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Abstract Submission Opens September 24, 2020
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2021 MRS® SPRING MEETING & EXHIBIT
April 18–23, 2021 | Seattle, Washington
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Symposium BI01: Incorporating Sustainability into Materials Science Education, Training and Public Outreach

Materials science is central to the sustainable development of new products and processes, from applications spanning clean energy technologies to water purification, to industrial-scale processes that are energy-efficient and benign to the environment and human health. The COVID-19 pandemic has emphasised the importance of materials science and how it scaffolds humanity.

Meeting the challenges of sustainable development will require a materials science workforce that is well-educated and trained in the principles of sustainability and how they interface with the broader context of related scientific fields, industrial-scale up, socioeconomics, and policy. Since sustainable technologies must ultimately be adopted by the public to be successful, public perception and outreach are also critical components to enabling a sustainable future.

Many of the 17 United Nations Sustainable Development Goals (UN SDGs), which originated at the United Nations Conference on Sustainable Development in 2012, intersect with the field of materials science. The UN SDGs also inform and underpin the research funding landscape, and represent an opportunity for companies, NGO's and university researchers and educators to contribute to sustainable development.

This symposium will bring together materials researchers and educators, industry and sustainability leaders, and science communications and outreach specialists. They will share and explore innovative pedagogy, curriculum materials and resources, skillsets required for the future workforce, and public outreach for integrating and employing sustainable systems thinking to ultimately help transform our world.

Topics will include:

- Techniques and tools for integrating sustainability into materials science courses
- Sustainability undergraduate and postgraduate programs
- Interdisciplinary approaches in sustainability education
- Using the UN Sustainable Development Goals in higher education, and K-12 curricula and pedagogy
- Informal science education approaches to public awareness, understanding and interest in sustainability
- Best practices in scientist communication training for public audiences
- Industry challenges and opportunities in pursuit of corporate social responsibility
- Globalization and sustainability education
- Skillsets and knowledge needed in the future materials science workforce
- Material life cycle assessment/ management
- Environmental impacts of Materials

A **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Theresa Davy	Tohoku University, Japan	**Vasiliki Kioupi**	Imperial College London, United Kingdom
Marc Fry	Ansys Granta, United Kingdom	**Elsa Olivetti**	Massachusetts Institute of Technology, USA
Gabrielle Gaustad	Alfred University, USA	**Elizabeth Pollitzer**	Portia, United Kingdom
Carol Handwerker	Purdue University, USA	**Rachael Relph**	My Green Lab, USA
Eva Hemmer	University of Ottawa, Canada	**Sara Rodriguez**	ETH Z¿rich, Switzerland

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Symposium CT01: *In Situ/Operando* Characterization of Solidï Liquid Interfaces for Sustainable Energy, Water and Environment

Sustainable energy, water, and environment are critical challenges facing the human society. To enable a sustainable future, it is of paramount importance to develop materials for energy conversion and storage, water filtration and purification, carbon capture and storage, and so on. These emerging functionalities mainly occur at the surfaces and interfaces of materials, especially solid-liquid interfaces, where molecular adsorption, chemical transformation, and charge storage processes occur. Materials development in these areas require synergistic activities of materials synthesis, characterization, and performance tests. However, *in situ/operando* characterization of solid-liquid interfaces remains challenging. Traditional surface science techniques usually require operation in vacuum which is incompatible with liquid environments. To bridge the gap between surface science and realistic conditions of solid-liquid interfaces, various *in situ/operando* imaging and spectroscopy methods have been recently developed, utilizing scanning probe, optical, electron, and/or X-ray based approaches. Such techniques have significantly advanced our understanding of the atomic and molecular scale structure and kinetics at solid-liquid interfaces, providing guidance for the rational design of materials for energy, water, and environmental technologies. This symposium will bring together scientists from around the world to discuss characterization techniques, fundamental theories/mechanisms, and practical applications related to solid-liquid interfaces.

Topics will include:

- Scanning probe based interfacial and electrochemical characterization
- *In situ/operando* optical spectroscopy of solid-liquid interfaces
- *In situ/operando* X-ray spectroscopy of solid-liquid interfaces
- Electron microscopy of solid-liquid interfaces
- Multi-modal characterization of solid-liquid interfaces
- Theory and modeling of solid-liquid interfaces
- Fundamental electric double layer structures at solid-liquid interfaces
- Solid-electrolyte interphases in batteries
- Interfacial reaction kinetics in electrocatalysis
- Electrochemical interfaces for supercapacitors
- Semiconductor-electrolyte interfaces for photocatalysis and photoelectrochemistry

Invited speakers include:

Rob Atkin	The University of Western Australia, Australia
Nina Balke	Oak Ridge National Laboratory, USA
Alexis Bell	University of California, Berkeley, USA
Shannon Boettcher	University of Oregon, USA
Oleg Borodin	U.S. Army Research Laboratory, USA
Maria Chan	Argonne National Laboratory, USA
William Chueh	Stanford University, USA
Yi Cui	Stanford University, USA
Zhenxing Feng	Oregon State University, USA
Giulia Galli	The University of Chicago, USA
Ricardo Garcia	Instituto de Ciencia de Materiales de Madrid, Spain
Andrew Gewirth	University of Illinois at Urbana-Champaign, USA
Enyuan Hu	Brookhaven National Laboratory, USA

Takuya Masuda	National Institute for Materials Science, Japan
Matthew McDowell	Georgia Institute of Technology, USA
Michael Mirkin	Queens College, City University of New York, USA
Jagjit Nanda	Oak Ridge National Laboratory, USA
Joaquin Rodriguez-Lopez	University of Illinois at Urbana-Champaign, USA
Reza Shahbazian-Yassar	University of Illinois at Chicago, USA
Francesca Toma	Lawrence Berkeley National Laboratory, USA
Michael Toney	SLAC National Accelerator Laboratory, USA
Huolin Xin	University of California, Irvine, USA
Bingjun Xu	University of Delaware, USA
Kang Xu	U.S. Army Research Laboratory, USA
Xiaoji Xu	Lehigh University, USA
Haimei Zheng	Lawrence Berkeley National Laboratory, USA

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Symposium CT02: *In Situ* TEM Characterization of Dynamic Processes During Materials Synthesis and Processing

In Situ imaging and spectroscopy techniques have emerged as primary tools for characterizing the dynamics of materials formation. The development of *in situ* capabilities for TEM has led to rapid advances in our understanding of nucleation, growth, assembly and coarsening in colloidal, electrochemical, organic, macromolecular, semiconductor, biomineral and other solution-based systems. The symposium will cover a broad range of topics related to *in situ* studies of materials formation including cluster formation and dynamics, particle nucleation, crystal growth, phase transformations, crystal defect formation and elimination, recrystallization, nanoparticle interactions and assembly, nanowire growth, polymeric, macromolecular and organic/inorganic self-assembly, chemical reactions, and interface dynamics in gases and liquids. This symposium aims to provide a platform of discussion to understand the physics and chemistry of materials formation using *in situ* TEM techniques for researchers from various fields.

Topics will include:

- Nucleation and crystal growth from solutions, melts and vapors
- Phase transformations
- Chemical and electrochemical reactions
- Interface-driven processes
- Mechanically, electrically or magnetically driven processes
- Self-assembly of nanoparticle superlattices
- Polymeric and organic/inorganic self-assembly and nanoparticle mediated growth and oriented attachment
- Crystallization in biomineral and biomimetic systems
- Electron beam effects during in situ study via transmission electron microscopy
- Technical advances, applications and practical experiences associated with electrochemical processes including batteries, water splitting, fuel cell and photoelectrochemistry.
- Developments in specialized holders and electron microscopes, data analysis and mining
- Practical challenges for microscopy

Invited speakers include:

Judy Cha	Yale University, USA	**Layla Mehdi**	University of Liverpool, United Kingdom
Qian Chen	University of Illinois at Urbana-Champaign, USA	**Eva Olsson**	Chalmers University of Technology, Sweden
Miaofang Chi	Oak Ridge National Laboratory, USA	**Peter Pauzauskie**	University of Washington, USA
Peter Crozier	Arizona State University, USA	**Quentin Ramasse**	SuperSTEM, United Kingdom
Jim De Yoreo	Pacific Northwest National Laboratory, USA	**Frances Ross**	Massachusetts Institute of Technology, USA
Yu Han	King Abdullah University of Science and Technology, Saudi Arabia	**Qiang Xu**	DENSsolutions, Netherlands
Yuki Kimura	INMï Leibniz Institute for New Materials, Germany	**Haimei Zheng**	Lawrence Berkeley National Laboratory, USA
Honggang Liao	Xiamen University, China		

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Symposium CT03: Imaging Materials with X-Raysð Recent Advances with Synchrotron and Laboratory Sources

The last decade has seen a tremendous evolution of x-ray imaging and microscopy. This has been driven by the rapid development of third and fourth generation x-ray facilities, as well as new laboratory sources and x-ray optics capable of producing beams routinely below 50 nm in size. The high penetrating power, extreme sensitivity of x-rays to strain and defects and the tunability of these new sources to access x-ray fluorescence of much of the periodic table has enabled *in situ* or *operando* studies of nano-scale properties materials. It is worth also emphasizing that small x-ray beams may also be used to induce an electrical current or light emission in the nano-object enabling enhanced scanning probe and photo excitation studies.Beyond a discussion of the methods which have been developed, and are still an object of active research (coherent diffraction imaging in forward or Bragg or full field imaging conditions, nano x-ray fluorescence imaging, micro-Laue diffraction é), this symposium aims to review the materials science issues that these new tools can help solving. The range of materials science topics and related applications is indeed very large: electronic and optoelectronic devices (including flexible devices), transport properties, photovoltaic applications, catalysis, energy harvesting and storage, and even structural materials.

In all these areas, being able to investigate local structure-function relationships at the nano-scale during operation is a fundamental issue. The techniques described above have begun to make a major impact on these fundamental materials science questions. Our invited speakers, as well as the growing community of x-ray facility users, will present a complete overview of the capabilities and science being engaged with x-ray imaging and microscopy. These capabilities are only going to grow with the new, high brightness, synchrotrons and tabletop facilities appearing and being planned worldwide.

Topics will include:

- Å X-Ray Imaging and Microscopy developments
- Å Coherent x-ray diffraction imaging
- Å Laue diffraction microscopy
- Å X-Ray fluorescence microscopy
- Å Full field diffraction x-ray microscopy
- Å Nano x-ray computed tomography
- Å Materials science utilizing the methods:
- Å Strain mapping and engineering
- Å Nanostructures (metals, oxides, semiconductors)
- Å *In Situ* or *Operando* studies
- Å Mechanical and transport properties
- Å Optoelectronic properties
- Å Bioinspired materials and biomimetics

Invited speakers include:

Emma Cating-Subramanian	University of Colorado Boulder, USA
Yong Chu	Brookhaven National Laboratory, USA
Thomas Cornelius	Institut Mat®riaux Micro®lectronique Nanosciences de Provence, France
Ross Harder	Argonne National Laboratory, USA
Jorge Nicolas Hernandez-Charpak	STROBE University of Colorado, USA
Hyunjung Kim	Sogang University, Republic of Korea
Kristina Kutukova	Fraunhofer Institute for Ceramic Technologies and Systems, Germany
Camille La Fontaine	Synchrotron SOLEIL, France
Christian Lavoie	IBM T.J. Watson Research Center, USA
John Miao	University of California, Los Angeles, USA
Hande Ozturk	Ozyegin University, Turkey
Marie-Ingrid Richard	European Synchrotron Radiation Facility, France
Beatrice Ruta	Universit®de Lyon, France
Gerd Schneider	Helmholtz-Zentrum Berlin, Germany
Tobias Schulli	European Synchrotron Radiation Facility, France
Nobumichi Tamura	Lawrence Berkeley National Laboratory, USA
Wenbing Yun	Sigray, Inc., USA
Izabela Zglobicka	Warsaw University of Technology, Poland
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Symposium CT04: Predictive Synthesis and Decisive Characterization of Emerging Quantum Materials

Quantum materials are a broad category of materials system in condensed matter physics, where the materials behaviors are governed by quantum phenomena that emerge from the complex interactions between the orbital, charge, lattice and spin degrees of freedom within the broad framework of symmetry and topology. In recent years, quantum materials are attracting enormous attention due to the enormous fundamental breakthroughs and meanwhile promising applications of manipulating dissipationless electronic states to embrace quantum information era. Given these rapid developments in quantum materials, we feel obliged to organize a symposium to address the vast opportunities and challenges, particularly how characterization can be augmented by theory and modeling, and how multi-modal characterizations can be combined with each other for a more conclusive evidence of the presence or absence of emergent quantum states. We envision this symposium to highlight most recent progress, applications and forefront challenges in synthesizing various types of quantum materials, such as novel semiconductors and metals with non-trivial topology, in bulk, thin film and two-dimensional forms. We emphasize the recent progress in materials characterization methods, such as angular-resolved photoemission spectroscopy (ARPES), x-ray free electron lasers, (in)elastic neutron scattering, among other emerging novel spectroscopies. Particular attention will be paid to the emerging new tools for quantum materials which are unavailable or impractical even a few years ago, such as 4-probe Scanning Tunneling Microscopy (STM) with in-situ transport, as well as ñautomatedòthin-film growth and characterization with real-time feedback & control, such as high-throughput pulsed lased deposition (PLD) techniques and directed atomic-manipulation using a scanning transmission electron-microscope (STEM). The goal of this symposium is to provide an interactive forum to facilitate materials scientists in various fields to quickly digest the exciting recent progress of quantum materials with reduced knowledge barrier and identify new opportunities. Specific sessions will be organized regarding the scientific theme topics rather than with the similarity of a category of materials to benefit cross-fertilization.

Topics will include:

Å Predictive modeling (e.g. computational screening, rational design, machine-learning, multiscale/stochastic modeling of growth) of quantum materials, multimodal characterizations, and response to external fields, leading to new material discovery, design and control.
Å Hallmark characterization techniques and augmented novel synthesis on quantum materials (e.g. unconventional superconductors, quantum spin liquids, topological phases of matters, 2D ferromagnets and antiferromagnets).
Å High-precision growth and characterization of thin films and heterostructures toward quantum control and manipulation.
Å Multimodal 2D materials for fundamental quantum properties exploration.
Å Harvesting defects and interfaces for quantum control and manipulation.
Å State-of-the-art photoemission spectroscopies and their role for band topology studies.
Å State-of-the-art x-ray scattering to explore the interplay between the charge, spin and orbital degrees of freedom.
Å Neutron scattering measurement to study the magnetic properties and exotic excitations in materials.
Å Ultrafast x-ray free electron laser or electron diffraction/microscopy for quantum materials properties far away from equilibrium.

Joint sessions are being considered with **EN06 - Frontier Energy Sciences in Halide Perovskites**.
Also, a **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Alan Aspuru-Guzik	University of Toronto, Canada	**Vidya Madhavan**	University of Illinois at Urbana-Champaign, USA
Francois Bocquet	Forschungszentrum J¿lich GmbH, Germany	**Joel Moore**	University of California, Berkeley, USA
Yue Cao	Argonne National Laboratory, USA	**Prineha Narang**	Harvard University, USA
Cui-Zu Chang	The Pennsylvania State University, USA	**Ni Ni**	University of California, Los Angeles, USA
Yulin Chen	Oxford University, United Kingdom	**Brenda Rubenstein**	Brown University, USA
Valeria del Campo	Universidad T®cnica Federico Santa Mar²a, Chile	**Angel Rubio**	Max Planck Institute, Germany
Chang-Beom Eom	University of Wisconsinï Madison, USA	**Suchitra Sebastian**	Cambridge University, United Kingdom
Claudia Felser	Max Planck Institute, Germany	**Xiaozhe Shen**	SLAC National Accelerator Laboratory, USA
Brent Fultz	California Institute of Technology, USA	**Nicola Spaldin**	ETH Z¿rich, Switzerland
An-Ping Li	Oak Ridge National Laboratory, USA	**Liuyan Zhao**	University of Michigan, USA

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Symposium CT05: Artificial Intelligence and Automation for Materials Design

Artificial intelligence (AI) is changing the way we discover, design and optimize materials for a broad range of applications in energy technology, biomedicine, climate adaptation and more sustainable built environments. However, the power and usefulness of AI strongly depends on the type, magnitude and quality of data it receives, and it is vulnerable to biases that are common at the cutting edge of materials science. Particularly when we do not always have ībig dataò Thanks to decades of ongoing development of machine and deep learning methods in theoretical computer science, the challenge in AI-driven materials design has shifted from what analysis to do, to deciding what data to collect and how to represent materials in machine friendly formats. Materials manufacturing has also reached the stage where AI is driving process, coupling data analysis with automated synthesis or simulation, and the creation of digital twins. This symposium will bring together artificial intelligence methods including machine learning, deep learning, computer vision, optimization and language processing and automation methods including sensing, process control, high-throughput sampling and robotics. Automated control and monitoring of synthesis and processing using AI and internet of things (IoT) technologies is essential for scaling the development of new materials to industrial levels, just as the creating of realistic and comprehensive digital twins has become the goal of computational materials modelling. This symposium is not restricted to a specific class of materials, or application domain, since digital technologies can be repurposed and re-applied across discipline boundaries to accelerate impact.

Topics will include:

Å Classification and screening of materials for advanced applications
Å Data-driven materials informatics and machine learning
Å Computer vision and deep learning for structure/property relationships
Å Automation of materials synthetic and simulations, including high-throughput systems and robotics
Å Process modelling and monitoring, including sensing and internet of things
Å Automated characterisation and feature extraction of materials
Å Material digital twins
Å AI supported certification of materials
Å Nanoinformatics

A **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Murat Akyol	Toyota Research Institute, USA	**Elizabeth Holm**	Carnegie Mellon University, USA
Nong Artrith	Columbia University, USA	**Anubhav Jain**	Lawrence Berkeley National Laboratory, USA
Alan Aspuru-Guzak	University of Toronto, Canada	**Nick Kotov**	University of Michigan, USA
Mathieu Bauchy	University of California, Los Angeles, USA	**Nicola Marzari**	£cole Polytechnique F®d®rale de Lausanne, Switzerland
Carmen Constantinescu	Fraunhofer Institute for Industrial Engineering IAO, Germany	**Bryce Meredig**	Citrine Informatics, USA
Stefano Curtalano	Duke University, USA	**Dane Morgan**	University of Wisconsinï Madison, USA
Sanket Deshmukh	Virginia Tech, USA	**Elsa Olivetti**	Massachusetts Institute of Technology, USA
Claudia Draxl	Humboldt-Universitªt zu Berlin, Germany	**Amanda Parker**	Commonwealth Scientific and Industrial Research Organisation, Australia
Alaa Elwany	Texas A&M University, USA	**Kristin Persson**	Lawrence Berekely National Laboratory, USA
Adalberto Fazzio	Universidade de S«o Paulo, Brazil	**Paul Pigram**	La Trobe University, Australia
Alejandro Franco	Universit®de Picardie Jules Verne, France	**Rampi Ramprasad**	Georgia Institute of Technology, USA
Luca Ghiringhelli	Fritz-Haber-Institut der Max-Planck-Gesellschaft, Germany	**Prahalada Rao**	University of Nebraskaï Lincoln, USA
Brian Giera	Lawrence Livermore National Laboratory, USA	**Kristofer Reyes**	University at Buffalo, The State University of New York, USA
Thomas Hammerschmidt	Ruhr-Universitªt Bochum, Germany	**Patrick Rinke**	Aalto University, Finland
Hendrick Heinz	University of Colorado Boulder, USA	**Chris Wolverton**	Northwestern University, USA

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Symposium CT06: From Quantum Mechanics to Materials Engineeringð Recent Progress on the Development and Novel Applications of *Ab Initio* Methods in Materials Science

Over the last few decades, first-principles (i.e. parameter free, quantum mechanical) simulations have emerged as an indispensable tool in materials science and engineering. These techniques have helped further our understanding of the behavior of existing materials at a fundamental level, and have also aided in the discovery and characterization of novel materials. Therefore, development of new computational techniques related to first-principles simulations, as well as the application of such novel computational strategies to investigate emergent materials, form one of the most active areas of research and development in the computational materials science community.

This symposium broadly aims to bring together researchers who are working to push the envelope of materials simulations using first-principles methods. This includes researchers from the fields of computational materials science and engineering, condensed matter physics, quantum chemistry, applied mathematics and high-performance scientific computing. The symposium will focus on recent developments in techniques related to: large-scale ground state and excited state calculations (including recent developments in linear scaling methods, many-body perturbation theory etc.), developments associated with techniques related to the study of strongly correlated systems (including e.g. quantum embedding methods), as well as the applications of these techniques to study novel materials and/or materials systems inaccessible via conventional first-principles techniques (including e.g. novel quantum materials, materials related to energy storage and conversion, refractory materials such as high entropy alloys, etc.).

Topics will include:

- First principles simulations
- *Ab initio* methods
- Quantum calculations
- Density functional theory
- Many body perturbation theory
- Ground state calculations
- Excited state calculations
- Strongly correlated systems
- Linear scaling methods
- Quantum materials
- Energy materials
- Novel methods and algorithms

Joint sessions are being considered with **CT07 - Excited-State Properties of Materialsð Theory and Computation**.

Invited speakers include:

Garnet Chan	California Institute of Technology, USA	**Anna Krylov**	University of Southern California, USA
Robert A. DiStasio Jr.	Cornell University, USA	**Chris A. Marianetti**	Columbia University, USA
Claudia Draxl	Humboldt-Universitªt zu Berlin, Germany	**Nicola Marzari**	£cole Polytechnique F®d®rale de Lausanne, Switzerland
Giulia Galli	The University of Chicago, USA	**Yuan Ping**	University of California, Santa Cruz, USA
Vikram Gavini	University of Michigan, USA	**Diana Y. Qiu**	Yale University, USA
Chen Huang	Florida State University, USA	**Su Ying Quek**	National University of Singapore, Singapore
Paul Kent	Oak Ridge National Laboratory, USA	**Lucia Reining**	Institut Polytechnique de Paris, France
Gabriel Kotliar	Rutgers, The State University of New Jersey, USA	**Kristian Sommer Thygesen**	Technical University of Denmark, Denmark
Leeor Kronik	Weizmann Institute of Science, Israel	**Vojtech Vlcek**	University of California, Santa Barbara, USA

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Symposium CT07: Excited-State Properties of Materialsð Theory and Computation

Recent studies of the electronic excited states of materials have led to the discoveries of rich and fascinating phenomena that are distinct from those in the ground state. Various theoretical and computational methods have been developed and utilized to understand material properties in excited states, which reveal a number of highly interesting physical effects with diverse potential technological applications. Examples include various excitonic effects in transition metal dichalcogenide (TMD) systems (including moir®minibands for the excitons in aligned TMD heterostructures) and magneto-optical responses in van der Waals magnets.

This symposium aims to bring together materials scientists and condensed matter physicists who develop and combine various theoretical and computational approaches to study materials in their electronic excited states. Abstracts are solicited in the areas of methodology development and material applications. The category of theoretical and computational methods includes modelling of electronic excited states, ab initio methods, computational spectroscopy, etc. The category of material systems includes bulk semiconductors, polymers and perovskites, as well as topological insulators, van der Waals crystals (e.g., transition metal dichalcogenides, 2D magnets), and one-dimensional materials (e.g., carbon nanotubes).

Topics will include:

- Excitons and light-matter interaction
- Electron-phonon coupling
- Many-body perturbation theory
- Time-dependent density functional theory
- Out-of-equilibrium material properties
- Computational spectroscopy
- Optical and transport properties of halide perovskites
- Excited-state properties of 2D semiconductors (e.g. transition metal dichalcogenides)
- Excited-state properties of magnetic nanostructures
- Excited-state properties of van der Waals superlattices
- Excited-state properties of 1D materials (e.g. carbon nanotube, polymers)

Joint sessions are being considered with **CT06 - From Quantum Mechanics to Materials Engineeringð Recent Progress on the Development and Novel Applications of *Ab Initio* Methods in Materials Science**.

Invited speakers include:

Claudia Draxl	Humboldt-Universitªt zu Berlin, Germany
Giulia Galli	The University of Chicago, USA
Feliciano Giustino	The University of Texas at Austin, USA
Angelika Knothe	The University of Manchester, United Kingdom
Ju Li	Massachusetts Institute of Technology, USA
Steven Louie	University of California, Berkeley, USA
Nicola Marzari	£cole Polytechnique F®d®rale de Lausanne, Switzerland
Alberto Morpurgo	Geneva University, Switzerland
Jeffrey Neaon	Lawrence Berkeley National Laboratory, USA
Xiaofeng Qian	Texas A&M University, USA
Su Ying Quek	National University of Singapore, Singapore
Lucia Reining	Institut Polytechnique de Paris, France
Angel Rubio	University of the Basque Country, Spain
David Ruiz-Tejerina	Centro de Nanociencias y Nanotecnolog²a, Mexico
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Symposium CT08: Mechanochemical Coupling in Chemical Treatment and Materials Degradationð Modeling and Experimentation

This symposium aims at the fundamental and cross-disciplinary understanding of mechano-chemical coupling (MCC) in chemical or electrochemical processes. This coupling is of great importance to everyday life and modern industry. For example, it affects the cyclability of rechargeable batteries, the impact resistance of screen cover glass, and the durability of materials in high-temperature and corrosive environments. Analytical, computational, and experimental tools have been developed discretely for each situation to comprehend, mitigate, or make use of these coupling effects, but rarely is this expertise leveraged between research areas. New cross-disciplinary interactions could therefore bring about a broad impact on MCC research. The symposium also aims to foster the synergy between theoretical and experimental investigations. Theoretical and computational models lay the groundwork for comprehending and predicting MCC in materials processing or degradation. Experimental studies complement modeling with quantitative unveiling of the coupling phenomena, such as the in-situ observations of oxidation or lithiation, and the atomic-resolution imaging of diffusion/reaction processes. Discussions of materials synthesis and fabrication methods based on MCC and discussions that advance understanding of fundamental material science issues are also welcomed. To promote cross-disciplinary discussion under the theme of MCC, we call for abstracts in, but not limited to, the following areas: mechano-chemical modeling of diffusion and reaction in multi-component systems, the degradation of bulk or thin-film materials at high temperatures and/or corrosive environments, new battery concepts that mitigate the MCC effect (e.g., Zero-Strain cathode materials), ion-exchange process in glass and polymers, and advanced energy materials.

Topics will include:

Å Modeling of diffusion-reaction in multi-component systems
Å Modeling of microstructure/texture evolution
Å Modeling of phase transformation and grain growth
Å Modeling of rechargeable batteries and fuel cells
Å First-principle calculation of MCC effect
Å Oxidization or corrosion of advanced alloys
Å Stress corrosion cracking
Å Ion-exchange toughening of glasses
Å Novel (e.g., zero-strain) cathode materials
Å Nuclear materials and irradiation effects
Å High-resolution characterization of mechanochemical coupled diffusion-reaction processes
Å Corrosion of glass and ceramics

Invited speakers include:

Alexander Freidin	Institute for Problems in Mechanical Engineering, Russian Academy of Sciences, Russian Federation
Stephane Gin	Commissariat ¨ l®nergie atomique et aux ®nergies alternatives, France
Xiaogang Li	University of Science and Technology Beijing, China
Guglielmo Macrelli	ISOCLIMA Group, Italy
Philippe Marcus	Chimie Paris Techï £cole Nationale Sup®rieure de Chimie de Paris, France
Linda Nazar	University of Waterloo, Canada
Jamie No±l	The University of Western Ontario, Canada
San Qiang Shi	The Hong Kong Polytechnic University, Hong Kong
Marcel A.J. Sommers	Technical University of Denmark, Denmark
Christiane Stephan-Scherb	Bundesanstalt f¿r Materialforschung und -pr¿fung (BAM), Germany
Mattias Thuvander	Chalmers University of Technology, Sweden
Filip Tuomisto	University of Helsinki, Finland
Chongmin Wang	Pacific Northwest National Laboratory, USA
Luning Wang	University of Science and Technology Beijing, China
Elaine West	Naval Nuclear Laboratory, USA

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Symposium EL01: Organic Semiconductors and Characterization Techniques for Emerging Electronic Devices

The impressive potential of next-generation flexible, printable, and biocompatible electronic devices made from organic materials continue to draw significant interest in the research community. New small-molecule electron acceptors have enabled organic photovoltaics with >17% power-conversion efficiencies in tandem devices; novel doping concepts such as double doping of conjugated polymers or using lewis acids would allow novel device concepts and conjugated polymers that can simultaneously transport electrons and ions have opened up new sub-fields in bioelectronics.

Despite these advances, robust structure-property-performance relationships that govern materials design and their use in such applications remain lacking as iterations of materials optimization have largely relied on an Edisonian strategy. Furthermore, discrepancies exist in the literature regarding where the dopants are in these conjugated materials and how they affect the electronic properties of the material. Along the same line, design rules to make new conjugated polymeric materials into flexible electronics still needs further development to provide improved mechanical property without sacrifice their electronic performance.

In this symposium, we will bring together those in the community who work on materials design, structural characterization and computational techniques to create a forum to discuss materials and device architecture challenges in emerging electronics applications. Furthermore, we will have one session dedicated to bringing together entrepreneurs and academics to cover the current status and challenges of commercialization for these emerging technologies.

Topics will include:

Å Emerging organic semiconductors and electronic devices such as thermoelectrics, photodetectors, neuromorphic devices, bioelectronics, photocapacitors, solar cells and photo/transistors
Å Doped organic semiconductors for organic electronics
Å Strategies for doping and characterization methods
Å Structure-property relationship in organic semiconductors used in electronic devices
Å Charge transport in organic electronics
Å Methods and characterization techniques for morphology evaluation and processing organic semiconductors for electronic devices
Å Interplay between chemical structure, interface, performance and stability in organic electronics
Å Merging experimental measurements with theory and simulation toward designed materials, structures, and properties
Å Quantifying the structure and dynamics of semiconducting polymers using scattering techniques

Joint sessions are being considered with **EL07 - Bioelectronicsð Fundamentals and Applications**.

Invited speakers include:

Zhenan Bao	Stanford University, USA	**Ting Lei**	Peking University, China
Lay-Lay Chua	National University of Singapore, Singapore	**Hanyang Li**	Zhejiang University, China
Brian Collins	Washington State University, USA	**Sabine Ludwigs**	Universitªt Stuttgart, Germany
Ying Diao	University of Illinois at Urbana-Champaign, USA	**Jianguo Mei**	Purdue University, USA
Mike Fusella	Universal Display Corporation, USA	**Christian Muller**	Chalmers University of Technology, Sweden
Enrique Gomez	The Pennsylvania State University, USA	**Lilo Pozzo**	University of Washington, USA
Monica Hansen	Power Bloom, USA	**Erin Radcliff**	University of Arizona, USA
Fei Huang	South China University of Technology, China	**Bob Schroeder**	University College London, United Kingdom
Sahika Inal	King Abdullah University of Science and Technology, Saudi Arabia	**Eleni Stavrinidou**	Linkºping University, Sweden
Ji-Seon Kim	Imperial College London, United Kingdom	**Benjamin Tee**	National University of Singapore, Singapore

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Symposium EL02: Fundamentals of Halide Semiconductors for Optoelectronics

For the last decade, metal halide semiconductors have successfully demonstrated their significant capability for optoelectronic applications. Recently, metal halide semiconductors have emerged as a new class of light emitters as well as various photodetectors. Their superior optical and electronic properties and the bandgap tunability suggest that they will be useful in various optoelectronic applications. Solution processability of halide semiconductors makes these materials especially attractive for low-cost and scalable manufacturing of next-generation optoelectronic devices.

On the other hand, there is still a lack of fundamental understandings in physics, chemistry, and materials science of these new halide optoelectronic materials. This symposium will focus on a wide range of metal halide semiconductors including lead-based halide emitters, low-dimensional halide semiconductors, and non-toxic heavy-metal-free halide semiconductors to explore the fundamentals of those halide materials, including theoretical calculation, crystal/defect chemistry, carrier dynamics, photophysics, and ion migration. This symposium will also cover their use in various optoelectronic devices including light-emitting diodes, visible and infrared photodetectors, radioactive detectors, and lasers.

Topics will include:

- Theoretical calculation and simulation on halide semiconductors
- Synthesis and crystal/defect chemistry of halide semiconductors
- Lead-based halide emitters
- Low-dimensional (0D, 1D, 2D) halide semiconductors
- Non-toxic heavy-metal-free halide semiconductors
- Carrier dynamics and transportation mechanisms
- Photophysics (excitation, recombination, PL, EL) of halide semiconductors
- New device architecture in halide LEDs
- Halide semiconductor lasers
- Detectors (photodetectors and radioactive detectors)
- Other optoelectronic devices

Joint sessions are being considered with **EN06 - Frontier Energy Sciences in Halide Perovskites**.
Also, a **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Natalie Banerji	University of Bern, Switzerland
Alexander Efros	U.S. Naval Research Laboratory, USA
Jinsong Huang	University of North Carolina at Chapel Hill, USA
Libai Huang	Purdue University, USA
Antoine Kahn	Princeton University, USA
Tae-Woo Lee	Seoul National University, Republic of Korea
Biwu Ma	Florida State University, USA
David Mitzi	Duke University, USA
Wanyi Nie	Los Alamos National Laboratory, USA
Olga S. Ovchinnikova	Oak Ridge National Laboratory, USA
Annamaria Petrozza	Istituto Italiano di Tecnologia, Italy
Paulina Plochocka	Laboratoire National des Champs Magn®tiques Intenses, France
Barry Rand	Princeton University, USA
Bayrammurad Saparov	The University of Oklahoma, USA
Edward H. Sargent	University of Toronto, Canada
Ruth Shinar	Iowa State University, USA
Franky So	North Carolina State University, USA
Stephen Sai-Wing Tsang	City University of Hong Kong, Hong Kong
Yanfa Yan	University of Toledo, USA
Hin-Lap Yip	South China University of Technology, China
Zhibin Yu	Florida State University, USA
Yu Zhang	Jilin University, China
Ni Zhao	The Chinese University of Hong Kong, Hong Kong

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Symposium EL03: Emerging Ionic Semiconductorsð Research and Applications

Semiconductor technology today relies on group-IV, III-V, and II-VI materials that feature four-fold coordination and covalent sp^3 bonding. The remarkable emergence of halide perovskite semiconductors has raised the prospects of materials with ionic bonding and more complex crystals structures for optoelectronic applications, including photovoltaics and solid state lighting. Balancing ionic and covalent bonding in complex structure motifs creates opportunities to discover semiconductors with properties and processing pathways unattainable in conventional materials. Examples of such include complex oxide materials designed to combine ferroelectricity with band gap in the VIS-NIR, and chalcogenide perovskite semiconductors that feature excellent light absorption and environmental stability. This symposium will be a forum to report exciting progress in these emerging ionic semiconductors, focusing on complex chalcogenides and oxides but also including nitrides and related compounds as appropriate. We encourage reports from a wide range of activities including theory, materials synthesis and characterization, devices, and applications. Abstracts on halides, binary oxides, and other conventional III-V and II-VI semiconductors are discouraged.

Topics will include:

- Computational and machine learning-enabled materials design
- Synthesis and processing science, bulk materials and thin films
- Physics and chemistry of complex-structured semiconductors
- Advanced characterization, with focus on device-relevant properties
- Device fabrication and test
- Applications, including but not limited to solar energy conversion, solid state lighting, microelectronics, thermoelectrics and phase change materials

Invited speakers include:

Ulrich Aschauer	University of Bern, Switzerland
Joseph Bennett	University of Maryland, Baltimore County, USA
Megan Butala	University of Florida, USA
Kazunari Domen	The University of Tokyo, Japan
Ann Greenaway	National Renewable Energy Laboratory, USA
Hideo Hosono	Tokyo Institute of Technology, Japan
Karsten Wedel Jacobsen	Technical University of Denmark, Denmark
Mercouri Kanatzidis	Northwestern University, USA
Eric Pop	Stanford University, USA
Pengfei Qiu	Shanghai Institute of Ceramics, Chinese Academy of Sciences, China
Karin Rabe	Rutgers, The State University of New Jersey, USA
Jayakanth Ravichandran	University of Southern California, USA
David Scanlon	University College London, England
Kimberly See	California Institute of Technology, USA
Zhimei Sun	Beihang University, China
Suhuai Wei	Beijing Computational Science Research Center, China
Matthias Wuttig	RWTH Aachen University, Germany
Andriy Zakutayev	National Renewable Energy Laboratory, USA
Alexandra Zevalkink	Michigan State University, USA
Shengbai Zhang	Rensselaer Polytechnic Institute, USA

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Symposium EL04: Ultrawide Bandgap Materials, Devices and Systems

Research in ultra-wide-bandgap (UWBG) semiconductor materials and devices continues to progress rapidly, providing new and exciting research opportunities for a wide range of electronic, optical, sensing and quantum applications. Materials with bandgaps exceeding that of GaN and SiC, such as GaO/AlGaO, diamond, c-BN and AlGaN are at the frontier of semiconductor materials research and device physics. Many of the fundamental properties of these emerging materials are still poorly understood; however, as an example, the physics of high-energy carrier scattering and transport processes responsible for electrical breakdown are largely unknown. Practical challenges such as efficient and controllable *n*-type and *p*-type doping, production of large area, low defect density substrates, the formation of reliable, low resistance electrical contacts and the integration of dielectric films with high quality interfaces are also yet to be sufficiently addressed to facilitate the delivery of mature, viable and cost competitive UWBG technologies. While such materials hold great promise for applications ranging from UV emitters/detectors, to more compact and efficient energy converters, to higher-power high-frequency amplifiers, to advances in quantum information science, many materials and processing challenges must be addressed before such UWBG semiconductors can reach maturity and have significant impact. This symposium will cover comprehensive topics related to the materials science, device physics, and processing of UWBG materials, with a perspective on the applications that are driving research in the field. Topics of current interest in the more traditional wide-bandgap materials will also be considered. In this symposium, we will arrange a special session focusing on vertical GaN power devices targeting high-voltage operation, in coordination with DOE's Advanced Research Projects Agency, ARPA-E. Approaches to addressing specific challenges in GaN, such as the epitaxial growth of thick, low-doped drift layers and the realization of selective-area doping, will be covered.

Topics will include:

- Bulk crystals and substrates
- Epitaxial growth
- Theory and first principal calculations
- Defects science and doping
- Novel polarization effects and utilization in devices
- Device performance and reliability
- Low-dimensional structures
- Carrier recombination dynamics
- Gate and passivation dielectrics
- Thermal properties and thermal engineering
- Advanced materials characterization techniques
- Color centers for quantum technologies
- Ultraviolet light emitting diodes and detectors

Invited speakers include:

Nasim Alem	The Pennsylvania State University, USA
Andrew Armstrong	Sandia National Laboratories, USA
Sukwon Choi	The Pennsylvania State University, USA
Srabanti Chowdhury	Stanford University, USA
Bruno Daudin	Commissariat ¨ l®nergie atomique et aux ®nergies alternatives, France
Ken Haenen	Hasselt University, Belgium
Mutsuko Hatano	Tokyo Institute of Technology, Japan
Isik Kizilyalli	Advanced Research Projects Agency-Energy, USA
Satoshi Koizumi	National Institute for Materials Science, Japan
Martin Kuball	University of Bristol, United Kingdom
Maki Kushimoto	Nagoya University, Japan

Walter Lambrecht	Case Western Reserve University, USA
Jingyu Lin	Texas Tech University, USA
Robert Nemanich	Arizona State University, USA
Takeyoshi Onuma	Kogakuin University, Japan
Siddharth Rajan	The Ohio State University, USA
Steven Ringel	The Ohio State University, USA
Zlatko Sitar	North Carolina State University, USA
Tokuyuki Teraji	National Institute for Materials Science, Japan
Hitoshi Umezawa	National Institute of Advanced Industrial Science and Technology, Japan
Xinqiang Wang	Peking University, China

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Symposium EL05: Advanced Functional, Linear/Nonlinear and Quantum Materials for Metasurfaces, Metamaterials and Nanophotonics

Metasurfaces are arrays of subwavelength anisotropic light scatters (optical antennas) that can produce abrupt changes in the phase, amplitude, or polarization of light. Within last few yearsôsignificant progress, novel designs of metasurfaces that refract and focus light have enabled many unique properties and applications. This symposium will cover the fundamental principles and technological applications of metasurfaces and metamaterials, and particularly aim to explore on new tunable/nonlinear/quantum materials, structures, and advanced optical science/functionality of metasurfaces and metamaterials for applications spanning from imaging/display system, bio/chemical sensing, photovoltaics and energy harvesting devices, to quantum information processing, medical devices, communication system, and data storage. The symposium seeks to provide a general overview of recent advances in new design concepts and material platforms, including fabrication techniques, advanced design approaches, and promising applications enabled by the new developments.

Topics will include:

Å Metasurfaces and metamaterials
Å Alternative metasurface and nanophotonic materials
Å Photonics with two-dimensional materials: graphene, transition metal dichalcogenides and beyond
Å Materials with epsilon-near-zero and hyperbolic dispersion properties
Å Tunable nano-photonics, metamaterials, metasurfaces
Å Topological photonic and parity-time symmetric materials
Å Biological and chemical sensing with metasurfaces
Å Quantum nanophotonics and metasurfaces
Å Ultrafast and nonlinear effects in metamaterials
Å Waveguides, devices and systems from metamaterials and nanophotonics
Å Advanced nanophotonic design strategies including machine learning, topological optimizations, and inverse design as well as new simulation methods
Å Novel fabrication techniques for improving plasmonic/metasurface properties
Å Novel imaging technologies with space-multiplexed metasurfaces

Invited speakers include:

Gleb Akselrod	Lumotive, USA
Harry Atwater	California Institute of Technology, USA
Victor Brar	University of Wisconsinï Madison, USA
Mark Brongersma	Stanford University, USA
Natalie de Leon	Princeton University, USA
Jennifer Dionne	Stanford University, USA
Nader Engheta	University of Pennsylvania, USA
Jonathan Fan	Stanford University, USA
Shanhui Fan	Stanford University, USA
Patrice Genevet	Centre National de la Recherche Scientifique, France
Min Gu	RMIT University, Australia
Shangjr Gwo	Academia Sinica, Taiwan
Deep Jariwala	University of Pennsylvania, USA
Mikhail Kats	University of Wisconsinï Madison, USA
Byoungho Li	Seoul National University, Republic of Korea

Xiangping Li	University of Jinan, China
Stefan Maier	Ludwig-Maximilians-Universitªt M¿nchen, Germany
Hiroaki Misawa	Hokkaido University, Japan
Jeremy Munday	University of Maryland, USA
Dragomir Neshev	Australian National University, Australia
Junsuk Rho	Pohang University of Science and Technology, Republic of Korea
Vladimir Shalaev	Purdue University, USA
Radwanul Hasan Siddique	Samsung Advanced Institute of Technology, USA
Volker Sorger	George Washington University, USA
Mahmooda Sultana	NASA Goddard Space Flight Center, USA
Luke Sweatlock	Northrop Grumman Corporation, USA
Din-Ping Tsai	The Hong Kong Polytechnic University, Hong Kong
Nanfang Yu	Columbia University, USA
Xiang Zhang	University of California, Berkeley, USA
Yang Zhao	University of Illinois at Urbana-Champaign, USA

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Symposium EL06: Molecular and Colloidal Plasmonicsð Synthesis and Applications

The plasmon, which is a coherent collective oscillation of electrons relative to a crystalline lattice, leads to a diverse range of phenomena such as tunable optical resonances, intense near-fields, hot electron generation, plasmonic heating, refractive index sensitivity, and photocatalytic activity. With these remarkable properties acting as a foundation, the field of plasmonics has rapidly evolved, first giving rise to fundamental research that then translated into widespread application. The field is now at stage where the needs of applications are often the driving force for the materials research being carried out. This symposium, therefore, aims to bring together a diverse community of researchers who are advancing the field of plasmonics through synthesis, nanofabrication, and application where the greater goal is to provide an understanding of the opportunities and challenges that lie ahead.

Topics will include:

Å Advances in the colloidal synthesis of plasmonic nanostructures
Å Hierarchical assembly of plasmonic nanoparticles
Å Chiral plasmonic nanostructures
Å Artificial plasmonic moleculesð interference, quantum and chirality effects
Å Colloidal plasmonic nanocomposites and nanoparticle-semiconductor hybrid nanomaterials
Å Non-noble metal plasmonic materials
Å Plasmonic heating of nanostructuresð thermoplasmonics and nanothermometry
Å Stabilization of plasmonic nanoparticlesð durable plasmonics and sinter-resistant plasmonic catalysts
Å Surface Enhanced Raman Spectroscopy (SERS) and Tip-Enhanced Raman Excitation Spectroscopy (TERES)
Å Ultrafast transient absorption spectroscopy, single particle spectroscopy, and super-resolution imaging
Å Harvesting hot electrons for plasmonic photochemistry and photovoltaic
Å Plasmonic photocatalystsð artificial photosynthesis, performance, and understanding
Å Plasmonics in environmental remediation
Å Plasmonic nanoparticles for drug delivery, pharmaceutical applications, and photothermal therapy

Invited speakers include:

Jost Adam	University of Southern Denmark, Denmark	**Teri Odom**	Northwestern University, USA
Alexandra Boltasseva	Purdue University, USA	**Sang-Hyun Oh**	University of Minnesota, USA
Jon Camden	University of Notre Dame, USA	**Michelle Personick**	Wesleyan University, USA
Jingyi Chen	University of Arkansas, USA	**Dong Qin**	Georgia Institute of Technology, USA
Lev Chuntonov	Technionï Israel Institute of Technology, Israel	**Nathaniel Rosi**	University of Pittsburgh, USA
Hongyou Fan	Sandia National Laboratories, USA	**Sara Skrabalak**	Indiana University Bloomington, USA
Alexander Govorov	Ohio University, USA	**Yugang Sun**	Temple University, USA
Greg Hartland	University of Notre Dame, USA	**Hui Wang**	University of South Carolina, USA
Christy L. Haynes	University of Minnesota, USA	**W. David Wei**	University of Florida, USA
Cherie Kagan	University of Pennsylvania, USA	**Nianqiang (Nick) Wu**	University of Massachusetts Amherst, USA
Nicholas Kotov	University of Michigan, USA	**Xiaohu Xia**	University of Central Florida, USA
Liberato Manna	Istituto Italiano di Tecnologia, Italy	**Younan Xia**	Georgia Institute of Technology, USA
Catherine Murphy	University of Illinois at Urbana-Champaign, USA	**Yadong Yin**	University of California, Riverside, USA
Ki Tae Nam	Seoul National University, Republic of Korea	**Hua Zhang**	City University of Hong Kong, Hong Kong
Zhihong Nie	Fudan University, China	**Jing Zhao**	University of Connecticut, USA

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Symposium EL07: Bioelectronicsð Fundamentals and Applications

Bioelectronics ï a field intended to advance healthcare and to provide tools to further understand physiology and pathology through the interface of biological systems with materials and devices. In biological systems, intercellular communication plays a pivotal role in tissue organization and function. Indeed, in their native three-dimensional (3D) environment, cells are intimately connected to each other and to the surrounding matrix, forming a complex microenvironment. In recent years, there has been an immense interest in developing materials and material assemblies that will monitor biological phenomena in a multiscale manner: from the molecular level to cellular networks and organ level, up-to macroscale for wearable compliant and flexible devices. This symposium will broadly cover state-of-the-art as well emerging materials and materials assembly approaches used in bioelectrical interfaces to explore communication between and within cells in their native state and monitor electrophysiological state of the body. The topics that will be covered will vary from polymeric systems to solid state electronic devices, from molecular control of materials properties to the macroscopic assemblies with highly-adjusted functionalities. This interdisciplinary symposium will bring together the chemical, physical and biological aspects of the current state-of-the-art bioelectronic interfaces.

Topics will include:

Å Understanding the interface between electronic materials and biological systems
Å Novel biocompatible and biodegradable electroactive small molecules and polymers
Å Conducting hydrogels
Å Carbon nanotubes, graphene, and inorganic active materials for bioelectronics
Å Soft materials for interfaces with electroactive cells
Å Flexible, stretchable active/passive materials used in bioelectronics
Å Materials for I/O neuronal interfaces
Å Solid state devices for subcellular interfaces.
Å Novel biological signal transduction approaches
Å Devices and materials that combine multiple sensing or stimulation modalities
Å Biologically transient electronics
Å Artificial skins and e-textiles for brain-machine interfacing and health monitoring
Å Biosensing/stimulation devices, and closed loop sensing/stimulation
Å Manufacturingð 3D printing, inkjet printing, electrospinning, laser and mechanical subtractive manufacturing
Å Functional materialsð self-healing polymers, conductive composites, fibers, liquid metal alloys, 2D materials, and soft active materials
Å Soft-roboticsð materials, manufacturing, and systems

Joint sessions are being considered with **SM03 - Advanced Neural Materials and Devices**.

Invited speakers include:

Polina Anikeeva	Massachusetts Institute of Technology, USA
Zhenan Bao	Stanford University, USA
Daniel Cohen	Princeton University, USA
Kaitlyn Crawford	University of Central Florida, USA
Bianxiao Cui	Stanford University, USA
Wei Gao	California Institute of Technology, USA
Laura Kayser	University of Delaware, USA
Stephanie Lacour	£cole Polytechnique F®d®rale de Lausanne, Switzerland
Nanshu Lu	The University of Texas at Austin, USA
Lan Luan	Rice University, USA
George Malliaras	University of Cambridge, United Kingdom

Nick Melosh	Stanford University, USA
Fiorenzo Omenetto	Tufts University, USA
Rahul Panat	Carnegie Mellon University, USA
Ritu Raman	Massachusetts Institute of Technology, USA
Jacob Robinson	Rice University, USA
Francesca Santoro	Istituto Italiano di Tecnologia, Italy
Bozhi Tian	The University of Chicago, USA
Brian Timko	Tufts University, USA
Luisa Torsi	Universit¨ degli Studi di Bari Aldo Moro, Italy
Flavia Vitale	University of Pennsylvania, USA
Jun Yao	University of Massachusetts Amherst, USA

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Symposium EL08: Next-Generation Interconnectsð Materials, Processes and Integration

Even as conventional Cu/ULK interconnect technology has slowed in recent years due to challenges in both ultra-low k integration and metal barrier scaling, a plethora of options are being investigated for technology nodes below 10 nm, including new conductors, dielectrics, barrier layers, and process integration methods. In parallel, emerging packaging technology such as 2.5D/3D ICs integration are demonstrating means to improve circuit density and performance. Technologies including Through Silicon Vias are increasingly utilizing recent interconnect material and process advances to further packaging innovations. Finally, using interconnects as a backbone, the introduction of additional functionality in the BEOL has constituted new areas of research and opportunity. This session will focus on both continued advances in conventional interconnect technology and new emerging areas. Topics will include advances in ILD materials and integration, novel etch stop and hard-mask materials, advanced metallization materials and processes, area selective deposition and supervia scaling boosters, alternatives to conventional interconnect technology (3D, optical interconnects) and the introduction of additional functionalities in the BEOL.

Topics will include:

- ILD Materials ULK synthesis, spin-on, sol-gel, fillable, flowable, PECVD precursors, MOF/COF, POC, PMO, photo-patternable low-*k*
- Novel etch stop and hardmask materials
- Selective Depositionsï Metal on Metal (MoM), Metal on Dielectric (MoD), Dielectric on Dielectric (DoD), Dielectric on Metal (DoM)
- Alternative to Cu/ULK interconnects 3D integration through silicon vias, bonding, thinning
- Introduction of additional functionality in the BEOL BEOL interconnect novel materials research
- Reliability, failure analysis methods and techniques electromigration
- Applications of interest, Advanced interconnectsï optical, wireless, C-based, beyond Cu, based on 1D or 2D materials
- Metallization for advanced interconnects CVD, PVD, ALD, ECD, ELD advances in liner, Cu seed, and fill
- Metal resistivity modeling, alternative metallization approaches for the tightest pitch
- Barrier-free metallization and self-forming barriers, bottom-up metallization schemes
- RIE, plasma processing, planarization, and cleaning technologies
- Directed assembly technology and molecular self-assembling technologies
- Surface modification for ALD/CVD/ELD and self-assembled monolayer (SAM)/polymer deposition
- TDDB Mechanical stability during integration (LER, LWR, line wiggling and pattern collapse) and CPI
- BEOL capacitors, transistors, resistive RAM and sensors device design, electrical testing and reliability
- Advanced process characterization design-technology co-optimization modeling techniques

Invited speakers include:

Jasmeet Chawla	Intel, USA	**Naoya Okada**	National Institute of Advanced Industrial Science and Technology, Japan
Remi Dussart	Universit®d'Orl®ans, France	**Suketu Parikh**	Applied Materials, Inc., USA
Jacques Faguet	Tokyo Electron Limited, USA	**Rikka Puurunen**	Aalto University, Finland
Daniel Gall	Rensselaer Polytechnic Institute, USA	**Kavita Sha**	Nova Measuring Instruments Ltd., USA
Mikhail Krishtab	imec, Belgium	**Mayumi Takeyama**	Kitami Institute of Technology, Japan
Vincent Larrey	CEA-LETI, France	**Rudy Wojtecki**	IBM T.J. Watson Research Center, USA
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Symposium EL09: Ferroelectricity and Negative Capacitanceð Fundamentals, Applications and Controversies

2021 will mark the 13th year since the concept of ferroelectric negative capacitance was first proposed as a response to the challenges posed by the ever-increasing energy dissipation in electronics. Under certain conditions, a ferroelectric material can be stabilized in an otherwise unstable, high-energy state, leading to local negative capacitance behavior or a static local negative dielectric permittivity. This unusual behavior opens the possibility of overcoming the fundamental Boltzmann limit for power dissipation in field-effect transistors, and has become a vibrant field of research in condensed mater physics, materials science, and semiconductor devices. Despite the mounting evidence for negative capacitance behavior, which ranges from its manifestation in complex-oxide heterostructures with unusual polar textures to reports of steep-slope switching in ferroelectric field-effect transistors, there are still many unanswered questions, as researchers grapple to understand the fundamental physics of negative capacitance phenomena and their implications for the realization of more efficient devices. More than ever, there is a need for increased dialogue between researchers from the nanoscale ferroelectrics and semiconductor device communities in order to demystify some of the contentious issues surrounding negative capacitance and to establish a common language for further advancing negative capacitance technology. This symposium aims to provide a forum for interactions between physicists, materials scientists and engineers in academia and industry, addressing all aspects of ferroelectric negative capacitance, as well as broader topics in nanoscale ferroelectricity that are of relevance to thin-film ferroelectric devices.

Topics will include:

- Physics and origin of negative capacitance (stabilized negative capacitance, transient negative capacitance, negative differential capacitance)
- Materials of relevance for fundamental studies and applications of negative capacitance (fluorite-type binary oxides, perovskites, organic ferroelectrics, CMOS-compatible ferroelectrics)
- Epitaxial ferroelectric and dielectric heterostructures
- Electrical characterization of ferroelectric and dielectric thin films and heterostructures (dielectric response, switching)
- Static and dynamic properties of ferroelectric domains, domain walls and exotic polarization textures
- Microscopic and structural characterization (TEM/STEM, XRD etc.) of ferroelectric heterostructures and of negative capacitance
- Density functional theory calculations and phenomenological modeling of nanoscale ferroelectrics and of negative capacitance
- Negative capacitance field-effect transistorsð theory, modeling and experimental demonstration
- Different device architectures (bulk and silicon-on-insulator, gate-all-around (GAA)/nanowire, nanosheet/nanotube FETs, FinFETs)
- Circuit- and system-level performance projections for negative capacitance field-effect transistors
- Negative capacitance in non-ferroelectric materials (piezoelectrics, 2D electron gases, interacting systems)
- Technological challengesð manufacturability, speed, reliability and variability
- Controversies, artefacts and alternative explanations of experimental observations

A **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Robert Clark	TEL Technology Center, America, LLC, USA	**Masaharu Kobayashi**	The University of Tokyo, Japan
Hiroshi Funakubo	Tokyo Institute of Technology, Japan	**Daewoong Kwon**	Inha University, Republic of Korea
Marty Gregg	Queen's University Belfast, United Kingdom	**Min-Hung Lee**	National Taiwan Normal University, Taiwan
Alexei Gruverman	University of Nebraskaï Lincoln, USA	**Igor Lukŷanchuk**	University of Picardy Jules Verne, France
Sumeet Gupta	Purdue University, USA	**Beatriz Noheda**	University of Groningen, Netherlands
Daewon Ha	Samsung Advanced Institute of Technology, Republic of Korea	**Patrycja Paruch**	University of Geneva, Switzerland
Genquan Han	Xidian University, China	**Ramamoorthy Ramesh**	University of California, Berkeley, USA
Michael Hoffmann	NaMLab, Germany	**Sayeef Salahuddin**	University of California, Berkeley, USA
Qianqian Huang	Peking University, China	**Florencio Sanchez**	Institut de Ci¯ncia de Materials de Barcelona, Spain
Jorge ĉ¶iguez	Luxembourg Institute of Science and Technology, Luxembourg	**Bin Xu**	Soochow University, China
Adrian Ionescu	£cole Polytechnique F®d®rale de Lausanne, Switzerland	**Peide Ye**	Purdue University, USA

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Symposium EN01: Sustainable Catalysisð Novel Materials for Energy Conversion Beyond Photocatalysis

The symposium will present the best-in-class electrocatalytic materials that rely on noble metals such as Ruthenium, Iridium, Platinum and those that are similar. 3D transition metals systems and organic, metal-organic and biologic electrocatalysts are attractive contenders; however, they come at cost of stability and/or performance. This symposium focuses material research concentrated on the development of sustainable electrocatalysts for energy conversion. The intent of the symposium is to cover aspects from fundamental and mechanistic *operando*/DFT studies to complete-cycle applications in order to bridge the knowledge among the different disciplines and scientific fields. The target is to accelerate and promote the maturity of sustainable electrocatalytic materials, in particular for the hydrogen evolution reaction, oxygen evolution reaction, oxygen reduction reaction and the carbon dioxide reduction reaction. In addition, we promote new insights for fuel cell applications, as well as alternative non-carbon based fuels, such as the electrocatalytic nitrogen reduction and similar non-carbon based fuels. We invite scientists to present their recent insights and materials developments that potentially can achieve equal state-of-the-art performances. The symposium includes explicitly discrete complete redox cycle applications, such as electrolyzers and fuel cells.

Topics will include:

Å Sustainable metal (compound) electrocatalysis
Å Sustainable metal-organic frameworks
Å Organic and organic-inorganic hybrid sustainable electrocatalytic materials
Å Metal-free electrocatalytic materials
Å Bioelectrocatalytic energy conversion
Å Stability studies, mechanistic operando and theoretical studies
Å Complete redox-cycles and discrete applications

Joint sessions are being considered with **EN02 - Sustainable Routes to Fuels and Commodity Chemicals Production via Electrochemical Methods**.

Invited speakers include:

Ulf-Peter Apfel	Ruhr-Universitª t Bochum, Germany
Curtis Berlinguette	The University of British Columbia, Canada
Thomas F. Jaramillo	Stanford University, USA
Yijiao Jiang	Macquarie University, Australia
Yongye Liang	Southern University of Science and Technology, China
Ron Naaman	Weizmann Institute of Science, Israel
Marc Robert	Universit®de Paris, France
Beatriz Roldan-Cuenya	Fritz-Haber-Institut der Max-Planck-Gesellschaft, Germany
Edward H. Sargent	University of Toronto, Canada

Serdar Sariciftci	Johannes Kepler Universitª t Linz, Austria
Yukari Sato	National Institute of Advanced Industrial Science and Technology, Japan
Yang Shao-Horn	Massachusetts Institute of Technology, USA
Peter K. Strasser	Technische Universitª t Berlin, Germany
Shi-Gang Sun	Xiamen University, China
Li-Jun Wan	Institute of Chemistry, Chinese Academy of Sciences, China
Qing Wang	National University of Singapore, Singapore
Masayuki Yagi	Niigata University, Japan
Jenny Y. Yang	University of California, Irvine, USA

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Symposium EN02: Sustainable Routes to Fuels and Commodity Chemicals Production via Electrochemical Methods

Sustainable methods in producing commodity chemicals and fuels that are scalable and cost-competitive are highly desired for the transition to a carbon-neutral future. Current processes mainly utilize fossil-based fuels, thus contributing to the increasing risks of global warming. To overcome this issue, solar energy, which is the most abundant renewable source, should be more effectively and broadly capitalized. For example, photoelectrochemical synthesis of fuels, organic and inorganic commodity chemicals (e.g. by water splitting or CO_2 reduction) exploiting direct sunlightð and renewable electricity sources for additional bias potentialð is a challenging but promising option. In this approach, lack of suitable materials that can perform the solar energy conversion process in an efficient and selective manner remains the biggest limitation. In addition, integrated large-scale photoelectrochemical devices and system concepts for producing fuels and commodity chemicals still need to be identified. Therefore, in-depth understanding of the individual materials characteristics as well as the interrelated properties in an integrated system are necessary to step closer towards the realization of such a sustainable route.

This symposium provides an international and interdisciplinary platform to discuss the latest trends and future directions in photoelectrochemical production of fuels and commodity chemicals. Specific emphasis will be placed on novel light absorbers, fundamental understanding through in-situ characterizations, photoelectrocatalysts for CO_2 reduction, as well as photoelectrosynthesis of valuable commodity chemicals. In addition, cell design and engineering aspects (mass transport, product separation, etc.) that enable large-scale operation of the solar energy conversion device will also be highlighted.

Topics will include:

- Å Novel photoelectrocatalyst materials, sustainable approaches and architectures
- Å Photoelectrochemical routes to water splitting, selective CO_2 reduction, and nitrogen reduction
- Å Photoelectrosynthesis of commodity chemicals (organic and inorganic)
- Å Tandem photoelectrochemical systems
- Å Fundamental understanding of reaction mechanism and novel materials properties
- Å *Ab initio* and DFT calculations for the rational design of photoelectrocatalysts
- Å *In Situ/Operando* characterization of photoelectrocatalytic systems
- Å Bio-photo-electrochemical hybrid approaches
- Å Scalable device designs and demonstrators for solar fuels and commodity chemicals production
- Å CFD simulation of photoelectrochemical systems

Joint sessions are being considered with **EN01 - Sustainable Catalysisð Novel Materials for Energy Conversion Beyond Photocatalysis**.

Invited speakers include:

Harry Atwater	California Institute of Technology, USA
Marco Bernandi	California Institute of Technology, USA
Kyoung-Shin Choi	University of Wisconsinï Madison, USA
Jason Cooper	Lawrence Berkeley National Laboratory, USA
Victor de la Pe¶a	IMDEA Energy, Spain
Dan Esposito	Columbia University, USA
Anna Fischer	Universitªt Freiburg, Germany
Giulia Galli	University of Chicago, USA
Daniel Grave	Ben-Gurion University of the Negev, Israel
Sophia Haussener	£cole Polytechnique F®d®rale de Lausanne, Switzerland
Akihide Iwase	Meiji University, Japan
Yan Jiao	The University of Adelaide, Australia

Chong-Yong Lee	University of Wollongong, Australia
Gang Liu	Institute of Metal Research, Chinese Academy of Sciences, China
Jingshan Luo	Nankai University, China
Miguel Modestino	New York University, USA
Takeshi Morikawa	Toyota Central R&D, Inc., Japan
Kristin Persson	Lawrence Berkeley National Laboratory, USA
Beatriz Roldan	Fritz-Haber-Institut der Max-Planck-Gesellschaft, Germany
Klaas Jan Schouten	Avantium, Netherlands
Tatsuya Shinagawa	The University of Tokyo, Japan
Wilson Smith	National Renewable Energy Laboratory, USA
Roel van de Krol	Helmholtz-Zentrum Berlin, Germany
Xiaolin Zheng	Stanford University, USA

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Symposium EN03: Intercalation Energy Storage Materials and Systems for Beyond Li-Ion Batteries

The next generation of electrochemical energy storage systems to compete with commercial Li-ion batteries will rely on breakthroughs in material and system innovations that balance performance and cost for particular niche markets. This symposium will cover recent developments in intercalation energy storage materials and systems of beyond Li-ion batteries. The symposium will have a special focus on design strategies at the materials and system level to enable the significant advancements of new battery concepts and technologies that can compete with Li-ion batteries. This considers either the performance and cost in niche markets such as large scale energy storage, fast charging devices, and high energy density devices, or applications that have special safety requirements or involve extreme environmental conditions. The establishment of such design strategies, however, often requires a critical understanding of structure-property and material-system relationships that are obtained through advanced characterizations, computations, synthesis and engineering.

This symposium will highlight the intercalation electrode materials for Na, K, Mg, Zn and Ca-ion batteries. Intercalation Li cathode materials with the focus on pairing with Li metal anode is also welcome. These materials are currently receiving widespread attention and are studied using advanced synthesis and electrochemical test methods in combination with novel in situ/ operando characterization approaches that include diffraction, spectroscopy and imaging techniques. Computational modeling, big data analysis and machine learning approaches are also increasingly being leveraged in electrode materials design of beyond Li-ion batteries. The synergistic application of experimental and modeling tools is enabling material innovations that can be tested in coin cells, and even in pouch and prismatic cells, making beyond Li-ion batteries increasingly viable for industrial applications. The symposium will therefore also bring industrial scientists and engineers working on advanced energy storage systems to share their visions with battery researchers in academia.

Topics will include:

- Å New materials and/or new design principles of Na^{+}, K^{+}, Mg^{2+}, Zn^{2+}, Ca^{2+} intercalation electrodes
- Å Intercalation Li cathode materials with the focus on pairing with Li metal anode
- Å Computational design, modeling and machine learning data analysis
- Å Advanced synthesis and crystal chemistry
- Å Advanced electrochemical characterizations in coin cells as well as pouch and prismatic batteries
- Å *In Situ* and *operando* techniques
- Å Diffraction, spectroscopy and imaging techniques

Invited speakers include:

Yasunobu Ando	National Institute of Advanced Industrial Science and Technology, Japan
Palani Balaya	National University of Singapore, Singapore
Peter Bruce	Oxford University, United Kingdom
Dany Carlier	Universit®de Bordeaux, France
Gerbrand Ceder	University of California, Berkeley, USA
William Chueh	Stanford University, USA
Claude Delmas	Institut de Chimie de la Mati¯re Condens®e de Bordeaux, France
Enyuan Hu	Brookhaven National Laboratory, USA
Yan-Yan Hu	Florida State University, USA
Won Tae Joe	LG Chem, Republic of Korea
Christopher Johnson	Argonne National Laboratory, USA

In Kim	Samsung Advanced Institute of Technology, Republic of Korea
Shinichi Komaba	Tokyo University of Science, Japan
Xiaolin Li	Pacific Northwest National Laboratory, USA
Jun Liu	Pacific Northwest National Laboratory, USA
Shyue-Ping Ong	University of California, San Diego, USA
Rosa Palacin	Institut de Ci¯ncia de Materials de Barcelona, Spain
Debra Rolison	U.S. Naval Research Laboratory, USA
Zulipiya Shadike	Brookhaven National Laboratory, USA
Dong Su	Institute of Physics, Chinese Academy of Sciences, China
Stanley Whittingham	Binghamton University, The State University of New York, USA
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Symposium EN04: Towards High Safety and High Energy Densityð Solid-State Batteries

Current Li-ion battery (LIB) technology enables the rapid development of mobile phone and transforms lives worldwide. However, LIBs based on intercalation chemistry are approaching their energy density limit. Moreover, safety, a key factor for electric vehicles, is always a critical challenge for LIBs. On the other hand, solid-state batteries present excellent safety, wide voltage window, and favorable compatibility with high-capacity electrodes.

This symposium intends to serve as a platform to cover the advanced materials, chemistries and technologies for solid-state batteries. Submissions are encouraged to cover solid-state electrolytes, solid-state electrolyte to Li metal anode stability and interaction, interfaces and advanced battery designs, sheet-type electrodes and electrolytes, in operando and ex operando characterizations, failure analysis and understanding, battery reliability and safety. Research from concept demonstration, fundamental understanding, to technology maturation and commercialization is targeted.

Topics will include:

Å Ion transport mechanism in electrode materials and solid-state electrolytes
Å Solid-state electrolytes
Å Interfaces
Å Li metal anodes
Å High capacity cathodes
Å Solid state lithium batteries
Å Solid state sodium batteries
Å Solid state battery design and processing
Å Advanced battery designs
Å Advanced characterizations
Å Fundamental understanding of solid-state battery operation and failure mechanisms

Invited speakers include:

Stefan Adams	National University of Singapore, Singapore
Corsin Battaglia	Empaï Swiss Federal Laboratories for Materials Science and Technology, Switzerland
Peter Bruce	University of Oxford, United Kingdom
Gerbrand Ceder	University of California, Berkeley, USA
Kyung Yoon Chung	Korea Institute of Science and Technology, Republic of Korea
Neil Dasgupta	University of Michigan, USA
Nancy Dudney	Oak Ridge National Laboratory, USA
Bruce Dunn	University of California, Los Angeles, USA
Akitoshi Hayashi	Osaka Prefecture University, Japan
Yanyan Hu	Florida State University, USA
Yunhui Huang	Huazhong University of Science & Technology, China
Dong Won Kim	Hanyang University, Republic of Korea
Yong-Gun Lee	Samsung Electronics SAIT, Republic of Korea
Yifei Mo	University of Maryland, USA
Cewen Nan	Tsinghua University, China
Mauro Pasta	University of Oxford, United Kingdom
Andy Sun	Western University, Canada
Venkataraman Thangadurai	University of Calgary, Canada
Yong Yang	Xiamen University, China
Yan Yao	University of Houston, USA
Bilge Yildiz	Massachusetts Institute of Technology, USA
Hongli Zhu	Northeastern University, USA

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Symposium EN05: Materials Challenges and Opportunities in Concentrated Solar Power Technologies

Concentrating solar power (CSP) is a rapidly advancing technology. It has the potential to provide short- and long-duration energy storage in the form of heat to supply renewable electricity on-demand. The carbon-free heat generated by CSP can also be used to drive high temperature processes for production of renewable hydrogen, fuels, or commodity chemicals, as well as to potentially facilitate water desalination, mineral purification, or biorefining.

CSP works by concentrating sunlight onto a receiver that collects the solar energy and converts it to heat, which can be used to power a turbine for electricity, ĩchargeòa thermal storage system for production of electricity off-sun, or to drive a chemical reaction. Current CSP facilities operate at temperatures in the range of 500 ï 600 ÁC, but next generation plants are aiming for temperatures of ≥700 ÁC for electricity generation and as high as 1000ÁC for solar thermochemical processes. The requirement for high temperature operation requires materials that can withstand heat and thermal expansion, are resistant to oxidation and corrosion, and can efficiently conduct heat. Coatings are necessary for receivers to maximize absorption or enhance durability. Thermal storage materials with improved stability and storage capacity are required. Materials development is imperative to perform solar thermochemical reactions such as water splitting, fuel production, and desalination.

This symposium aims to promote CSP within the materials science and engineering community and to bring together researchers of diverse backgrounds (experimental, characterization, analysis, and computational) to address the multidisciplinary challenges of this emerging field. Graduate students, post-docs, and early-career researchers are encouraged to submit abstracts. The symposium is expected to draw participation and support from a national and international demographic from academia, national labs, and the commercial sector.

Topics will include:

Å Coatings development through computational models, surface modifications and novel deposition methods
Å Thermal and thermochemical energy storage materials
Å Advanced *in situ* and *ex situ* materials characterization
Å Simulation and modelling of mechanical, thermal and optical properties of emerging materials and coatings
Å Solar-thermochemistry for hydrogen and fuel production, fine chemicals and industrial processes
Å Characterization of high-temperature performance, durability and aging of CSP components
Å Design and manufacture of corrosion-resistant materials and coatings

Invited speakers include:

Gang Chen	Massachusetts Institute of Technology, USA
Yulong Ding	University of Birmingham, United Kingdom
Brenda L. Garcia-Diaz	Savannah River National Laboratory, USA
Ivan Jerman	National Institute of Chemistry, Slovenia
Matthias Krause	Helmholtz-Zentrum Dresden-Rossendorf, Germany
Malay Mazumder	Boston University, USA

Anthony McDaniel	Sandia National Laboratories, USA
Jian-Ping Meng	Chinese Academy of Sciences, China
Kenneth Sandhage	Purdue University, USA
Chris Sansom	Cranfield University, United Kingdom
Ellen Stechel	Arizona State University, USA
Shannon Yee	Georgia Institute of Technology, USA

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Symposium EN06: Frontier Energy Sciences in Halide Perovskites

The introduction of halide perovskites has led to an unprecedented development in the area of energy harvesting and conversion. This new family of materials can be easily processed into thin films, single-crystals, and nanocrystals at low temperatures, and they are highly tunable in chemical compositions (from being hybrid organic-inorganic to all-inorganic), resulting in numerous crystal structures. Such versatility makes halide perovskites emerge as a new platform for harnessing efficient conversions between light, electricity, mechanical, and chemical energies. In this proposed symposium, we will focus on the most cutting-edge energy-science topics including new crystal/defect theories, unusual atomic/nano-/micro-structures, high-resolution characterizations, exceptional properties, giant ferroelectric polarization,innovative materials synthesis, new interface sciences, and quantum information sciences. The goal is to bring together the most active scientists in this field from all over the world and to discuss the next frontier of perovskite energy sciences. The results from this symposium discussion will stimulate broad fundamental efforts in pushing perovskite-based energy technologies to the next level.

Topics will include:

Å Multiscale simulation and high-throughput computational screening of halide perovskites
Å Structural formation and transformation of halide perovskites
Å Multifunctional properties of halide perovskites
Å Light-matter interaction in halide perovskites
Å High-spatiotemporal-resolution characterization (e.g. microcopy, multimodal studies) of halide perovskites
Å Ionic transport in halide perovskites
Å Surface/Interface science of halide perovskites
Å Spin physics in halide perovskites
Å Strain engineering and epitaxy of halide perovskites
Å Quantum information science in halide perovskites

Joint sessions are being considered with **CT04 - Predictive Synthesis and Decisive Characterization of Emerging Quantum Materials**, and **EN07 - Thin-Film Compound Semiconductor Photovoltaics**.
Also, a **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Mahshid Ahmadi	University of Tennessee, Knoxville, USA
Moungi Bawendi	Massachusetts Institute of Technology, USA
Kylie Catchpole	Australian National University, Australia
Emmanuele Deleporte	£cole Normale Sup®rieure Paris-Saclay, France
Ana Flavia Nogueira	The University of Campinas, Brazil
Giulia Grancini	University of Pavia, Italy
Oki Gunawan	IBM T.J. Watson Research Center, USA
Peijun Guo	Yale University, USA
Alex Jen	City University of Hong Kong, Hong Kong
Prashant Kamat	University of Notre Dame, USA
Mercouri Kanatzidis	Northwestern University, USA
Hemamala Karunadasa	Stanford University, USA
Maria A. Loi	University of Groningen, Netherlands

Joachim Maier	Max Planck Institute for Solid State Research, Germany
Olga Malinkiewicz	Saule Technologies, Poland
David Mitzi	Duke University, USA
Tom Miyasaka	Toin University of Yokohama, Japan
Ivan Mora Ser·	Universitat Jaume I, Spain
Thilo Stº ferle	IBM Research GmbH, Switzerland
Tze Chien Sum	Nanyang Technological University, Singapore
Carolin Sutter-Fella	Lawrence Berkeley National Laboratory, USA
Su-Huai Wei	Beijing Computational Science Research Center, China
Jingbi You	Institute of Semiconductors, Chinese Academy of Sciences, China
Xiaodan Zhang	Nankai University, China
Furong Zhu	Hong Kong Baptist University, Hong Kong

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Symposium EN07: Thin-Film Compound Semiconductor Photovoltaics

Recent advances in thin film compound semiconductor photovoltaics have demonstrated the potential for generating sustainable and cost-efficient energy, with demonstrated conversion efficiencies above 23% and advantages in manufacturing and materials costs. Both fundamental understanding and processing techniques have been enabling. Emerging areas of research include the materials science of degradation, understanding and controlling fluctuations in properties, reducing interface and grain boundary recombination, further simplification and cost reduction in fabrication, and tandem devices. The symposium will focus on the science and technology of single and polycrystalline materials, defects, interfaces, the interplay of materials and bandstructure, characterization methods, and advanced manufacturing in thin film compound semiconductor photovoltaics. Relevant materials include those based on chalcogenide semiconductors such as CIGSe, CZTS, and CdTe as well as the associated heterojunction partner materials. Novel absorber materials, heterojunction partner layers, and tandem devices are also of high interest. The symposiumôs strong program of technical talks is tentatively planned to be augmented by the popular ñYoung Scientists' Tutorialò on the most critical topics in the field. An exciting addition this year is that a joint session is tentatively planned with symposium EN06 on the intersections of chalcogenides and perovskites focused on commonalities in terms of materials, processing, device physics, and integration into tandems.

Topics will include:

- Å Deposition, growth and fabrication processes
- Å Novel materials and device concepts
- Å Carrier selective, low recombination, low resistance contact structures
- Å Materials with superior properties, especially high minority carrier lifetime
- Å Characterization, theory, and modeling
- Å Surfaces, interfaces and extended defects
- Å Materials integration, degradation and reliability
- Å Tandem and multijunction devices

Joint sessions are being considered with **EN06 - Frontier Energy Sciences in Halide Perovskites**.
Also, a **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Daniel Abou-Ras	Helmholtz-Zentrum Berlin, Germany
Shubhra Bansal	University of Nevada, Las Vegas, USA
Nicolas Barreau	Universite de Nantes, France
Marie Buffiere	Qatar Foundation, Qatar
Jessica de Wild	imec, Belgium
Ken Durose	University of Liverpool, United Kingdom
Marika Edoff	Uppsala University, Sweden
Chris Ferekides	University of South Florida, USA
Yulia Galagan	Netherlands Organisation for Applied Scientific Research, Netherlands
Xiaojing Hao	University of New South Wales, Australia
Robert Hoye	Imperial College London, United Kingdom
Jin-Kyu Kang	Daegu Gyeongbuk Institute of Science & Technology, Republic of Korea

Dmitry Krasikov	First Solar, USA
Lorelle Mansfield	National Renewable Energy Laboratory, USA
Brian McCandless	University of Delaware, USA
Akira Nagaoka	University of Miyazaki, Japan
Arthur Onno	Arizona State University, USA
Alex Redinger	University of Luxembourg, Luxembourg
Walajbad Sampath	Colorado State University, USA
Roland Scheer	Martin-Luther-Universitªt-Halle-Wittenberg, Germany
Jonathan Scragg	Uppsala University, Sweden
Susanne Siebentritt	University of Luxembourg, Luxembourg
Thomas Unold	Helmholtz-Zentrum Berlin, Germany
Pawel Zabierowski	Warsaw University of Technology, Poland

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Symposium EN08: Progress in Understanding Charge Transfer at Electrochemical Interfaces in Batteries

The quantity, rate and repeatability at which energy can be stored and accessed in batteries is regulated by charge transfer at the electrode interfaces. This symposium will cover new advances and emerging concepts for probing, understanding and controlling the transfer of ions and electrons across battery electrode interfaces. Phenomena of interest include but are not limited to determination of intrinsic barriers to charge transfer, the structure, composition and properties of evolving interphases active in transfer, and materials design and synthesis of both electrolyte and electrode resulting in enhanced and resilient transfer. Additionally, efforts focusing on integrating computational and experiment to deepen our knowledge of a materia's role in charge transfer and in situ and operando methods to characterize the interface/interphase evolution are of particular interest. Emphasis will be placed on energy storage applications, where the interaction strengths of redox active ions with the electrode are a critical factor for battery efficiency and resiliency. Symposium contributions are encouraged that address basic materials science hypotheses related to charge transfer processes across heterogeneous interfaces or address challenges in the development of *in situ/operando* measurements and computational modelling for interrogating the charge transfer process. This symposium will explore state-of-the-art research on interfacial processes across the battery technology spectrum, bringing together materials scientists and engineers from numerous disciplines.

Topics will include:

Å Electrode-electrolyte interphase identity, properties, and temporal evolution
Å Electrode and electrolyte material design for interface and interphase resiliency
Å Characterization of interfaces and interphases including *in situ/operando* methods
Å Computational modelling of charge transfer and interphase formation and properties
Å Ion transport mechanisms at heterogeneous interfaces

Invited speakers include:

Chibueze Amanchukwu	University of Chicago, USA
Perla Balbuena	Texas A&M University, USA
Nina Balke	Oak Ridge National Laboratory, USA
Fikile Brushett	Massachusetts Institute of Technology, USA
George Crabtree	Argonne National Laboratory, USA
David Ginger	University of Washington, USA
Kelsey Hatzell	Vanderbilt University, USA
Brett Helms	Lawrence Berkeley National Laboratory, USA
Katharine Jungjohann	Sandia National Laboratories, USA
Rana Mohtadi	Toyota Research Institute, USA
Karl Mueller	Pacific Northwest National Laboratory, USA

Huilin Pan	Zhejiang University, China
Shyue Ping Ong	University of California, San Diego, USA
David Prendergast	Lawrence Berkeley National Laboratory, USA
Joaquin Rodriguez-Lopez	University of Illinois at Urbana-Champaign, USA
Charles Schroeder	University of Illinois at Urbana-Champaign, USA
Don Siegel	University of Michigan, USA
Charles Sing	University of Illinois at Urbana-Champaign, USA
Chris Takacs	Stanford University, USA
Esther Takeuchi	Stony Brook University, The State University of New York, USA
Sarah Tolbert	University of California, Los Angeles, USA
Atsuo Yamada	The University of Tokyo, Japan

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Symposium EN09: Advances in Conversion Electrodes for Reliable Electrochemical Energy Storage

This symposium will focus on the emerging chemistries of conversion electrodes for current and future energy storage systems. Miniaturization of computing devices and development of hybrid/electric vehicles has caused a reliance on energy dense devices ubiquitous in professional and social dealings. Furthermore, as interest in using renewable energy to replace traditional power sources increases, the necessity for large scale implementation of cost-effective energy dense electrochemical storage has become apparent. Batteries based on conversion chemistries, instead of intercalation of ions, are a promising pathway for next generation devices, as they inherently offer higher capacities and energy densities. Within the scope of conversion batteries there is a wide variety in the materials being studied, whether dependent on multivalent or single charged ion chemistries, or primary versus secondary capabilities. This includes promising advances in the fields of both aqueous (e.g. Zn/MnO_2) and organic (e.g. Li/FeF_3) batteries. The binding factor of these materials is the necessity of understanding the interplay between interfacial reactions and concurrent solution processes responsible for battery performance. Enveloping an array of expertise, this symposium aims to bring together a diverse set of talks in order to expose similar research communities to new material analysis and the advances of contending fields. Symposium organization will be split into two parts, one for the focus on advances in the field of aqueous chemistries, and the second highlighting recent work on conversion electrodes in organic media. Grouping the talks by content allows participants and audience members to attend talks within the field of interest and encourages exposure to new battery chemistries. The focus of chosen talks for both sections will be on the development of electrode materials, effects of the electrolyte and additives on reaction chemistries, and the characterization and modeling methods for identifying the mechanistic pathways of conversion chemistries. Along with the inclusion of a varied set of battery formulations, this symposium is intended to unite a collection of researchers working within a wide spread effort to develop these systems. This includes speakers from academia, national laboratories, startup companies and established industries.

Topics will include:

Å Current advances in electrode materials for conversion chemistries
Å New designs and architectures for conversion electrodes
Å Synthetic routes for conversion electrode materials
Å Current advances in development of solvents and additives for conversion electrodes
Å *In Situ/Operando* techniques for establishing conversion pathways
Å Development of multimodal approaches to elucidating conversion reactions
Å Computational modelling of energy storage materials
Å Simulations of conversion reactions

Invited speakers include:

Hector Abruna	Cornell University, USA	**Katharine Harrison**	Sandia National Laboratories, USA
Naga Phani Aetukuri	Indian Institute of Science, India	**Tim Lambert**	Sandia National Laboratories, USA
Perla Balbuena	Texas A&M University, USA	**Linsen Li**	Shanghai Jiao Tong University, China
Pieremanuele Canepa	National University of Singapore, Singapore	**Nian Liu**	Georgia Institute of Technology, USA
Jang Wook Choi	Seoul National University, Republic of Korea	**Debra Rolison**	U.S. Naval Research Laboratory, USA
Xinliang Feng	Technische Universitª t Dresden, Germany	**Xia Wei**	ZPower, USA
Joshua Gallaway	Northeastern University, USA	**Jie Xiao**	Pacific Northwest National Laboratory, USA
Andy Gewirth	University of Illinois at Urbana-Champaign, USA	**Gautam Yadav**	Urban Electric Power, USA

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Symposium EN10: Transformation, Reaction and Organization at Functional Interfaces for Sustainable Energy Systems and Environmental Managements

For electrochemical energy devices (e.g., electrocatalysts, fuel cells) and environment systems, the gas/solid, liquid/solid and solid/solid interfaces are critical nexus where many important chemical processes take place. For example, the surfaces of electrocatalysts can be one kind of gas/solid or liquid/solid interfaces where electrochemical reactions take place and materials transform. In addition, the interfaces at several environmental devices (e.g., heavy ion removal) may experience re-organizations in different processes. However, these interfacial processes are not well understood and controlled, which affects the development of devices for *energy, environment and sustainability*. To address the pressing opportunities and challenges, we have designed this symposium to highlight the recent trends in the transformation, reaction and organization of functional interfaces for sustainable energy systems and environmental managements. The symposium will bridge expertise in academia research and industrial applications from electrochemical deposition, interfacial reactions, functional control, advanced characterization and scientific management to applications of energy and environmental devices. Particular attention will be paid to the understanding of interfacial chemistry, the control, and multimodal *in situ* characterization of functional materials in catalysts, energy conversion and environmental processes. This topic also includes novel architectures for mechanistic studies, such as the use of single crystal surfaces and substrate-supported entities as model systems. This symposium will provide an interactive forum for scientists from various fields interested in the application of interfacial engineering. We hope this symposium will benefit materials scientists from various backgrounds, and will help encourage the implementation of rational design, smart control and advanced characterization approaches to solve the needed problems in this field.

Topics will include:

Å Interface for Energy-Water nexus
Å Control of electrochemical deposition for catalysis applications
Å Electrocatalyts interfaces during electrochemical reactions
Å Model systems for electrochemical energy systems
Å The electrode/electrolyte (e.g. solid/liquid and solid/solid) interfaces in energy conversion
Å *In Situ/Operando* characterizations of electrochemical interfacial processes in functional materials
Å Interface for fluid-geomaterials or nature materials
Å Interface for extreme conditions (nuclear, waster, heavy-metal separation, sequestration)
Å Opportunities and challenges of using 4th generation synchrotron X-ray facilities for studies of interfaces of functional materials

A **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Chih-hung Chang	Oregon State University, USA
Sheng Dai	Oak Ridge National Laboratory, USA
Kristina Edstrº m	Uppsala University, Sweden
Xiaofeng Feng	University of Central Florida, USA
Zhanhu Guo	The University of Tennessee, Knoxville, USA
Yaqin Huang	Beijing University of Chemical Technology, China
Deborah Jones	Universit®de Montpellier, France
Richard Kurtz	Louisiana State University, USA
Joe Lenders	Wiley Publishing, Germany
Sanjeev Mukerjee	Northeastern University, USA
Steven Sloop	OnTo Technology LLC, USA
Jacob Spendelow	Los Alamos National Laboratory, USA
Severin Vierrath	Universitª t Freiburg, Germany
Robert Weatherup	University of Oxford, United Kingdom
Xingchen Ye	Indiana University Bloomington, USA
Yingjie Zhang	University of Illinois at Urbana-Champaign, USA
Xiaoyu Zheng	University of California, Los Angeles, USA
Hua Zhou	Argonne National Laboratory, USA

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Symposium NM01: Superconductors as Quantum Materials

This symposium will broadly cover research frontiers on superconductors as quantum materials including efforts on raising the superconducting transition temperature (T_c) and the understanding of superconducting pairing mechanisms. The first part of the symposium will focus on emerging systems that include nickelate thin films, twisted bilayer graphene, Weyl semimetals, and 2D chalcogenides. Discussions of synthesis and fabrication approach to discover new superconductors and to improve the characteristic superconducting properties (T_c, J_c, H_c, etc.) are encouraged. The second part will be devoted to intrinsic and engineered topological superconductors (TSCs). The synthesis, experimental properties, and implementation of TSCs in quantum devices will be discussed. The third part will be dedicated to recent breakthroughs on raising T(c) using the following approaches: physical pressure, interfacial coupling, advanced doping, and excitation out-of-equilibrium. The fourth part will cover the understanding of pairing mechanisms and recent predictions for new superconducting materials. Developments in novel computational tools from first-principles calculations to the recent emerging application of machine learning will be presented and discussed. The recent exciting progress in superconductivity T_c enhancement, topological superconductivity, and its applications in quantum information offer remarkable momentum to kick off this symposium. The work presented and discussed will guide future searches for novel superconductors and related materials, to advance both fundamental research and applications in quantum science and technologies.

Topics will include:

- Novel superconductors
- Emerging cuprate-analog: Nickelate
- Intrinsic topological superconductors
- Topological superconducting heterostructures
- Tuning superconductivity by high pressure, field-effect gating, and other methods
- Near room temperature superconductivity in superhydrides
- Interface and monolayer superconductors
- Twistronics for superconductivity
- Band structure calculations and numerical simulations
- Predictions for novel superconductors
- STM and local spectroscopies
- Optical, THz, photoemission spectroscopies and NMR
- Quantum applications of unconventional superconductors

Invited speakers include:

Xianhui Chen	University of Science and Technology of China, China
Ching-Wu Chu	University of Houston, USA
David Cobden	University of Washington, USA
Clarina Cruz	Oak Ridge National Laboratory, USA
Hong Ding	Institute of Physics, Chinese Academy of Sciences, China
Laura Greene	Florida State University, USA
Genda Gu	Brookhaven National Laboratory, USA
Sophie Gueron	Universit®Paris-Saclay, France
Russell Hemley	University of Illinois at Chicago, USA
Yi-Ting Hsu	University of Maryland, USA
Harold Hwang	Stanford University, USA
Wai-Kwong Kwok	Argonne National Laboratory, USA
David Larbalestier	Florida State University, USA
Kam-Tuen Law	The Hong Kong University of Science and Technology, China
Qiang Li	Brookhaven National Laboratory, USA
Yufan Li	Johns Hopkins University, USA
Yanming Ma	Jilin University, China
Guoxing Miao	University of Waterloo, Canada
Akira Ohtomo	Tokyo Institute of Technology, Japan
Liling Sun	Institute of Physics, Chinese Academy of Sciences, China
Maw-Kuen Wu	Academia Sinica, Taiwan
Qikun Xue	Tsinghua University, China
Ming Yi	Rice University, USA
Yuanbo Zhang	Fudan University, China
Igor Zutic	University at Buffalo, The State University of New York, USA

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Symposium NM02: Superconducting Materials and Applications

The symposium will broadly cover the advances in current and emerging superconducting materials from both fundamental and applications perspective. It includes novel and customized superconducting materials for electronics, such as quantum computation, and large-scale superconducting applications, such as prototype superconducting power devices, conductors for high field magnets, accelerators, and newly proposed compact fusion reactors. Overall, in this symposium we intend to cover the rapid progress made worldwide in both application and fundamental understanding of superconducting materials. A key focus of this symposium is to promote the transition from basic science discovery to technology deployment. The emphasis will be on superconducting quantum limited sensors and superconducting qubit with related technologies. We will address the challenges for the development of superconducting qubits that requires material perfection achievable through the identification of the noise sources in the system, and a clear understanding of the influence of the solid-state environment on the sudden long-term fluctuations of the qubit parameters.

For large scale applications, we will focus on high performance, homogeneity through length, cost-effectiveness, high throughput and scalability. The superconducting materials of interests include conventional low temperature superconductors for electronics and sensors, intermetallic superconductors (Nb-Ti, Nb_3Sn), medium- and high-temperature superconductors (cuprates, iron-based compounds, MgB_2), superconducting multi-layers and composites, the recently discovered very high-temperature hydride superconductors and other emergent materials exhibiting unconventional superconductivity like topological superconductors. Symposium contributors in the area of materials are encouraged to address issues including: 1) response of superconductivity to structural, chemical, and defect tuning; 2) improvement of existing practical materials; 3) synthesis, growth mechanisms, high throughput fabrication routes, and; 4) methods to improve application-relevant properties such as flux pinning.

Topics will include:

Å Superconducting qubitï materials issues, gates and error corrections
Å Josephson junction technology and interface
Å Topological superconductors and unconventional superconductivity
Å REBCO wires and Coated Conductorsï processing and applications
Å Fe-based superconductors and potential applications
Å Bi-based, Nb-based, MgB_2 tapes and round wiresï processing and applications
Å Flux pinning and critical currentsï intrinsic pinning behavior, anisotropy, irradiation effect
Å Energy applications and devices based on superconducting materials

Invited speakers include:

Kathleen Amm	Brookhaven National Laboratory, USA
Amalia Ballarino	CERN, Switzerland
Alexander Brinkman	University of Twente, Netherlands
Noriko Chikumoto	Chubu University, Japan
Jerry Chou	IBM T.J. Watson Research Center, USA
Paul Chu	University of Houston, USA
Valentina Corato	ENEA, Italy
Gianni Grasso	ASG Superconductors, Italy
Sophie Gueron	Universit® Paris-Saclay, France
Hideo Hosono	Tokyo Institute of Technology, Japan
Andrew Houck	Princeton University, USA
Kazumasa Iida	Nagoya University, Japan
Teruo Izumi	National Institute of Advanced Industrial Science and Technology, Japan
Dieter Koelle	Universitª t T¿bingen, Germany
Sergey Kubatkin	Chalmers University of Technology, Sweden
Sergey Lee	SuperOx, Japan
Yanwei Ma	Institute of Electrical Engineering, Chinese Academy of Sciences, China
Kaname Matsumoto	Kyushu Institute of Technology, Japan
Judith McManus-Driscoll	Cambridge University, United Kingdom
Franco Nori	RIKEN, Japan
Xavier Obradors	Institut de Ci¯ncia de Materials de Barcelona, Spain
Marty Rupich	American Superconductor, USA
Robert Schoelkopf	Yale University, USA
Carmine Senatore	University of Geneva, Switzerland
Judy Wu	University of Kansas, USA
Yutaka Yamada	Shanghai Superconductors, China

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Symposium NM03: Topological and Quantum Phenomena in Intermetallic Compounds and Heterostructures

Intermetallic compounds host a broad range of quantum, topological, and multiferroic phenomena, including chiral spin textures, Weyl and Dirac states, novel superconductivity, heavy fermion behavior, ferroelasticity, and magnetocaloric behavior. This diverse range of properties rivals that of the well-studied transition metal oxides; however, outstanding challenges remain in controlling stoichiometry and defects, fabricating atomically precise interfaces, and characterizing the fundamental electronic and magnetic structures. This symposium will explore common themes across the various families of intermetallics, including Heusler compounds, lacunar spinels, Weyl semimetals, rare earth compounds, skyrmion compounds, and others. We welcome submission on bulk crystal and epitaxial film growth, advanced characterization, materials prediction/design, and new device concepts.

Topics will include:

- Heusler compounds
- Weyl and Dirac semimetals
- Heavy fermion compounds
- Bulk and interfacial skyrmions, chiral spin textures
- 2D magnets
- Spintronics
- Defects, strain and interface engineering
- Half metallic ferromagnets
- Unconventional and topological superconductivity
- Ferroelasticity, shape memory effect, magnetocalorics
- Magnetocalorics
- Topological Kondo insulators
- Anomalous Hall and Spin Hall effect in intermetallics and connection to Nodal Lines

Joint sessions are being considered with **NM04 - Magnetic Skyrmions and Topological Effects in Materials and Nanostructures**.

Invited speakers include:

Ana Akrap	University of Fribourg, Switzerland
Christina Birkel	Arizona State University, USA
Ken Burch	Boston College, USA
Nicholas Butch	National Insitute of Standards and Technology, USA
Paul Canfield	Iowa State University, USA
Jennifer Cano	Stony Brook University, The State University of New York, USA
Claudia Felser	Max Planck Institute for Chemical Physics of Solids, Germany
M. Zahid Hasan	Princeton University, USA
Jennifer Hoffman	Harvard University, USA
Roni Ilan	Tel Aviv University, Israel
Roland Kawakami	The Ohio State University, USA
Javier Landaeta	Max Planck Institute for Chemical Physics of Solids, USA
Tyrel McQueen	Johns Hopkins University, USA
Emilia Morosan	Rice University, USA
Katja Nowack	Cornell University, USA
Johnpierre Paglione	University of Maryland, USA
Chris Palmstrom	University of California, Santa Barbara, USA
Stuart Parkin	Max Plack Institute Halle, Germany
Karin Rabe	Rutgers, The State University of New Jersey, USA
Ram Seshadri	University of California, Santa Barbara, USA
Susanne Stemmer	University of California, Santa Barbara, USA
Valentin Taufour	University of California, Davis, USA
Yoshinori Tokura	RIKEN, Japan
Masaki Uchida	The University of Tokyo, Japan
Maia Vergniory	Donostia International Physics Center, Spain
Roland Weisendanger	Universitª t Hamburg, Germany
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Symposium NM04: Magnetic Skyrmions and Topological Effects in Materials and Nanostructures

Magnetic skyrmions are particle-like spin textures of nanometer-size dimensions that exhibit long lifetimes due to topological protection. Since the first discovery of the skyrmion lattice phase in bulk MnSi about a decade ago, these topological magnetic textures have been observed in a large number of chiral magnets as well as magnetic multilayers. The research field of skyrmions currently extends in numerous directions ranging from fundamental aspects related to the field of topology to prospective technological applications in spintronic devices for information storage and manipulation. It is also realized that the field of skyrmions shares numerous common points with the field of magnetic and polar materials hosting topological band structures, thus highlighting the universality of topological concepts. The latter demands for new skyrmion materials and systems posing important challenges to the field of materials science.

The aim of our symposium is to bring together specialists working on a broad range of problems in the emerging field of skyrmionics and adjacent fields. The symposium will cover the fundamental aspects such as the topology of skyrmions and topological electronic phases in magnetic and polar materials, physical mechanisms underlying the Dzyaloshinskii-Moriya interaction and will proceed towards applied and practical problems. Those include the growth of known bulk skyrmion-hosting materials on substrates and the control of interfaces in magnetic multilayers to optimize skyrmion formation as well as the prediction and discovery of novel skyrmion materials. Experimental observation and characterization of skyrmion phases, magnetic textures of individual skyrmions, their dynamics and magnetochiral effects using a broad range of experimental techniques (magnetometry, magnetic force microscopy, Lorentz microscopy, neutron scattering, optical and microwave spectroscopy, etc.) will receive extended coverage. On the most practical side the symposium will address novel concepts of spintronic devices. The symposium will thus bridge the opposites along the three distinct directions: fundamental and applied materials research, theory and experiment, young researchers and established leaders in the field.

Topics will include:

Å Fundamental topological aspects and physical mechanisms underlying skyrmions
Å Discovery of novel skyrmion materials, both theoretical predictions and experiments
Å Electronic structure of chiral magnets and their optical properties
Å Magnetic and correlated topological materials at the interface with skyrmion physics
Å Growth of skyrmion-hosting bulk materials and magnetic multilayers
Å Experimental observation of skyrmion phases, magnetic textures and dynamics (magnetometry, Lorentz microscopy, neutron scattering, etc.)
Å Micromagnetic simulations of skyrmion structure, dynamics and device operation
Å Microwave magnetochiral and non-reciprocity effects of nanoscale confinement on skyrmion phases
Å Novel concepts of spintronic devices and neuromorphic computing employing skyrmions

Joint sessions are being considered with **NM03 - Topological and Quantum Phenomena in Intermetallic Compounds and Heterostructures**.

Invited speakers include:

Meigan Aronson	University of British Columbia, Canada
Geetha Balakrishnan	University of Warwick, United Kingdom
Stefan Bl¿gel	Forschungszentrum J¿lich GmbH, Germany
Felix B¿ttner	Helmholtz-Zentrum Berlin, Germany
Rafal Dunin-Borkowski	Forschungszentrum J¿lich GmbH, Germany
Karin Everschor-Sitte	University of Mainz, Germany
Claudia Felser	Max Planck Institute, Germany
Aurore Finco	University of Montpellier, France
Dirk Grundler	£cole Polytechnique F®d®rale de Lausanne, Switzerland
Alex Hoffmann	Argonne National Laboratory, USA
Kyoko Ishizaka	The University of Tokyo, Japan
Wanjun Jiang	Tsinghua University, China
Roland Kawakami	The Ohio State University, USA
Istvan Kezsmarki	Universitª t Augsburg, Germany

Jelena Klinovaja	Universitª t Basel, Switzerland
Denys Makarov	Helmholtz-Zentrum Dresden-Rossendorf, Germany
Lane Martin	University of California, Berkeley, USA
Christian Pfleiderer	Technische Universitª t M¿nchen, Germany
Martino Poggio	Universitª t Basel, Switzerland
Nicolas Reyren	Centre National de la Recherche Scientifique, France
Achim Rosch	University of Cologne, Germany
Avadh Saxena	Los Alamos National Laboratory, USA
Yoshinori Tokura	RIKEN, Japan
Tobias Weber	Institut Laue-Langevin, France
Jonathan White	Paul Scherrer Institut, Switzerland
Roland Wiesendanger	Universitª t Hamburg, Germany
Seonghoon Woo	IBM T.J. Watson Research Center, USA
Xiuzhen Yu	RIKEN, Japan

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Symposium NM05: Functional Nanoparticle Materialsð Synthesis, Property and Applications

Inorganic nanoparticles (e.g., Au) with controlled size, shape, and composition are now a ubiquitous building block within the nanoscience and nanoengineering communities. Ordered assemblies of nanoparticles, or so-called artificial photonic crystals or ómetamaterialsô exhibit collective electronic and optical behaviors for applications in nanoelectronics. Successful integration of nanoparticles into large area of ordered arrays requires fundamental understanding to achieve surface functionality, reproducible assembly, and mechanical robustness and patternability. Fundamental issues related to size, shape, and surface chemistry critically determine their assemblies and interactions. To address these issues, this symposium will cover the general topics of self-assembly of colloidal nanoparticles. Specifically, this symposium will focus on (1) fundamental synthetic and functionalization strategies to form large area of self-assembled nanoparticle arrays; (2) structural and property characterizations of nanoparticle self-assembly and interactions.

Topics will include:

- Large area formation and integration of self-assembled nanoparticle arrays
- Nanoparticle surface chemistry to control nanoparticle self-assembly and packing
- Structural and property characterizations of self-assembled nanoparticle arrays
- Advanced spectroscopy and transport studies on electronic structure, carrier dynamics, energy transfers and charge separation processes of self-assembled nanoparticle arrays

Invited speakers include:

Feng Bai	Henan University, China	**Christopher Schuh**	Massachusetts Institute of Technology, USA
Cherie Chagan	University of Pennsylvania, USA	**Lia Stanciu**	Purdue University, USA
Qian Chen	University of Illinois at Urbana-Champaign, USA	**Molly Stevens**	Imperial College London, United Kingdom
Dale Huber	Sandia National Laboratories, USA	**Zaicheng Sun**	Beijing University of Technology, China
Randall Lee	University of Houston, USA	**Younan Xia**	Georgia Institute of Technology, USA
Stephanie Lee	Stevens Institute of Technology, USA	**Xingchen Ye**	Indiana University Bloomington, USA
Elias Nakouzi	Pacific Northwest National Laboratory, USA	**Hua Zhang**	City University of Hong Kong, Hong Kong
Svetlana Neretina	University of Notre Dame, USA	**Xin Zhang**	Pacific Northwest National Laboratory, USA
Teri Odom	Northwestern University, USA		

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Symposium NM06: Manipulation and Detection of Physical Properties of Two-Dimensional Quantum Materials

The family of two-dimensional (2D) layered quantum materials has been quickly expanding following the discovery of graphene fifteen years ago. Other quantum 2D materials have recently joined the club following the pioneering works on twisted graphene, van der Waals bonded transition metal halides and chalcogenides, and other materials such as topological insulators and Weyl semiconductors, thus opening a new dimension of research in this vast field. The scope of this symposium is to present and discuss the recent developments in the rapidly progressing field of (quasi)two-dimensional layered quantum materials which are interesting for both fundamental science as well as for potential next generation optical and spintronics applications. Research on these materials is rapidly evolving due to the world-wide excitement on their intriguing magnetic, electronic, superconducting and optical properties and potential applications. The main focus of this symposium is to discuss the advanced state-of-the-art experimental tools and theoretical calculations used to manipulate and detect the physical properties (magnetic, superconducting, structural, opto-electronics, etc.) of quantum materials, heterostructures and devices, particularly, on the atomically thin crystals, whose response is exceedingly difficult to detect by employing conventional bulk techniques. The central goal of this symposium is to bring together both experimentalists and theoreticians investigating the physics, chemistry, materials science and engineering aspects of quantum materials.

Topics will include:

Å Usage of novel techniques (such as spin polarized scanning tunneling microscopy, single spin magnetometry, scanning magnetic circular dichroism microscopy, second harmonic generation, and electron tunneling etc.) to detect physical properties from atomically thin crystals
Å Twist and stacking dependent physical properties (structural, superconducting, magnetic, electronic and optical)
Å Development of micromagnetometry and magneto-optical techniques
Å Control and manipulation of physical properties of 2D quantum materials by electric field, electrostatic doping, pressure, etc..
Å Proximity and intercalation induced physical properties
Å Electron spin dynamics from quantum materials
Å Prototype device concepts and realization
Å Modelling, prediction of new properties, and time-dependent density functional theoretical calculations

Joint sessions are being considered with **NM07 - Beyond Graphene 2D Materialsð Synthesis, Properties and Device Applications**.
Also, a **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Monica Allen	University of California, San Diego, USA	**Archana Raja**	Lawrence Berkeley National Laboratory, USA
Judy Cha	Yale University, USA	**Jurek Sadowski**	Brookhaven National Laboratory, USA
Hyeonsik Cheong	Sogang University, Republic of Korea	**Budko Serguei**	Ames Laboratory, USA
Scott Crooker	Los Alamos National Laboratory, USA	**Sefaattin Tongay**	Arizona State University, USA
Pengcheng Dai	Rice University, USA	**Adam Tsen**	University of Waterloo, Canada
Hsieh David	California Institute of Technology, USA	**Angela Walker**	National Institute of Standards and Technology, USA
Cory Dean	Columbia University, USA	**Guanzhong Wu**	The Ohio State University, USA
Jeanie Lau	The Ohio State University, USA	**Shiwei Wu**	Fudan University, China
Patrick Maletinsky	Universitª t Basel, Switzerland	**Changsong Xu**	University of Arkansas, USA
Alberto Morpurgo	Universit®de Gen¯ve, Switzerland	**Xiaodong Xu**	University of Washington, USA
Harikrishnan Nair	The University of Texas at El Paso, USA	**Gogotsi Yury**	Drexel University, USA
Arun Paramekanti	University of Toronto, Canada		

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Symposium NM07: Beyond Graphene 2D Materialsð Synthesis, Properties and Device Applications

Two-dimensional (2D) materials with atom-scale thicknesses have spawned a new frontier in materials research. While graphene attracted the majority of attention in the early days of 2D materials research, other classes of 2D materials beyond graphene soon captivated the interest of the physics, chemistry, engineering, and materials science communities. Given the massive interest in and rapid pace of development in 2D materials, this symposium aims to (i) curate leading research results, (ii) cultivate a diverse community of scholars, and (iii) provide a roadmap for future research opportunities. The symposium will focus on elemental 2D materials beyond graphene (e.g. phosphorene, borophene, silicene, antimonene and germanene), compound 2D materials (e.g. transition metal chalcogenides), layered metal oxides and halides, organic-inorganic metal halide layered perovskites, and 2D molecular frameworks. The symposium will focus on the synthesis, fundamental properties, characterization, device physics studies, and applications of these materials. New synthetic strategies for controlled growth of 2D materials, *in situ* and other advanced analytical techniques, and device architectures for quantum information science are emerging areas of interest and will be the subjects of special focus in this symposium. This symposium expects to bring together a broad community of researchers from a variety of disciplines including materials science, surface science, inorganic chemistry, condensed matter physics, device engineering, and quantum information science.

Topics will include:

Å Controlled and scalable synthesis of 2D materials
Å Van der Waals heterostructures of 2D with other low-D materials (mixed dimensional and hierarchical materials)
Å Chemical functionalization and characterization of 2D materials
Å *In Situ* atomic-scale imaging and structural characterization of 2D materials
Å Fundamental physical properties of 2D materials and their heterostructures
Å Flexible devices and circuits from 2D materials and their heterosructures
Å 2D materials for sensing and energy conversion/storage
Å 2D materials in quantum information science
Å First principles modeling of 2D materials and heterostructures

Invited speakers include:

Deji Akinwande	The University of Texas at Austin, USA	**Mark Knight**	Northrop Grumman Corporation, USA
Manish Chhowalla	Cambridge University, United Kingdom	**Kian Ping Loh**	National University of Singapore, Singapore
Albert Davydov	National Institute of Standards and Technology, USA	**Jeff Long**	University of California, Berkeley, USA
William Dichtel	Northwestern University, USA	**Jiwoong Park**	The University of Chicago, USA
Marija Drndic	University of Pennsylvania, USA	**Joan Redwing**	The Pennsylvania State University, USA
Xiangfeng Duan	University of California, Los Angeles, USA	**Evan Reed**	Stanford University, USA
Goki Eda	National University of Singapore, Singapore	**Hyeon Suk Shin**	Ulsan National Institute of Science and Technology, Republic of Korea
Yuri Gogotsi	Drexel University, USA	**Vincent Tung**	King Abdullah University of Science and Technology, Saudi Arabia
Sinead Griffin	Lawrence Berkeley National Laboratory, USA	**Huili Grace Xing**	Cornell University, USA
Mark Hersam	Northwestern University, USA	**Andrea Young**	University of California, Santa Barbara, USA
Philip Kim	Harvard University, USA	**Wenjing Zhang**	Shenzhen University, China
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Symposium NM08: Nanoscale Heat Transportð Fundamentals

Understanding and controlling the interactions between energy carrying particles and nanostructural features brings new opportunities for manipulation of thermal transport processes and thermal physical properties. Due to the continuous progress in nanofabrication technologies, modern nanoscale materials and devices have characteristic length scales of the order of relevant energy carriers such as phonons, phonons, electrons, and magnons. This translates into an unprecedented opportunity to achieve novel thermal properties and functions. Despite significant advances, a better understanding of thermal transport in nanoscale materials and interactions between energy carriers and surfaces and interfaces is still required. There exist multiple thermal transport regimes that need to be fully elucidated in order to obtain a full spectrum of thermal capabilities: these include ballistic, quasi-ballistic, localized, hydrodynamic, coherent, incoherent, strongly anharmonic regimes. In addition to the complexities of crystalline materials, materials and systems with disordered or amorphous structures also possess significant challenges for understanding and manipulating thermal transport processes. In bulk crystalline systems, manipulation of crystal bonding and distorted local/global structures such as lone pairs, grain boundaries etc. also allow for manipulation of phonon mean free paths down to atomic length scales. In addition, new tools such as machine learning and high-throughput experiments can allow for wider exploration of new materials and development of new experimental techniques. This symposium will bring together a wide range of different thermal transport research areas including experimental, theoretical, and computational techniques recently developed to address the unknowns on nanoscale thermal transport phenomena with the objective of obtaining a better basic understanding of thermal transport processes in technologically relevant materials and devices.

Topics will include:

Å Theory and experiments on nanoscale heat transport phenomena
Å Thermal conductance at interfaces
Å Heat conduction in disordered and amorphous materials
Å Ultralow thermal conductivity in crystalline bulk thermoelectric materials
Å Thermal radiation at the nanoscale
Å Machine learning to predict and understand thermal properties of materials
Å Non-equilibrium and picosecond thermal transient behaviors
Å Heat transport in soft matter (e.g. biological and bioinspired materials)
Å Thermal phonon imaging
Å Thermal transport characterization techniques (e.g. mean-free path spectroscopies)
Å Electron-phonon, and phonon-phonon interactions
Å Novel models and simulation methods to predict thermal transport properties

Invited speakers include:

Philippe Ben-Abdallah	Institut dÕOptique, France	**Yoshiaki Nakamura**	Osaka University, Japan
Kanishka Biswas	Jawaharlal Nehru Centre for Advanced Scientific Research, India	**Pamela Norris**	University of Virginia, USA
David Broido	Boston College, USA	**Pramod Reddy**	University of Michigan, USA
David Cahill	University of Illinois at Urbana-Champaign, USA	**Xiulin Ruan**	Purdue University, USA
Gang Chen	Massachusetts Institute of Technology, USA	**Ivana Savic**	Tyndall National Institute, Ireland
Olivier Delaire	Duke University, USA	**Li Shi**	The University of Texas at Austin, USA
Kevian Esfarjani	University of Virginia, USA	**Junichiro Shiomi**	The University of Tokyo, Japan
Pawel Keblinski	Rensselaer Polytechnic Institute, USA	**Clivia Sotomayor Torres**	Institut Catal¨ de Nanoci¯ncia i Nanotecnologia, Spain
Yee Kan Koh	National University of Singapore, Singapore	**Zhiting Tian**	Cornell University, USA
David Lacroix	Universit®de Lorraine, France	**Richard Wilson**	University of California, Riverside, USA
Arum Majumdar	Stanford University, USA	**Lilia Woods**	University of South Florida, USA
Alan McGaughey	Carnegie Mellon University, USA	**Xanthippi Zianni**	TEI of Central Greece, Greece

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Symposium NM09: Nanogenerators and Piezotronics

Recent advances in nanogenerator research demonstrated their feasibility and great potential in harvesting various types of energy from the environment, leading to novel power sources that operate over a broad range of conditions for extended time periods with high reliability and independence. During the past decade, the nanogenerator technology by using triboelectric, piezoelectric and other mechanisms has experienced a gigantic development. The integration of nanogenerators, energy storage units and functional devices has led to the implementation of various types of micro/nano-systems for implantable electronics, remote and mobile environmental sensors, nano-robotics, intelligent MEMS/NEMS, portable/wearable personal electronics and blue energy technology. The long-overlooked coupling between piezoelectric polarization and semiconductor properties in piezoelectric semiconductors, results in both novel fundamental phenomena and unprecedented device applications, and thus the rapidly rising research interests in the emerging fields of piezotronics and piezo-phototronics. These two processes enable technology advances in societal pervasive areas, e.g. sensing, human-machine interfacing, robotics, healthcare and more. This progress in the fields of piezotronics and piezo-phototronics, leads to compelling opportunities for research in materials science and broader areas, from basic studies of piezoelectricity and semiconductor properties in functional nanomaterials to the development of applications of ñsmarterò electronics and optoelectronics.

This symposium aims to advance fundamental understanding and technological development of mechanical energy conversion materials, devices and systems; as well as the coupling between piezoelectric polarization and semiconductor behaviors and functionalities. Abstracts on theoretical and experimental studies about topics listed below are particularly welcomed.

Topics will include:

Å Triboelectric, piezoelectric, flexoelectric and ferroelectric nanomaterials/nanostructures: synthesis, characterization, integration and material science
Å Novel designs and fabrications of triboelectric, piezoelectric, flexoelectric and ferroelectric nanogenerators for high-performance energy harvesting
Å Novel strategies in design, integration and power management of hybrid cells/nanogenerators for concurrently harvesting multitype energies
Å Self-charging power cell and Self-powered system design, integration and application
Å Tribotronics for electronics and sensors
Å Mechanism and characteristics of triboelectric and discharge effects
Å Piezotronics and Piezophototronics in 1D/2D nanomaterials for smart adaptive electronics and optoelectronics
Å Fundamental study on material science, band structure and interface engineering in piezotronics and piezophototronics
Å Novel approaches in integration and nanomanufacturing of piezotronic and piezophototronic devices
Å Fundamental and technological issues in piezocatalysis: catalytic properties modulated by piezoelectric or ferroelectric polarization

A **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Jeong Min Baik	Sungkyunkwan University, Republic of Korea
Jun Chen	University of California, Los Angeles, USA
Canan Dagdeviren	Massachusetts Institute of Technology, USA
Christian Falconi	Universit¨ de Roma, Italy
Jianhua Hao	The Hong Kong Polytechnic University, Hong Kong
Chenguo Hu	Chongqing University, China
Unyong Jeong	Pohang University of Science and Technology, Republic of Korea
Sohini Kar-Narayan	University of Cambridge, United Kingdom
Chengkuo Lee	National University of Singapore, Singapore
Keon Jae Lee	Korea Advanced Institute of Science and Technology, Republic of Korea
Pooi See Lee	Nanyang Technological University, Singapore
Luigi Occipinti	University of Cambridge, United Kingdom

Guylaine Poulin-Vittrant	Universit®de Tours, France
Nelson Sep¼lveda	Michigan State University, USA
Xudong Wang	University of Wisconsinï Madison, USA
Zhong Lin Wang	Georgia Institute of Technology, USA
Zuankai Wang	City University of Hong Kong, Hong Kong
Magnus Willander	Linkºping University, Sweden
Morten Willatzen	DTU Fotonik, Denmark
Wenzhuo Wu	Purdue University, USA
Qing Yang	Zhejiang University, China
Chi Zhang	Beijing Institute of Nanoenergy and Nanosystems, Chinese Academy of Sciences, China
Haixia Zhang	Peking University, China
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Symposium SM01: Materials Modulating Stem Cells and Immune Response

Extracellular matrix (ECM) interacts with cells, providing structural, mechanical, biochemical, and compositional information, which strongly influences cellular function. Further, a variety of molecules tethered to ECM influence tissue development and homeostasis. Therefore, it is important to use state-of-the-art technique to probe the fundamental role of ECM in directing cellular function, tissue development and morphogenesis. Design and construction of biomaterials by incorporating the structural and functional principles from ECM holds great promise in advancing biomaterial research including scaffold, implant interfaces, and cell culture substrate. Among all the important cell types, stem cells and immune cells play the vital role in regenerative process and maintenance of tissue homeostasis. Therefore, the understanding on the interplay between stem/immune cells with biomaterials determines the functionality of the biomaterials and their ultimate therapeutic effects. Stem cells and immune cells sense multiple intrinsic features of ECM. Those signals are transduced from the cell membrane to the nucleus to regulate gene expression, eventually affecting cell fate. Hence, the design of biomaterials with an appropriate physicochemical property to instruct stem/immune cells can elicit the desirable cell differentiation and favor the biomaterial integration and healing.

In this symposium, a selection of multidisciplinary speakers will cover a wide range of important topics related to modulation of cellular response via biomaterials. This symposium will offer valuable insights into interactions between cells and synthetic materials that can be applied to the design of innovative bio-instructive materials including scaffold, implant interfaces, cell culture substrate, which will enable advances in diverse fields spanning biophysics, tissue engineering, stem cell delivery, vaccination and immunotherapies, and implantable devices.

Topics will include:

Å Chemistry and physics of biomaterials
Å Design and fabrication of scaffolds, implants and cell substrates
Å Biomimetic hydrogels and materials surfaces
Å Biointeractive materials
Å Mechanotransduction
Å Design and engineering of stem cell niche
Å Morphogenesis inspired biomaterial
Å Single-cell mechanics
Å Immunomodulatory biomaterials
Å Foreign body reaction to biomaterials
Å Biomaterial-based immune therapy
Å Cell culture and encapsulation technologies
Å Microfabrication

Joint sessions are being considered with **SM04 - Beyond Nanoï Challenges and Opportunities in Drug Delivery**.

Invited speakers include:

Jiang Chang	Shanghai Institute of Ceramics, Chinese Academy of Sciences, China
Xuesi Chen	Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, China
Andr®s J. Garc²a	Georgia Institute of Technology, USA
Julien Gautrot	Queen Mary University of London, United Kingdom
Bingyun Li	West Virginia University, USA
Matthias L¿tolf	£cole Polytechnique F®d®rale de Lausanne, Switzerland
Xavier Trepat	Institute for Bioengineering of Catalonia, Spain

Wolfgang Wagner	RWTH Aachen University, Germany
Jun Wang	South China University of Technology, China
Weiwei Wang	Helmholtz-Zentrum Geesthacht, Germany
Fiona Watt	King's College London, United Kingdom
Jie Yan	National University of Singapore, Singapore
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Symposium SM02: Next-Generation Antimicrobial Materialsð Combating Multidrug Resistance and Biofilm Formation

The emergence and rapid spread of antimicrobial resistance (AMR) pose a global threat to public health. This crisis takes roots in the global overuse and misuse of antibiotics and is getting worse because of the too little investment from the public and private sectors into antimicrobial research and developmentð as treating bacterial infections was assumed to be a problem that had been solved. Yet today, as pointed out in the ŕReview On Antimicrobial Resistanceòcommissioned by the UK government, 700,000 people worldwide die from AMR each year. Unless immediate action is taken, this could increase to 10 millions lives lost per year by 2050, at a cumulative cost to global economic output of 100 trillion USD. To address this crisis, antimicrobial materials could play a key role. They can substitute or supplement antibiotics, thereby helping contain the spread of resistant pathogens in high-risk areas, including the medical sector. Todate, antimicrobial materials with diverse active agents based on small molecules, polymers, nanomaterials (inorganic, organic, and hybrids), and nanostructures have been developed. Additionally, significant efforts have been directed toward understanding their activity mechanisms, which are key to their optimization and eventual translation from bench-top to bed-side. This symposium will bring together experts from different disciplines involved in antimicrobial materials to discuss the current research pipeline, including (1) novel antimicrobials for the fight against antibiotic-resistant bacteria and biofilms, (2) advances in the mechanistic understanding of antimicrobial materials, and (3) progresses in translational research and development: from the laboratory to the patient/market.

Topics will include:

Å Small molecules that sensitize multidrug-resistant bacteriað molecular structures, performances, and activity mechanisms
Å Peptides for sensitizing antibiotic-resistant bacteriað structural features, performances, and activity mechanisms
Å Polymers for antimicrobial applicationsð synthesis, solution structures, and modes of action.
Å Nanoparticles and 2D nanomaterials with antimicrobial activitiesð synthesis, morphology features, and modes of action;
Å Nanomaterials with stimulus-induced antimicrobial activities
Å Nanomaterials for sensitizing multidrug-resistant bacteriað structural features and activity mechanisms
Å Nanoparticle-(bio)molecule hybrids with antimicrobial activity
Å Materials with anti-quorum sensing activity
Å Highly porous and microstructured antimicrobial materials
Å Engineering interfaces to prevent biofilm formationð structural, electric, morphological and mechanical aspects
Å Stimulus-responsive materials for anti-biofilm applications
Å Taking antimicrobial materials from the bench-top to the bed-sideð where do we stand?
Å Antimicrobial materials in the in vivo and/or clinical studies
Å Applied antimicrobial materialsð from paint to ship hulls
Å Antimicrobial materials in the environmentð benefits and risks

Invited speakers include:

Mahfuza Ali	3M, USA
Mary Chan-Park	Nanyang Technological University, Singapore
Anushree Chatterjee	University of Colorado Boulder, USA
Chunying Chen	National Center for Nanoscience and Technology, China
Jianzhong Du	Tongji University, China
Karine Glinel	Universit®Catholique de Louvain, Belgium
Jayanta Haldar	Jawaharlal Nehru Centre for Advanced Scientific Research, India
James Hedrick	IBM T.J. Watson Research Center, USA
Elena Ivanova	Swinburne University of Technology, Australia
Xingyu Jiang	Southern University of Science and Technology, China

Huiyu Liu	Beijing University of Chemical Technology, China
Alexandra Mu¶oz-Bonilla	Instituto de Ciencia y Tecnolog²a de Pol²meros, Spain
Antonella Piozzi	Sapienza Universit¨ di Roma, Italy
Chuanbing Tang	University of South Carolina, USA
Joerg Tiller	Technische Universitª t Dortmund, Germany
Xudong Wang	University of Wisconsinï Madison, USA
Gerard Wong	University of California, Los Angeles, USA
Jun-Jie Yin	U.S. Food & Drug Administration, USA
Yuliang Zhao	National Center for Nanoscience and Technology, China

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Symposium SM03: Advanced Neural Materials and Devices

There is growing interest in the interface of biomaterials and nervous system from professionals in human health, biomedical engineering, and neuroscience. Neural prostheses are devices that are implanted into the nervous system for bidirectional communication (recording from and stimulation of neural tissue) to treat or assist people with disabilities of neural function. There have been several major advances in neural interface technologies during past couple of years, however, the engineering of stable and reliable electronic-neural tissue interface is essential for long-term functionality of these implants. The quality of signal transduction between the electrodes and neurons depends on physical and chemical properties of the electrode-tissue interface that ultimately relies on the specifics of the material design that enables a long-term stable and functional interface. The challenge for materials science is to design and develop multifunctional biomaterials to safely integrate with neural tissue with minimal biological response. Substrates and electrode materials must meet strict electrochemical requirements such as long-term stability, biocompatibility, and resistance to corrosion in physiological environment. Furthermore, the implant materials should match the mechanical properties of surrounding tissue to prevent injury due to micromotion and allow for adequate exchange of nutrients and waste so that the surrounding tissue remain healthy. This symposium will focus on the latest advances in biomaterials to control/engineer neuron-electronic interfaces to produce stable and functional implants with greater longevity than what is possible today. Session topics will spotlight the latest efforts to achieve the most effective and safest strategies to communicate with neurons.

Topics will include:

Å Novel natural materials, biocompatible materials, and small molecules for neural interfaces (substrates, conductive materials, etc.)
Å Neuron guidance
Å Immobilization & patterning of axon guidance molecules
Å Drug delivery to the brain
Å Surface modification of neural electrodes
Å Biocompatibility of neural electrodes with surrounding tissues
Å Microelectrode design and biocompatibility
Å Electroactive materials (inorganic/organic)
Å Biostability of the neuroprosthetic devices
Å Signal transduction at electrode tissue interface
Å Limb prostheses, artificial retina, cochlear implants, nerve conduits
Å Neurochemical sensing
Å Brain-on-a-chip devices
Å Organic bioelectronics

Invited speakers include:

Magnus Berggren	Linkº ping University, Sweden	**George Malliaras**	University of Cambridge, United Kingdom
Taek Dong Chung	Seoul National University, Republic of Korea	**David Martin**	University of Delaware, USA
Bianxiao Cui	Stanford University, USA	**Nick Melosh**	Stanford University, USA
Tracy Cui	University of Pittsburgh, USA	**Laura Poole-Warren**	University of New South Wales, Australia
Eric Glowacki	Linkº ping University, Sweden	**John Rogers**	Northwestern University, USA
Andreas Hierlemann	ETH Z¿rich, Switzerland	**Sameer Sheth**	Baylor College of Medicine, USA
Eric Hudak	National Institute of Health, USA	**Klaus Tybrandt**	Linkº ping University, Sweden
Dae-Hyeong Kim	Seoul National University, Republic of Korea	**Chong Xie**	Rice University, USA

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Symposium SM04: Beyond Nanoï Challenges and Opportunities in Drug Delivery

New biomaterials can contribute to drug delivery by enabling spatiotemporal control of drug release, overcoming biological barriers on multiple levels, and providing additional functions to enhance the precision of the delivery. Significant efforts have been made to improve the efficacy and safety of anticancer medicine in the last few decades. Lessons learned from past efforts are now applied to address fundamental challenges in drug delivery and expanded to new opportunities in emerging therapeutic fields such as gene editing and immunotherapy. This symposium will invite experts in the field of controlled drug delivery, nanomedicine, biomaterials, cell therapeutics, and global health to discuss fundamental issues, innovation, and new opportunities in drug delivery.

We welcome abstract submissions on a broad range of topics relevant to local and systemic drug delivery as well as imaging and diagnostics, including drug-device combination products; nanomedicine for novel applications such as infectious diseases and neurological disorders; drug/vaccine delivery for enhancing global health; functional biomaterials for immunotherapy; cell-based therapy; machine learning in the design of drug and carrier. We will actively promote discussions on challenges in clinical translation of novel drug delivery systems and new combinations of drug delivery and emerging therapeutic modalities.

Topics will include:

- Drug and device (Drug-device combination, Scaffolds)
- Nanomedicine for cancer therapy
- Nanomedicine for novel applications
- Machine learning for drug delivery design
- Gene delivery/editing
- Bioinspired materials for drug delivery
- Local drug delivery
- Brain barrier and CNS delivery
- Infectious disease and global health
- Biomaterials and drug delivery for immunotherapy
- Cell-based therapeutics
- Imaging and Theranostics

Invited speakers include:

Yunching (Becky) Chen	National Tsing Hua University, Taiwan
James Dahlman	Georgia Institute of Technology, USA
Bruno De Geest	Ghent University, Belgium
Tejal Desai	University of California, San Francisco, USA
Andrew Ferguson	The University of Chicago, USA
Dan Heller	Memorial Sloan Kettering Cancer Center, USA
Ick Chan Kwon	Harvard Medical School, USA
Dennis Lee	Bill & Melinda Gates Foundation, USA
Wenguang Liu	Tianjin University, China
James Moon	University of Michigan, USA
Elizabeth Nance	University of Washington, USA
Juliane Nguyen	University of North Carolina at Chapel Hill, USA

Guangjun Nie	National Center for Nanoscience and Technology, China
David Nisbet	Australian National University, Australia
Dan Peer	Tel Aviv University, Israel
Gaurav Sahay	Oregon Health & Science University, USA
Tatiana Segura	Duke University, USA
Conroy Sun	Oregon State University, USA
Tina Vermonden	Utrecht University, Netherlands
Jun Wang	South China University of Technology, China
John Wilson	Vanderbilt University, USA
Kim Woodrow	University of Washington, USA
Chae-Ok Yun	Hanyang University, Republic of Korea

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Symposium SM05: Progress in Multimaterials and Multiphase-Based Multifunctional Materials

This symposium will focus on the latest advances in multifunctional materials employing multimaterial systems and multiphase materials to achieve added functionality to increase the efficiency, autonomy and lifespan of the system by performing multiple functions that would have been considered by designers as mutually exclusive. It will cover a broad array of topics ranging from novel material development, new materials modelling and design methods, to the latest advances in multimaterial fabrication to create the multifunctional applications of the future. Multifunctional materials are different from conventional materials as they can fulfill more than one functions. For example, composites, when incorporating with stimuli-responsive materials into their matrices, can morph and adapt their shape and properties upon the exposure to environmental changes to enable multiple functionalities, such as active sensing and actuation, self-diagnosis and self-healing, energy harvesting and storage. Multifunctional materials using multimaterial systems and multiphase materials are an emerging active research field due to their potentials of efficient use of materials and increasing material/structure intelligence, for a wide range of applications including smart/intelligent structures, adaptive flexible electronics, autonomous soft robots, smart energy harvesting and storage devices, and biomedical devices. The creation of multifunctional materials usually couples multimaterial and multiphysics responses to achieve multifunctionality. Examples include the material systems coupling between mechanical, thermal, electrical, magnetic behaviours. This symposium will include both basic science in new knowledge and new materials as well as the development for future novel applications. It will be organized into three parts, transitioning from one to another to highlight the importance of joint efforts in materials, modeling, design, fabrication, and novel applications. The first part will be on new chemistry and new materials that can lead to new functionalities, the second part will aim at the new understanding of process-structure-function relationship that leads to new models, designs and fabrication methods, and the third part will concentrate on new concept that can engage practical applications across a wide range of engineering fields.

Topics will include:

Å Multimaterial systems and composites for enhanced intelligence and functionality (materials)
Å Materials with multiphysics responses to environmental stimuli (materials)
Å Active stimuli-responsive metamaterials and architected materials (materials)
Å Self-sensing and self-healing materials (materials)
Å Functional robotic materials (materials/design)
Å Multiphysics modeling and simulations (modeling and design)
Å Process-structure-function relationship (modeling, design, and fabrication)
Å Topology optimization or AI-based design and fabrication (modeling, design and fabrication)
Å Advanced manufacturing and fabrication (design and fabrication/novel applications)
Å Smart materials in life science and biomaterials (novel applications)
Å Active materials for sustainability and energy (novel applications)
Å Materials for energy harvesting and storage (novel applications)
Å Functional materials-based actuators, sensors, flexible electronics (novel applications)

Invited speakers include:

Christopher Barner-Kowollik	Queensland University of Technology, Australia
Michael Dickey	North Carolina State University, USA
Huajian Gao	Nanyang Technological University, Singapore
Nakhiah Goulbourne	National Science Foundation, USA
Oliver Gould	Helmholtz-Zentrum Geesthacht, Germany
Julie Greer	California Institute of Technology, USA
Kyung-Suk Kim	Brown University, USA
Nicholas Kotov	University of Michigan, USA
Les Lee	Air Force Research Laboratory, USA
Barbara Mazzolai	Istituto Italiano di Tecnologia, Italy
John Rogers	Northwestern University, USA
Metin Sitti	Max Planck Institute for Intelligent Systems, Germany
Nancy Sottos	University of Illinois at Urbana-Champaign, USA
Vladmir Tsukruk	Georgia Institute of Technology, USA
Richard Vaia	Air Force Research Laboratory, USA
Yujie Wei	Institute of Mechanics, Chinese Academy of Sciences, China
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Symposium SM06: Materials and Fabrication Schemes for Robotics

Advances of robotic systems in recent years are largely attributed to increases in computing performance, as well as progresses in machine learning and control theories. However, there has been little change in the way robots are assembled or in the choice of materials, actuators and sensors that are used to drive current robotic systems. The traditional concept of motor driven robots based on mechanical transmission and computer control is deeply rooted in the current hardware design of robotic systems. Exciting advances in materials science, including the development of smart materials, energy harvesting and actuation-schemes, as well as the adoption of bio-inspired design principles can offer radically new ways to construct and operate robots. This is a three-day symposium and the focus of this symposium is to inspire and discuss the latest development of new materials and fabrication schemes that can support the development of a new generation of robots that are multi-functional, power-efficient, compliant, and autonomous in ways akin to biological organisms. It addresses new working mechanisms for actuation, assembly, and reconfiguration, strategical large-scale fabrication, as well as applications in molecular and cellular delivery, surgery, and sensing.It will also discuss the role of materials research for biohybrid and bioinspired robots that translate fundamental biological principles into engineering design rules and smart materials or integrate living components into synthetic structures to create robots that perform like natural systems. This symposium aims to provide a timely supporting platform for scientists and engineers to disseminate, communicate, and form collaborations.

Topics will include:

- Å Soft Materials and Robotics
- Å E-skin and Human Robot Interaction
- Å Shape Memory, Self-healing and Learning Materials
- Å Biohybrid Systems and Design Considerations
- Å New stimuli-responsive materialsð biological, organic, and inorganic materials and their hybrids
- Å Integrated Multi-material Fabrication 3D/4D Printing
- Å Embodiment and Applications
- Å Translational Challenges and Case Studies
- Å Manipulation and assembly mechanisms for creation of small machines and robots

Invited speakers include:

Jose Alvarado	The University of Texas at Austin, USA	**Karl Kratz**	Helmholtz-Zentrum Geesthacht, Germany
Eduard Arzt	Leibniz Institute for New Materials, Germany	**Cecilia Laschi**	Scuola Superiore SantôAnna, Italy
Chiara Daraio	California Institute of Technology, USA	**Alexander Leshansky**	Technionï Israel Institute of Technology, Israel
Michael Dickey	North Carolina State University, USA	**Hod Lipson**	Columbia University, USA
Larisa Florea	Trinity College Dublin, The University of Dublin, Ireland	**Herbert Shea**	£cole Polytechnique F®d®rale de Lausanne, Switzerland
Ambarish Ghosh	Indian Institute of Science, India	**Rebecca Shulman**	Johns Hopkins University, USA
Ximin He	University of California, Los Angeles, USA	**Sam Stupp**	Northwestern University, USA
Ho-Young Kim	Seoul National University, Republic of Korea	**Shoji Takeuchi**	The University of Tokyo, Japan

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Symposium SM07: Building Advanced Materials by Self-Assembly

The symposium will cover a broad range of topics that are germane to building advanced materials via self-assembly. Self-assembly is an important phenomenon on the formation of minerals in nature and has been become to a popular method to synthesize advanced materials in both lab and industrial scales. Up to now, plentiful materials prepared via self-assembly have been applied in various fields such as energy, catalysis, biomedicine, and electrics. For instance, advanced luminescent materials have been prepared self-assembly of intrinsically non-emissive molecules with aggregation-induced emission (AIE) .

One of the challenges facing this fast-growing field of advanced materials is to develop a fundamental understanding of self-assembly mechanisms, which will be addressed in this symposium. Contributions will include, but are not limited to: 1) Advances in synthesis of advanced materials via self-assembly; 2) Investigations into self-assembly mechanisms; 3) Observation of the self-assembly pathways via *in situ* techniques; 4) Theoretical development on the self-assembly; 5) Materials with aggregation-induced emission and their applications. The Symposium aims to bring researchers updated information on the fundamental self-assembly research through theory to experiments. It is also designed for the experienced researchers to reinforce their knowledge on the scopes of development of new techniques, especially the state-of-the-art *in situ* characterization tools, to understand mechanisms of self-assembly.

Topics will include:

Å Building advanced materials via self-assembly
Å Observation of the self-assembly pathways via *in situ* techniques
Å Control of morphology and size during synthesis of advanced materials via self-assembly pathways
Å Mechanism studies of self-assembly
Å Biomaterials and polymer self-assembly
Å Colloidal interactions and crystallization
Å Fluorescent and phosphorescent AIE-based polymers, oligomers and molecules
Å Design principles and operational mechanisms of the AIE based molecules
Å Biocompatible AIE probes for sensing, imaging and other biomedical applications
Å Applications of advanced materials build via non-classical crystallization pathways in areas of energy, catalysis, environment, biomedicine, optics, electrics, magnetics, etc.
Å Self-assembly of inorganic or inorganic-organic clusters

A **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Luisa De Cola	Universit®de Strasbourg, France	**Nicholas Kotov**	University of Michigan, USA
James De Yoreo	Pacific Northwest National Laboratory, USA	**Yan Li**	Peking University, China
Julia Dshemuchadse	Cornell University, USA	**Alvaro Mata**	The University of Nottingham, United Kingdom
Hongyou Fan	Sandia National Laboratories, USA	**Utkur Mirsaidov**	National University of Singapore, Singapore
Kristen A. Fichthorn	The Pennsylvania State University, USA	**Anjun Qin**	South China University of Technology, China
Oleg Gang	Columbia University, USA	**Kevin Rosso**	Pacific Northwest National Laboratory, USA
Pupa Gilbert	University of Wisconsinï Madison, USA	**Dmitri Talapin**	The University of Chicago, USA
Yuning Hong	La Trobe University, Australia	**Dong Wang**	Shenzhen University, China
Zachary Hudson	The University of British Columbia, Canada	**Yun Yan**	Peking University, China
Rongchao Jin	Carnegie Mellon University, USA	**Xingchen Ye**	Indiana University Bloomington, USA
Andrey Klymchenko	Universit®de Strasbourg, France		

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Symposium SM08: Next-Generation Materials and Technologies for 3D Printing and Bioprinting

Industrial, government, and academic researchers are evaluating 3D printing and bioprinting technologies to overcome the limitations associated with conventional medical manufacturing processes. These technologies involve processing of three-dimensional structures in a layer-by-layer manner. 3D printing technologies are being used with new classes of materials to create implants, instruments, devices, and other products for medicine, surgery, and dentistry. 3D printing is also being used for consumer products, motor vehicles, aerospace, and other technological applications. New types of bioprinting technologies are being use for processing cells and biomaterials into artificial tissues, structures for in vitro testing, and food products. The industrial use of 3D printing and bioprinting technologies is a multi-billion dollar activity, which significant growth occurring in Europe, Asia, Africa, and the Americas. This symposium will consider recent developments by researchers in academia and industry into novel materials and technology for 3D printing and bioprinting. Several topics related to 3D printing, including development of computer models, novel 3D printing and bioprinting technologies, and novel materials for use in 3D printing and bioprinting, will be discussed. This symposium will create collaboration and discussion among the many groups involved in the development and use of 3D printing technologies, including materials engineers, manufacturers, and clinicians.

Topics will include:

Å New materials and methods for vat photopolymerization
Å Improvements to the material jetting process
Å Innovative input materials for binder jetting
Å Novel materials and methods for material extrusion
Å Innovations in materials and methods for powder bed fusion
Å Improvements to the sheet lamination process
Å Novel input materials for directed energy deposition
Å Next generation materials and approaches for bioprinting
Å Innovations in the chemistry of polymers, ceramics, composites, metals, and biopolymers for 3d printing and bioprinting
Å 3D printing of smart materials
Å Validation of 3D printing and bioprinting technologies
Å Mechanical testing of 3D printed structures
Å Design and computational aspects associated with 3D printed and bioprinted structures
Å Use of modeling approaches to understand the printing mechanism
Å Industrial applications of 3D printing and bioprinting
Å Translation of 3D printed medical products for commercial or clinical use

Invited speakers include:

Doug Chrisey	Tulane University, USA	**Geetha Manivasagam**	Vellore Institute of Technology, USA
Tal Dvir	Tel Aviv University, Israel	**Wei Sun**	Drexel University, USA
Jinah Jang	Pohang University of Science and Technology, Republic of Korea		

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Symposium SM09: Peptide and Protein Design for Responsive Materials

Nature has evolved a variety of creative approaches to many aspects of materials design. Biomolecular interactions found in peptides and proteins enable the construction of large, complex structures with multiple functions across multiple length scales. This has inspired sophisticated functional materials observed in all living organisms, where most materials exhibit a hierarchy of structure that is critical to their functions. Researchers have recognized the potential of biological tools in the creation of synthetic materials with new materials created using peptide and protein interactions. Specifically, this symposium will focus on the significant progress that has been made towards understanding the design rules, mechanisms and driving forces behind the design and hierarchical assembly of peptides and proteins and derivatives thereof. Materials made from peptides and proteins can be engineered through precise molecular modifications using natural and non-natural amino acids. Furthermore, secondary structure (i.e., molecular conformation), tertiary structure (i.e., intramolecular structure), and quaternary structure (i.e., intermolecular structure) can all be designed to control materials across multiple length scales in order to control responses to external fields (e.g., electric, magnetic, and shear), temperature, salts, pH, and light. This control can lead to multifunctional and stimuli-responsive systems with spatial-, temporal-, and dosage-controlled functionalities for a diverse range of applications in biomedical materials (e.g., tissue engineering, drug delivery, biosensing) as well as bioelectronics, composite templating, energy harvesting, and high performance structural materials. With advances in synthetic peptide and polypeptide synthesis as well as synthetic biology, materials need not be limited to small-scale, high-tech, or bio-tech applications. Peptides and proteins will be discussed as building blocks for potential technology spanning high-tech to commodity materials.

This interdisciplinary symposium will bring together those working in the field of materials design, spanning computation/simulation and experiment, exploiting bio-inspired self-assembly of biologically relevant molecules including peptides and polypeptides, proteins, and peptoids well as hybrid and composite systems.

Topics will include:

- Principles and materials design rules (incl. computation and simulation)
- Theory-driven molecular and self-assembled material design
- Building complex nanostructure through bio-inspired self-assembly (incl. peptide and protein origami)
- Novel hybrids molecules for functional materials designs (incl. peptoids, biomolecule conjugates with other molecules such as synthetic polymers or DNA)
- Use of non-natural amino acids in synthetic peptides and recombinantly expressed proteins for material design, formation, and function
- Designing of 3D functional structures (incl. hydrogel and organogel networks, colloidal particle assemblies, membranes, auxetic materials)
- Designing 1D nanostructured functional materials (incl. nanowires, nanotubes, nanofibers)
- Design of stimuli-responsive materials exploiting peptide and proteins
- Controlling biological interactions by design (incl. cell behavior, protein adhesion, immune responses)
- Design of peptide and protein materials for biological application (incl. tissue engineering, cellular therapies, controlled and targeted drug delivery)
- Design of peptide and protein materials for energy applications (incl. biosensing, energy harvesting and electronic applications)
- Design of peptide and protein materials with exotic mechanical behaviors (incl. extreme extensibility and stiffness)
- 3D and 4D advanced manufacturing and printing technologies of peptide and protein materials

Invited speakers include:

David Baker	University of Washington, USA	**Kristi Kiick**	University of Delaware, USA
Dermont Brougham	University College Dublin, Ireland	**Yong-beom Lim**	Yonsei University, Republic of Korea
Julie Champion	Georgia Institute of Technology, USA	**Julie Liu**	Purdue University, USA
Chun-long Chen	Pacific Northwest National Laboratory, USA	**Alvaro Mata**	The University of Nottingham, United Kingdom
Timothy Deming	University of California, Los Angeles, USA	**Alberto Saiani**	The University of Manchester, United Kingdom
Trevor Douglas	Indiana University Bloomington, USA	**Akif Tezcan**	University of California, San Diego, USA
Sarah Heilshorn	Stanford University, USA	**Derek Woolfson**	University of Bristol, United Kingdom
Ming Jiang	Fudan University, China	**Ting Xu**	University of California, Berkeley, USA
Sinan Keten	Northwestern University, USA	**Zhimou Yang**	Nankai University, China

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Abstract Submission Opens September 24, 2020
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2021 MRS® SPRING MEETING & EXHIBIT
April 18–23, 2021 | Seattle, Washington
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Symposium SM10: Progress in Green Chemistry Approaches for Sustainable Polymer Materials

This symposium will broadly cover current and emerging green chemistry approaches for sustainable polymer materials. The first part of the symposium will focus on sustainable processes and green chemistries for the synthesis of polymer materials and the second part will focus on the design and applications of degradable polymer materials including both hydrolytic and self-immolative polymers. The first part of this symposium will focus on emerging green chemistries for synthetic polymer materials (ˆgreen polymersð). A key focus will be on alternative chemistries towards green polymers from less toxic precursors (such as non-isocyanate based polyurethanes). The symposium will focus on the significant developments of innovative green synthesis strategies for polymer materials (e.g. non-isocyanate polyurethanes or polycarbonates), their material performances in key applications such as coatings and hydrogels, and emerging green processing methods including foaming or 3D printing processes. Key is facilitating a rapid transition from basic science to practical deployment fitting the broad range of polymer materials applications. Degradable polymers should include both hydrolytic materials (e.g., poly(phospho)esters, polycarbonates,é) and self-immolative materials (e.g. polythiocarbamates, polythiocarbonates, polyacetals,...). Symposium contributions should address obstacles confronting the development of practical applications from emerging materials. Discussion of synthesis and processing routes; methods to improve properties important for applications; and discussions that advance understanding of fundamental material science issues, especially degradation process and mechanism, are also welcomed. As plastics constitute a strong environmental concern, essential alternative materials are highly desirable. Breakthrough research to achieve applications requirements with degradable materials should be highlighted. This symposium will provide state of the art research on hydrolytically degradable and self-immolative polymer materials for various applications, bringing together scientists and engineers from various disciplines. Opportunities will be identified in the areas of packaging, coatings, cosmetics and medicine. To enable degradable materials, key is materials development and therefore the focus of the symposium is identifying materials for each application that need to exhibit appropriate degradation within required rate ranges and conditions. For instance, in food packaging, materials have to be able to protect the food during storage and then degrade in industrial or home composts conditions, in cosmetics and pharmaceutical formulations, materials have to release encapsulated active ingredients once applied on the skin or absorbed in the body by their controlled degradation rate. Life-cycle assessment of these materials will be another aspect discussed at the symposium. Abstracts will be solicited to cover the different areas of applications.

Topics will include:

- Novel green synthesis routes towards green polymers (e.g. NIPUs, polycarbonates) (water borne formulations,é)
- Polymers from renewable plant-based raw materials
- Design of green polymers for rapidly developing processing technologies (eg 3D printing)
- UV-curable green-polymers floorings and coatings
- Green-polymers or degradable polymers networks and hydrogels
- Design of green-polymer and degradable polymer hybrids
- Sustainable chemical foaming processes
- Hydrolytically degradable polymersð new materials and applications
- Synthesis of self-immolative polymer materials
- Strategies to control polymers degradation / depolymerization rate
- Mechanistic studies of the polymer degradation / depolymerization processes
- Application of degradable / self-immolative polymers in sensing devices, microcapsules, and nanoscale assemblies such as micelles and vesicles
- Material life-cycle analysis

Invited speakers include:

Sylvain Caillol	Universit®de Montpellier, France
Christophe Detrembleur	Universit®de Li¯ge, Belgium
Andrew Dove	University of Birmingham, United Kingdom
Elizabeth Gillies	Western University, Canada
Masami Kamigaito	Nagoya University, Japan
Arjan W Kleij	Institut Catal¨ d'Investigaci· Qu²mica, Spain
Luc Leemans	DSM, Netherlands
Xiao-Bing Lu	Dalian Institute of Technology, Chinese Academy of Sciences, China
Thomas Schaub	BASF, Germany
Andreas Taden	Henkel AG & Co., Germany
John Torkelson	Northwestern University, USA

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Symposium SM11: Design and Analysis of Bioderived and Bioinspired Multifunctional Materials

Over the past century, humankind has enjoyed the consumer convenience and technological advancements enabled by petroleum-based plastics, while at the same time perpetuating the negative consequences of non-degradable plastic wastes after their service life. To increase the sustainability of human society, new strategies for materials synthesis and a focus on renewable resources is needed. To that end, Nature provides abundant raw materials that can be transformed into biodegradable high-performance and multifunctional materials, including cellulose, hemicellulose, lignin, chitin, alginate, and silk, among many others. If these biopolymers can be rationally processed, modified, and designed, they can be used as advanced materials with potential applications as structural and engineering products and with utility in environmental remediation, optical devices, electronic substrates, energy harvesting systems and storage materials, as well as biomedical devices. Furthermore, Nature also offers numerous examples of structural designs that endow materials with exceptional performance, thus providing inspiration for the design of functional materials in concert with sustainable technology. This symposium will provide updates on the state-of-the-art research on the design and analysis of multifunctional materials, structures, and devices that are derived from and inspired by Nature, bringing together scientists and engineers across various disciplines.

Topics will include:

Å Structure-property relationships in bioderived materials, such as cellulose, hemicellulose, lignin, silk and chitin
Å Advanced functionalization, processing, and characterization of bioderived materials
Å Design of high performance (strong, tough, and light-weight) and multifunctional materials from bioderived materials or using bioinspired strategies
Å Design of bio-derived or bio-inspired materials for optical and electronic applications
Å Design of energy harvesting and storage materials and devices from bioderived materials or bioinspired structures

Invited speakers include:

Lars Berglund	KTH Royal Institute of Technology, Sweden
Mark C. Thies	Clemson University, USA
Peter Ciesielski	National Renewable Energy Laboratory, USA
Maneesh Gupta	Air Force Research Laboratory, USA
Liangbing Hu	University of Maryland, USA
Olli Ikkala	Aalto University, Finland
David Kaplan	Tufts University, USA
Haeshin Lee	Korea Advanced Institute of Science and Technology, Republic of Korea
Mark MacLachlan	University of British Columbia, Canada
Phillip Messersmith	University of California, Berkeley, USA
Jin Kim Montclare	New York University, USA
Masaya Nogi	Osaka University, USA
Rojas Orlando	University of British Columbia, Canada
Lars Wagberg	KTH Royal Institute of Technology, Sweden
Guang Yang	Huazhong University of Science & Technology, China
Shu-Hong Yu	University of Science and Technology of China, China

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Symposium SM12: Bioinspired Macromolecular Assembly and Hybrid Materialsð From Fundamental Science to Applications

Living organisms produce a wide variety of complex, nano-, micro-, and macroscale structured functional materials in an energy-efficient and highly reproducible manner, all under rather mild aqueous synthetic conditions. Throughout these processes, specialized biomacromolecules, such as proteins and peptides, enable 1) the hierarchical organization to assemble biomaterials and execute high-level functions; and 2) the precise control over crystal nucleation, growth kinetics, phase transformation, and self-assembly, ultimately giving rise to biominerals with versatile functions. Inspired by nature, numerous approaches have been developed for the design and synthesis of bioinspired materials by using engineered proteins, peptides, DNAs, and other sequence-defined synthetic polymers (e.g. peptoids). These efforts address one of the grand challenges of materials scienceð to design and synthesize functional materials that rival those found in biology.

This symposium will highlight recent developments in the areas of 1) bioinspired macromolecular self-assembly to exploit (bio)macromolecules as building blocks to create hierarchical materials, and 2) biomimetic control over crystallization including a) bioinspired control over inorganic (nano)crystal nucleation and growth, and b) nanoparticle self-assembly and attachment. This symposium will also address 3) the most recent insights obtained in the principles underlying (bio) macromolecular self-assembly and bio-controlled crystal formation (including using *in situ* molecular imaging and computational tools).

Topics will include:

Å Hierarchical assembly of proteins, peptides, peptoids, or other biomimetic polymers into nanostructured materials
Å Biomineralization
Å Bioinspired crystal growth
Å Bio-controlled nanoparticle self-assembly
Å *In Situ* characterization of bioinspired macromolecular self-assembly and bio-controlled inorganic crystal formation
Å Theory driven design of (bio)macromolecules for self-assembly and for controlling inorganic crystal formation
Å Biological applications of soft materials assembled from (bio)macromolecules that includes proteins, peptides, and peptoids

Joint sessions are being considered with **SM09 - Peptide and Protein Design for Responsive Materials**.

Invited speakers include:

David Baker	University of Washington, USA
James De Yoreo	Pacific Northwest National Laboratory, USA
Fabrizio Gelain	Universit¨ degli Studi di Milano-Bicocca, Italy
Habil Hans Bº rner	Humboldt-Universitª t zu Berlin, Germany
Yu Huang	University of California, Los Angeles, USA
Takashi Kato	The University of Tokyo, Japan
David Kisailus	University of California, Riverside, USA
Marc Knecht	University of Miami, USA
Xiang Yang Liu	National University of Singapore, Singapore
Galia Maayan	Technionï Israel Institute of Technology, Israel
Rajesh Naik	Air Force Research Laboratory, USA

Wim Noorduin	AMOLF, Netherlands
Darrin Pochan	University of Delaware, USA
Adrianne Rosales	The University of Texas at Austin, USA
Nathaniel Rosi	University of Pittsburgh, USA
Molly Stevens	Imperial College London, United Kingdom
Samuel Stupp	Northwestern University, USA
Jing Sun	Qingdao University of Science & Technology, China
Akif Tezcan	University of California, San Diego, USA
Shu Yang	University of Pennsylvania, USA
Zhimou Yang	Nankai University, China
Ronald Zuckermann	Lawrence Berkeley National Laboratory, USA

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Symposium SM13: Advances in Membrane and Water Treatment Materials for Sustainable Environmental Remediation

While the past century of water treatment and environmental remediation has been largely influenced by chemical treatments (*e.g.*, chlorination, peroxide, persulfate, ozone), the future of water treatment will be defined by advanced materials innovations. From membrane technologies and adsorbent materials, to photo- and electrocatalysts, materials research is driving new functionalities that are redefining what is possible in treatment and remediation applications. Novel engineered materials are being explored for drinking water, wastewater, industrial process water, and groundwater treatments, to both enable more efficient treatments of conventional contaminants, and provide solutions to emerging contaminants (*e.g.*, microplastics, perfluorinated compounds, algal toxins, pharmaceutical & personal care products). With water concerns closely tied to climate change, sustainability and green chemistry have been important considerations in development of the next generation of water treatment materials. This symposium aims to bring together research leaders for a discussion on the state-of-the-art of materials for water.

Topics will include:

- Membrane science and technology
- Adsorbent materials for aqueous contaminants
- Photocatalysts for water contaminant treatment
- Electrochemical catalysts and materials
- Nanomaterials for water treatment
- Reactive materials (*e.g.*, zero valent iron) for remediation applications
- Biomaterials and biosourced materials for water treatment
- Sustainable or ῝greenὸ materials for water and environmental clean-up
- Materials development directed at emerging contaminants

Invited speakers include:

Rose Amal	University of New South Wales, Australia	**Baoxia Mi**	University of California, Berkeley, USA
Jaie Wei Chew	Nanyang Technological University, Singapore	**Francois Perreault**	Arizona State University, USA
Tai-shung Chung	National Singapore University, Singapore	**Thijs Vlugt**	Delft University of Technology, Netherlands
Carlos Martinez Huitle	Instituto de Qu²mica, Brazil	**Paul Westerhoff**	Arizona State University, USA
David Jassby	University of California, Los Angeles, USA	**Dongyuan Zhao**	Fudan University, China
Gregory Lowry	Carnegie Mellon University, USA	**Julie Zimmerman**	Yale University, USA
Meagan Mauter	Carnegie Mellon University, USA	**Pedro Zlvarez**	Rice University, USA

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Symposium ST01: Mechanical Behavior at Micro/Nano-Scale

The decreasing dimensions of functional and structural materials in micro-electronic devices, large-scale integrated circuits, thin-film solar cells, electrical sensors, and electronic textiles has motivated research on the micro- and nanoscale mechanical behavior of materials. Consequently, understanding the effects of intrinsic and extrinsic length scales on the mechanical properties and deformation mechanisms of micro/nano-scale materials, and tuning their behavior through micro/nanostructure engineering has drawn considerable attention.

This symposium will cover the mechanical behaviors of current and emerging micro/nano-scale materials and composites. Structural micro/nanomaterials and composites have excellent mechanical performance and multifunctional properties, which can be tuned by altering their structural architecture, microstructural features and exploiting material size effects. These materials are of particular interest as lightweight load bearing structures and in functional devices for use in extreme conditions of stress, temperature, pressure and chemical reactivity, such as in space and within living matter. This symposium will include the fundamental mechanical behaviors of individual structures, as well as the deformation of hierarchical composites.

Topics will include:

- Novel methods to tailor the microstructures of micro- and nanoscale materials
- Mechanical and physical properties of micro/nano-scale materials in extreme environments
- Metallic nanocomposites and multilayers
- Characterization and mechanics of interfaces
- *In situ* testing on fracture and fatigue of micro/nano-scale materials
- Integration of micro/nano-scale materials into applications and devices
- Deformation behavior of low-dimensional materials
- Advanced sensors and actuators for measuring mechanical, physical properties of materials

Joint sessions are being considered with **ST02 - *In Situ* Mechanical Testing of Materials at Small Length Scales, Modeling and Data Analysis**.

Invited speakers include:

Irene Beyerlein	University of California, Santa Barbara, USA
Robert Carpick	University of Pennsylvania, USA
Chris Eberl	Fraunhofer Institute for Mechanics of Materials IWM, Germany
David Goldsby	University of Pennsylvania, USA
Khalid Hattar	Sandia National Laboratories, USA
Dongchan Jang	Korea Advanced Institute of Science and Technology, Republic of Korea
Takayuki Kitamura	Kyoto University, Japan
Jessica Krogstad	University of Illinois at Urbana-Champaign, USA

Erica Lilleodden	Helmholtz-Zentrum Geesthacht, Germany
Jun Lou	Rice University, USA
Michael Mills	The Ohio State University, USA
Amit Misra	University of Michigan, USA
Warren Oliver	KLA Corporation, USA
Mitra Taheri	Johns Hopkins University, USA
Joost Vlassak	Harvard University, USA
Yuntian Zhu	North Carolina State University, USA

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Symposium ST02: *In Situ* Mechanical Testing of Materials at Small Length Scales, Modeling and Data Analysis

In Situ small-scale mechanical testing enables new insights into deformation and failure mechanisms of a wide range of materials including bulk materials, monocrystalline materials, thin films as well as low-dimensional materials. The direct observation of deformation phenomena in controlled geometries helps to unravel fundamental deformation processes. In addition, the influence of microstructure features (e.g. grain boundaries, interfaces, dislocation density) or crystal structure (e.g. glide systems, crystal anisotropy, elasticity) on the overall deformation properties of a material can be directly evaluated. Newest experimental techniques allow performing mechanical measurements under controlled external conditions including at high or low temperature, gas environments or under radiation exposure. In addition, advances in deformation devices including MEMS have established new areas such as in situ tribology or in situ fatigue and fracture experiments.

The current session will focus on recent advances in nanomechanical testing, including experimental techniques that allow measurements with high throughput, at variable strain rate or in-operando. A special focus will be set on developments in the field of diffraction and imaging methods that allow to extract quantitative mechanical data from local microstructure components or nano-sized objects under load at high spatial resolution. This includes new detector developments facilitating faster imaging or increased frame rates for diffraction pattern acquisition. New analysis routines including machine learning will be addressed that allow to obtain quantitative information from large datasets. Finally, the session will highlight the comparison of experimental data with results obtained from modelling using MD, DDD and crystal plasticity FE methods.

Topics will include:

Å Fundamental studies in mechanical and indentation testing (crystal plasticity, phase transformations,...)
Å *In Situ* techniques (synchrotron, electron microscopy, light microscopy, é)
Å High throughput small scale testing
Å Geometries for deformation, wear, fatigue and fracture testing
Å Novel preparation methods for micro- and nanoscale objects for small scale testing (FIB, lithography, é)
Å Advances in deformation testing devices including MEMS
Å High temperature and environmental testing
Å High resolution local strain and stress measurement during in situ Deformation
Å Modelling of deformation using MD, DDD and crystal plasticity FE methods

Joint sessions are being considered with **ST01 - Mechanical Behavior at Micro/Nano-Scale**.

Invited speakers include:

Erik Bitzek	Friedrich-Alexander-Universitª t Erlangen-N¿rnberg, Germany
Dan Gianola	University of California, Santa Barbara, USA
Wendy Gu	Stanford University, USA
Yuichi Ikuhara	The University of Tokyo, Japan
Josh Kacher	Georgia Institute of Technology, USA
Sandra Korte Kerzel	RWTH Aachen University, Germany
Subin Lee	Max-Planck Institute for Iron Research, Germany
Marc Legros	Centre dŒlaboration des Mat®riaux et dŒtudes Structurales, France

Andy Minor	University of California, Berkeley, USA
Thomas Pekin	Humboldt-Universitª t zu Berlin, Germany
Rajaprakash Ramachandramoorthy	Empaï Swiss Federal Laboratories for Materials Science and Technology, Switzerland
Ruth Schwaiger	Forschungszentrum J¿lich GmbH, Germany
Zhiwei Shan	Xi'an Jiaotong University, China
Mitra Taheri	Johns Hopkins University, USA
Qian Yu	Zhejiang University, China
Yong Zhu	North Carolina State University, USA

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Symposium ST03: Design, Synthesis and Characterization of Architected Materials for Structural Applications

Architected materials derive their mechanical behavior both from their geometry and the composition of their constituents. The utilization of topological features as a design parameter in architected materials offers new opportunities to create novel materials with unprecedented mechanical properties exceeding the conventional limits. Typical examples include negative Poisson's ratio, pentamode stiffness, negative thermal expansion coefficient, and negative bulk modulus. In order to attain the desired properties to meet the diverse technological demands for various applications, we need to establish a new property-structure-process relationship integrated with geometric contributions.

The specific focus may be placed on the optimal design of architectures, cost-effective synthesis of such architectures, and theoretical and experimental analyses of their behavior under the static and dynamic loading environments. Topics of interest include multi-scale design of architected materials, topology optimization for wide range of applications, synthesis of architectures from various types of base materials, scalable manufacturing of architected materials, multiscale characterization of mechanical responses (experimental and computational), and mechanical and non-mechanical couplings such as light, heat, electricity, etc. This field lies at the cusp between physics, chemistry, engineering, and mathematics, and has broad applications to the fields of mechanics, energy, automotive, aerospace and construction.

Topics will include:

Å Mechanics of architected materials
Å Topology optimization of hierarchical architectures
Å Novel characterization techniques for mechanical and microstructural analysis
Å Multi-scale computation for mechanical analysis
Å Advances in manufacturing including 3D printing, batch and parallel manufacturung techniques
Å Multimaterial architectures and manufacturing
Å Applications of mechanical architected materials
Å 3D weaving and knitting
Å Novel synthesis methods capable of topology control
Å Applications using architected materials- Sensing, Robotics, etc.

Invited speakers include:

In-Suk Choi	Seoul National University, Republic of Korea	**Bas Overvelde**	AMOLF, Netherlands
Vikram Deshpande	Cambridge University, United Kingdom	**Jordan Raney**	University of Pennsylvania, USA
Julia Greer	California Institute of Technology, USA	**Chris Spadaccini**	Lawrence Livermore National Laboratory, USA
Jonathan Hopkins	University of California, Los Angeles, USA	**Lorenzo Valdevit**	University of California, Irvine, USA
Seokwoo Jeon	Korea Advanced Institute of Science and Technology, Republic of Korea	**Martin Wegener**	Karlsruhe Institute of Technology, Germany
Miso Kim	Korea Research Institute of Standards and Science, Republic of Korea	**Rayne Zheng**	University of California, Los Angeles, USA
Erica Lilleodden	Helmholtz-Zentrum Geesthacht, Germany		

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Symposium ST04: High Entropy Materialsð From Fundamentals to Potential Applications

High-entropy materials (HEMs) has become an exciting and vibrant field of materials science as a new generation of materials. The HEM design concept, shifts the focus away from the corners of phase diagrams toward their centers, allows compositions beyond the scope of traditional materials, offering unprecedented properties, challenges and opportunities for a wide range of structural and functional applications. Although we understand HEMs much better today, there are still significant gaps in our knowledge that hinder widespread uses of HEMs. The goal of this symposium is to share the latest research advances in materials with high configurational entropy, including high-entropy and complex concentrated alloys, high-entropy oxides/ nitrides, high-entropy metallic glasses, etc and discuss major materials issues for HEMs from property-targeted design to process optimization, from structures to properties, and from the fundamental science to viable industrial applications. This symposium will cover fundamental theory and data-driven material design, fabrication, processing and microstructure control, such as homogenization, precipitation, nanostructure, and grain-boundary engineering using conventional equipment, combinatorial fabrication, additive manufacturing etc, phase stability and diffusivity under extreme environment, mechanical behavior under different deformation mechanisms, corrosion, physical, magnetic, electric, thermal, coating, and biomedical behavior, advanced characterization, such as synchrotron, three-dimensional atom probe and 4D STEM, computational modeling and simulations, and industrial applications, such as structural, mechanical, biomedical, energy applications. In this symposium, we hope to deepen understanding of why HEMs attract such intensive interest, as well as highlight some challenging issues awaiting resolution to provide viable paths to widespread application and adoption of HEMs.

Topics will include:

- Å Fundamental Theory and Data-driven Design of HEMs
- Å Process Development for Tailor-made Synthesis and Microstructure Control
- Å Phase Transformation (thermodynamics and kinetics) under Extreme Environments
- Å Structural/Mechanical Properteis of HEMs, such as fatigue, creep, and fracture behavior
- Å Dynamic Mechanical Behavior under Different Deformation Mechanisms
- Å Physical, Chemical and Fuctional Properties of HEMs
- Å Intensive Structural Characterization using Cutting-edge Analysis Techniques (e. g. chemical short range ordering)
- Å Theoretical Modeling and Computational Simulations
- Å Inovative Industrial Applications (e.g. Structural Parts, Catalysis and Energy Storage Materials)

Invited speakers include:

Brian Cantor	University of Oxford, United Kingdom
Hyunjoo Choi	Kookmin University, Republic of Korea
Jean-Philippe Couzini®	Institut de Chimie et des Mat®riaux de Paris Est, France
William Curtin	£cole Polytechnique F®d®rale de Lausanne, Swaziland
J¿rgen Eckert	Montanuniversitª t Leoben, Austria
Katharine Flores	Washington University in St. Louis, USA
Annett Gebert	Leibniz Institute for Solid State and Materials Research Dresden, Germany
Julia R. Greer	California Institute of Technology, USA
Liangbing Hu	University of Maryland, USA
Haruyuki Inui	Kyoto University, Japan
Kevin J. Laws	University of New South Wales, Australia

Chain Tsuan Liu	City University of Hong Kong, Hong Kong
Zhaoping Lu	University of Science and Technology Beijing, China
Evan Ma	Johns Hopkins University, USA
Daniel Miracle	Air Force Research Laboratory, USA
Budaraju Srinivasa Murty	Indian Institute of Technology Madras, India
Dierk Raabe	Max-Planck-Institut f¿r Eisenforschung GmbH, Germany
Robert O. Ritchie	Lawrence Berkeley National Laboratory, USA
Benjamin Schuh	Montanuniversitª t Leoben, Austria
Nobuhiro Tsuji	Kyoto University, Japan
Yonggang Yao	University of Maryland, USA
An-Chou Yeh	National Tsing Hua University, Taiwan

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Symposium ST05: Mechanics of Energy Storage Materials

Mechanical behavior of materials is critical to the performance of electrochemical energy storage over multiple length scales from nanoscale to system level. The mechanical properties of materials and devices strongly interplay with chemical, thermal and other material properties in energy storage devices, which collectively determines their performance and robustness, such as cycle life, power density, energy density, and durability against deformation and impact.

In the last few years, we have witnessed a huge wave of fundamental studies in unraveling the mechanical behavior of energy storage materials, and its coupling with chemical, electrochemical and thermal processes. These studies include simulations across multi-scales, transmission electron microscopy and Synchrotron imaging at nanoscale, and mechanical and fatigue analysis at macro-scale. The fundamental understanding has been transformed to exciting progresses in material and device developments, such as new electrode materials with high capacity (e.g. Li, Si), solid state electrolytes and batteries, structural batteries which can also function as structural components, flexible and stretchable batteries, and new cell and pack designs.

The symposium will highlight current progress of advanced experimental and computational methodologies in understanding and improving the mechanical behaviors of electrochemical materials for energy storage and their interaction with other important processes, including but not limited to chemical, electrochemical and thermal processes. It is intended to bring experts from materials science, mechanical engineering, chemistry, and other relevant disciplines to review current state of art and formulate the outstanding research needs and grand challenges for next-generation energy storage technologies.

Topics will include:

- Mechanical behavior of electrode materials in electrochemical processes (e.g. Si, Li, 3d oxide cathodes)
- Electro-mechanical behavior of solid state electrolytes and interfaces
- Structural batteries for light-weighting vehicles and aircrafts
- Mechanical failure of energy storage devices
- Mechano-chemical coupling in battery materials and electrode designs
- Muti-scale computational methods for analyzing mechanical behavior
- Advanced characterization tools for mechanical behavior in energy storage
- Flexible and stretchable batteries

Invited speakers include:

Leif Asp	Chalmers University of Technology, Sweden
Veronica Augustyn	North Carolina State University, USA
Emile Greenhalgh	Imperial College London, United Kingdom
Julia Greer	California Institute of Technology, USA
Jurgen Janek	Justus-Liebig-Universitªt Giessen, Germany
Hee-Tak Kim	Korea Advanced Institute of Science and Technology, Republic of Korea
Ju Li	Massachusetts Institute of Technology, USA
Xin Li	Harvard University, USA
Yijin Liu	SLAC National Accelerator Laboratory, USA

Matthew McDowell	Georgia Institute of Technology, USA
Matt Pharr	Texas A&M University, USA
Yue Qi	Michigan State University, USA
Jeff Sakamoto	University of Michiganï Ann Arbor, USA
Tomasz Wierzbicki	Massachusetts Institute of Technology, USA
Jie Xiao	Pacific Northwest National Laboratory, USA
Xingcheng Xiao	General Motors, USA
Kejie Zhao	Purdue University, USA
Zijian Zheng	Hong Kong Polytechnic University, Hong Kong

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