposium we focus on integration of different nanotechnologies to make devices with new functionality.

Symposium Organizer
- **Michael Lilly**, Sandia National Laboratories, USA, mplilly@sandia.gov

S15: Failure: The Greatest Teacher

The vast majority of scientific literature and discussion report positive results, but there's a lot to be learned from negative results as well. This symposium offers an opportunity for people to discuss their great ideas that didn't work out for one reason or another and potentially get suggestions, point out some hidden law of physics that they had overlooked, or simply tell a story of the forensic work behind WHY something didn't work out in case it inspires spinoff ideas. Speakers and audience alike are encouraged to check their egos at the door and engage in a frank and friendly discussion that is sure to spill over into the evening.

Symposium Organizers
- **Geoff Brennecka**, Sandia National Laboratories, USA, glbrenn@sandia.gov
- **Jon Ihlefeld**, Sandia National Laboratories, USA
- **Jon-Paul Maria**, North Carolina State University, USA

S16: Highlights of Student Research in Basic Science and Electronic Ceramics

Undergraduate student research is being conducted at universities all over the world, but rarely are these students allowed the opportunity to present their work at a meeting in front of their colleagues and esteemed professionals of the ceramics and materials community. This symposium will showcase undergraduate research to encourage innovation and involvement and to highlight the scientific contributions of undergraduate students to ceramics research.

Proposed Symposium Topics:
- Nanostructured materials, nanocomposites and interfacial effects
- Novel processing approaches
- Novel characterization approaches
- Dielectric, piezoelectric, ferroelectric and multiferroic materials
- Energy harvesting materials and applications
- Energy storage materials and applications
- Other science and applications of ceramic electronic materials

Symposium Organizers
- **Kelsey Meyer**, New Mexico Institute of Mining and Technology, USA, kecmeyer@gmail.com
- **Troy Ansell**, Oregon State University, USA
- **Geoff Brennecka**, Sandia National Laboratories, USA