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November 29–December 2, 2021 | Boston, Massachusetts
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Symposium BI01: Developing an Open Source Introductory Textbook for the Materials Community

The materials community is one of the few in science that does not have an open access textbook for the introduction of our discipline. This symposium is focussed on addressing this need and developing an efficient and continuing process to create a high quality open source electronic textbook that will be vetted by our society along with the other materials societies such as TMS, ACeRs, and ASM. We are planning on inviting top practitioners as well as emerging, young researchers in each of the foundational areas of materials science and engineering.

The main outcomes of this symposium will be to identify small editorial boards for each area and to develop a plan to write the first set of chapters. The vision is to create a server based publishing platform to permit continual updating of the chapters with editorial board oversight. New chapters can be added and expanded as time goes on. An instructor will be able to choose the sections they want and produce a pdf for their students at no cost.

The goal of this symposium is to work towards developing a sophomore level text that covers the fundamental topics that apply to all areas of materials essential to an introductory text. We expect experienced materials educators to set the scope and depth of the material in each area during planned working sessions and then to identify early career materials scientists and engineers to lead the effort for writing and editing the text, examples, worked problems, and other digital content for each topical area. The plan is to not only provide excellent up to date content, but also provide a prestigious platform for early career materials scientists and engineers to build a strong reputation in their fields. We expect that these efforts will be very valued by academic institutions for tenure and promotion decisions as well as advancement at national labs and industry. Furthermore, we expect to have wide participation across all of the materials societies and include broad international participation in this effort.

We welcome talks/posters in any area that is relevant to the development of a textbook, from fundamental content, approaches to developing active learning activities, resources, pitfalls we need to be aware of, design and content of figures, etc. We would also welcome talks about the needs of the international community, industry, or any other interested groups.

Topics will include:

- Vision for an open source materials textbook
- Best practices for open source material
- Needs of the materials community
- Working Group Sessions on: Mathematics, Computation, and Data tools for Materials Education Fundamentals: (Bonding, Structure, Defects, Thermodynamics, and Kinetics), Structural Materials, Soft Functional Materials, EMO Functional Materials, and Characterization of Materials
- Implementation: Editorial Boards, Data Management and Version Control, Copyright, Figures, Drawings, Photographs, etc.
- Resources for an open source text: active learning modules, computational tools, virtual reality tools, individual and teach based problem sets, video, animation, and other resources

Invited speakers include:

Scott Beckman	Washington State University, USA	**Angus Rockett**	Colorado School of Mines, USA
Amy Clark	Colorado School of Mines, USA	**Anton Van Der Ven**	University of California, Santa Barbara, USA
Michael Falk	Johns Hopkins University, USA	**Stan Whittingham**	Binghamton University, The State University of New York, USA

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Symposium BI02: Women in Materials Science—Pioneers and a Vision for a More Inclusive Future

This symposium will cover recent advances and innovations in materials science and engineering contributed by women researchers spanning academia, national labs and industry. Speakers will present their research addressing a range of topics from the future of energy and catalysis to soft matter and biomaterials, nanoscience and technologies, and beyond. In addition, speakers are encouraged to share their personal experiences to unveil the historical and current challenges faced by women in science, technology, engineering and mathematics (STEM) fields, as well as the positive changes leading to expanding opportunities and improved work-life balance. Though focused on women, we anticipate the topics addressed here will resonate with all genders and ultimately impact all who pursue demanding careers in STEM. This symposium aims to bring together researchers at all career stages and from different backgrounds whose work exemplifies cutting-edge science and engineering and whose personal paths show the way for future generations to continue to break remaining biases and foster a scientific environment with better gender diversity, equity, and inclusive engagement. The multi-disciplinary topics covered in this symposium will prompt cross-talks and collaborations between researchers with different backgrounds and expertise. Individual stories shared by the speakers will also inspire researchers at different critical stages of career development. In addition to topic-focused technical sessions, the symposium will feature a panel discussion that will include technical leaders, as well as contributors from the social sciences who have studied gender issues from a broader context and can provide insight in terms of historical trends, unconscious gender bias, the unexpected benefits of gender (and other) diversity in the workplace, etc.

Topics will include:

- Scientific research led by female researchers related to materials science and beyond (50-70%)
- Challenges and strategies to achieve work-life balance.
- Career and professional development for scientists and engineers at different career stages.
- Policies and approaches to break the biases and close the gender gap in STEM.

Invited speakers include:

Kathy Ayers	Nel Hydrogen, USA
Zhenan Bao	Stanford University, USA
Mei Cai	General Motors, USA
Jennifer Dionne	Stanford University, USA
Judith Driscoll	University of Cambridge, United Kingdom
Julia R. Greer	California Institute of Technology, USA
Clare Grey	University of Cambridge, United Kingdom
Sossina Haile	Northwestern University, USA
Kelsey Hatzell	Princeton University, USA
Sohee Jeong	Sungkyunkwan University, Republic of Korea
Cherie Kagan	University of Pennsylvania, USA
Y. Shirley Meng	University of California, San Diego, USA
Delia Milliron	The University of Texas at Austin, USA
Mihri Ozkan	University of California, Riverside, USA
Nicola Spaldin	Swiss Federal Institute of Technology in Zurich, Switzerland
Molly Stevens	Imperial College London, United Kingdom
Vanessa Wood	ETH Zürich, Switzerland
Haimei Zheng	Lawrence Berkeley National Laboratory, USA

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Symposium CH01: *In Situ* and *Operando* Techniques Applied to Electrochemical Systems—A Key Toolkit for Deep Understanding

The increase of global Earth's temperature is linked generally to greenhouse gas emission that never ceased to increase during the last century. E-mobility and storage are the leitmotif to reduce directly the amount of CO(2) emission. In both cases, batteries might play a key role to reduce the greenhouse emission. To date, Li and post-Li ion batteries are intensively studied and their deep investigations by sophisticated techniques, in particular *operando*, are crucial to solve all the issues. Data gathered from advanced *operando* techniques, at large scale facilities or in-house, are crucial only if they are obtained from reliable electrochemical cells that mimic properly the real operation of battery materials, which is never an easy task. Hence, the design of such cells has to be fit to the technique of choice and meet all the necessary requirements. Once a proper design is found, the surface, the bulk, the interfaces, and finally the combination of those can be studied simultaneously and lead to the elucidation of complex reaction mechanisms, thus further improving the battery technology. This symposium will focus on the current progress made in the field of advanced *in situ* and *operando* characterizations (experimentally and theoretically) with a special focus on the understanding and improvement of bulk-to-interfacial issues including also safety aspects. Worldwide specialists will present new science, techniques, data analysis and propose a deeper understanding of electrochemical energy-based system beyond the state-of-the-art.

Topics will include:

- Electrochemical energy processes
- Batteries, supercapacitors, Li-ion batteries and post-Li ion batteries
- *In Situ* and *Operando* based techniques at large scale facilities and in house
- X-ray and neutron-based methods
- Special electrochemical cell design
- Data processing, machine learning and data analytics

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

Invited speakers include:

Daniel Abraham	Argonne National Laboratory, USA
Hajime Arai	Tokyo Institute of Technology, Japan
Erik Berg	Uppsala University, Sweden
Jordi Cabana	University of Illinois at Chicago, USA
Montse Casas Cabanas	CIC energiGUNE, Spain
Isodora Cekic-Laskovic	Forschungszentrum Jülich GmbH, Germany
Karena Chapman	Stony Brook University, The State University of New York, USA
Miaofang Chi	Oak Ridge National Laboratory, USA
Jean-Noël Chotard	Université de Picardie Jules Verne, France
Raphaële Clément	University of California, Santa Barbara, USA
Jakub Drnec	European Synchrotron Radiation Facility, France
Helmut Ehrenberg	Karlsruhe Institute of Technology, Germany
François Fauth	ALBA Synchrotron, Spain
Gillian Goward	McMaster University, Canada
Clare Grey	University of Cambridge, United Kingdom
Kent Griffith	Northwestern University, USA
Laurence Hardwick	University of Liverpool, United Kingdom
Brett Lucht	University of Rhode Island, USA
Sandrine Lyonnard	Commissariat à l'énergie atomique et aux énergies alternatives, France
Ingo Manke	Helmholtz-Zentrum Berlin, Germany
Aleksandar Matic	Chalmers University of Technology, Sweden
Vanessa Peterson	Australian Nuclear Science and Technology Organisation, Australia
Yang Shao-Horn	Massachusetts Institute of Technology, USA
Neeraj Sharma	University of New South Wales, Australia
Paul Shearing	University College London, United Kingdom
Lorenzo Stievano	Université de Montpellier, France
Emmanuelle Suard	Institut Laue-Langevin, France
Marnix Wagemaker	Delft University of Technology, Netherlands
Huolin Xin	University of California, Irvine, USA
Wolfgang Zeier	Justus-Liebig-Universität Giessen, Germany

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Symposium CH02: Solid-State Chemistry of New Materials

Chemistry plays a central role in the development and characterization of new inorganic materials. From developing synthetic techniques that make new families of materials available to elucidating fundamental correlations between the crystal structure and functionality, solid state chemistry unifies researchers across several disciplines. This symposium will explore these diverse fields with a special focus on how the underlying chemistry of new materials dictates their physical properties. These sessions will provide a forum where experimental and computational materials chemists can discuss the current state-of-the-art in materials design and characterization. Contributions that use detailed structure and property characterization are encouraged, particularly when supported by electronic structure calculations.

Topics will include:

- Photocatalysis
- Solid state lighting
- Hydrogen production
- Crystal chemistry
- X-ray and neutron scattering
- Thermoelectrics
- Dielectrics, ferroelectrics, and multiferroics

Joint sessions are being considered with **EQ13 - Nitride Materials—Synthesis, Characterization and Modeling**.

Invited speakers include:

Ryu Abe	Kyoto University, Japan
Kanishka Biswas	Jawaharlal Nehru Centre for Advanced Scientific Research, India
Eric Bloch	University of Delaware, USA
Laurent Cario	Institut des Matériaux Jean Rouxel, France
Laurence Croguennec	Institut de Chimie de la Matière Condensée de Bordeaux, France
Michele Dolgos	University of Calgary, Canada
Richard Dronskowski	RWTH Aachen University, Germany
Duncan Gregory	University of Glasgow, United Kingdom
Shintaro Ishiwata	University of Tokyo, Japan
Kim Jelfs	Imperial College London, United Kingdom
Houria Kabbour	University of Lille, France
Hemamala Karunadasa	Stanford University, USA
Sung-Wng Kim	Sungkyunkwan University, Republic of Korea
Yoji Kobayashi	Kyoto University, Japan
Kirill Kovnir	Iowa State University, USA
Antoine Maignan	ENSICAEN, France
Jarad Mason	Harvard University, USA
James Neilson	Colorado State University, USA
Ryo Ohtani	Kyushu University, Japan
Wendy Queen	École Polytechnique Fédérale de Lausanne, Switzerland
James Rondinelli	Northwestern University, USA
Kate Ross	Colorado State University, USA
Kimberly See	California Institute of Technology, USA
Natalia Shustova	University of South Carolina, USA
Sara Thoi	Johns Hopkins University, USA
Sayaka Uchida	The University of Tokyo, Japan
Luisa Whittaker-Brooks	The University of Utah, USA
John Wiley	The University of New Orleans, USA
Taner Yildirim	National Institute of Standards and Technology, USA

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Symposium CH03: Frontiers in Scanning Probe Microscopy—Beyond Imaging of Soft Materials

Scanning Probe Microscopy (SPM) is one of the major tools responsible for the emergence of novel soft functional materials and the characterization of their physical properties at the nanoscale. For the last years, we have witnessed a further proliferation of SPM in many areas of research: SPM helps to solve various materials challenges in the fields of energy harvesting, organic electronics, biosensors, self-assembly, biotechnology, life sciences, and medical applications. The number of advanced SPM techniques that become commercially available these days keeps growing extremely fast. Many recent results are exciting and generally accepted but some are treated as controversial yet. The amount of collected observables is also increasing and machine learning processes (such as data clustering or Artificial Intelligence) are now mature to analyze the data ideally user-independent.

The main objective of the symposium is to offer an international forum to share research with worldwide leading scientists active in the field of scanning probe microscopy on soft and polymeric (bio)materials, as well as with industrial colleagues to discuss the potential of novel SPM techniques and to promote and discuss existing SPM methods applied to solve new problems. To attain this objective, a broad discussion of experts in different areas of material sciences and engineering, biophysics, condensed matter, and instrumentation development is needed. It is expected that the interdisciplinary nature of this symposium will attract strong participation from both academia and industry in the multidisciplinary environment of MRS meetings.

The series of symposiums on SPM techniques organized within the framework of the MRS over the last decade has been extremely successful in bringing together international leaders in both academia and industry and attracting the great interest of young researchers and students.

Topics will include:

- Nano-mechanical properties of soft materials (acquisition and analysis)
- Modelling of the tip/sample interactions
- Force measurements at surface/interface
- Novel SPM designs and new measurement methods
- Mapping at the nanoscale of the mechanical (and viscoelastic) properties of materials (polymer blends, nanocomposites, hydrogels, biopolymers, …) cells and viruses
- Mechanical manipulation of single molecules
- Novel methodologies for the acquisition of the observables
- Novel methodologies/processes for the data analysis including advanced statistics and machine learning
- Nanodielectrics
- Piezoelectric and flexoelectric organic based materials (polymers, composites)
- High speed and high-resolution SPM
- Combined multimodal SPM (Raman, IR, …)
- Towards industrial, biological, and medical applications

Invited speakers include:

Wojciech Chrzanowski	University of Sidney, Australia	**Takaharu Okajima**	Hokkaido University, Japan
Liam Collins	Oak Ridge National Laboratory, USA	**Bede Pittenger**	Bruker Corporation, USA
Sonia Contera	Oxford University, United Kingdom	**Roger Proksch**	Oxford Instruments, USA
Greg Haugstad	University of Minnesotta, USA	**Franceso Simone Ruggeri**	Wageningen University & Research, Netherlands
Jason Killgore	National Institute of Standards and Technology, USA	**Xiaoji Xu**	Lehigh University, USA
Malgorzata Lekka	Institute of Nuclear Physics Polish Academy of Sciences, Poland		

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Symposium CH04: Accelerating Materials Characterization, Modeling, and Discovery by Physics-Informed Machine Learning

Machine learning methods are making rapid inroads into all fields of science, driven by data volumes, computational resources, and utility of the methods at finding correlations in high dimensional spaces. Both methods (algorithms) and infrastructure (combinatorial and high-throughput experimentation, high-performance computing, databases, data-management systems, workflows, repositories) are being developed to both create and tackle the large increase in data volume, facilitating the leap from single lab-based experiment-computation-output models to one where researchers can utilize available public materials data infrastructure, leading to new materials discoveries, enhanced predictive capabilities, and accelerated scientific understanding.

This symposium will bring together the latest advances in the development and application of machine learning and related data analytics methodologies to enhance the characterization of materials, extract relevant features for improving theory-experiment comparisons, and assist in solving inverse problems relevant to structural and functional characterization.Further, it will encompass robust uncertainty quantification approaches, such as the use of Bayesian methods for challenging characterization and prediction tasks and enabling automated experimentation, as well as discuss methods that extend beyond traditional correlative machine learning methods towards causal inference to better understand drivers of materials' behaviors.

Topics will include:

- High-throughput materials synthesis for the generation of large and consistent datasets
- High-throughput characterization and computations for materials discovery
- New techniques and methods enabled by machine learning approaches for probing and characterizing the structural, chemical and/or electronic nature of materials
- Bridging computation and experimental data via machine learning and statistical methods, including solving inverse problems, feature extraction and selection, and materials design
- Materials data infrastructure – databases, data-management systems, workflows and best practices for 21st century materials science
- Causal inference and Bayesian models for incorporating prior information, model selection, and uncertainty quantification
- Reinforcement learning and Gaussian process methods for automated experimentation, materials design, synthesis and characterization

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

Invited speakers include:

Alan Aspuru-Guzik	University of Toronto, Canada	**Sergei Kalinin**	Oak Ridge National Laboratory, USA
Keith Butler	Rutherford Appleton Laboratory, United Kingdom	**Julia Ling**	Citrine Informatics, USA
Stefano Curtarolo	Duke University, USA	**Elsa Olivetti**	Massachusetts Institute of Technology, USA
Claudia Draxl	Humboldt-Universität zu Berlin, Germany	**Kristin Persson**	University of California, Berkeley, USA
Nicola Ferrier	Argonne National Laboratory, USA	**Rampi Ramprasad**	Georgia Institute of Technology, USA
Adam Forster	Aalto University, Finland	**Matthias Scheffler**	Fritz Haber Institute of the Max Planck Society, Germany
John Gregoire	California Institute of Technology, USA	**Lenka Zdeborova**	Commissariat à l'énergie atomique et aux énergies alternatives, France
Elizabeth Holm	Carnegie Mellon University, USA		

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Symposium DS01: Accelerating Experimental Materials Research with Machine Learning

In almost all areas of materials research, reliable knowledge can only be gained by performing experiments. In these areas, the pace at which knowledge gained is highly dependent upon both the rate at which experiments can be completed and the choice of which experimental conditions to probe. Recently, machine learning and automation have become major players in both of these areas by accelerating the pace of experiments and choosing experiments in a manner that ensures the generation of new knowledge. While these approaches have already provided breakthroughs in fields ranging from nanomaterial growth, electronic property selection, and mechanical structure design, they have also unified a community of researchers through the uncovering of new challenges unique to these novel human-machine partnerships. While this community includes both active learning systems in which experiments are chosen and interpreted by machine learning, and autonomous research systems in which experiments are also performed without human intervention, all systems have to address challenges regarding structuring the machine learning process, providing prior knowledge, incorporating uncertainty, and fruitfully leveraging the human-machine partnership. The symposium will highlight achievements and challenges from these fields of active and autonomous research ranging from the presentation of new materials discoveries made using such platforms to fundamental innovations in the development of machine-learning guided experiments.

Topics will include:

- Materials discoveries made using autonomous research systems
- Materials discoveries made using machine learning guided experiments (active learning)
- Comparisons of conventional high-throughput experimentation and active learning
- Benchmarking methods for quantifying efficacy of active learning methods
- Generality vs. specificity in terms of experimental platform development, including hardware, software, and ontologies
- Virtues and limitations of Bayesian optimization and the role of decision-making policies
- When is property vs knowledge maximization a false dichotomy and when is it a necessity
- Uncertainty quantification and propagation for machine learning modeling of physical process
- Accommodating modeling systematic uncertainty
- Automated physical modeling and scientific learning
- Automatable infrastructure including hardware/software and distributed systems
- Human-Machine partnering in Materials Research including visualization tools for active learning
- Limitations of Gaussian Processes in describing materials systems
- Transfer learning, multiple-information source optimization, and contributions from simulation

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

Invited speakers include:

Milad Abolhasani	North Carolina State University, USA	**Amanda Krause**	University of Florida, USA
Alan Aspuru-Guzik	University of Toronto, Canada	**Benji Maruyama**	Air Force Research Laboratory, USA
Christoph J. Brabec	University of Erlangen, Germany	**Elsa Olivetti**	Massachusetts Institute of Technology, USA
Tonio Buonassisi	Massachusetts Institute of Technology, USA	**Kristin Persson**	University of California, Berkeley, USA
John Gregoire	California Institute of Technology, USA	**Kris Reyes**	University at Buffalo, The State University of New York, USA
Jason Hattrick-Simpers	National Institute of Standards and Technology, USA	**Helge Stein**	Karlsruhe Institute of Technology, Germany
Jason Hein	The University of British Columbia, Canada	**Ichiro Takeuchi**	University of Maryland, USA
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Symposium DS02: Advanced Atomistic Algorithms in Materials Science

The symposium will focus on recent advances in algorithm development of novel atomistic simulation methodologies, both at the level of electronic structure calculations and of empirical-potential-based simulations, and on their applications. The symposium will be centered on methods that aim at addressing size and time-scale limitations of conventional techniques, two problems that often severely limit the scope of atomistic simulations in materials science. As a first-principle method, density functional theory (DFT) has become an invaluable tool for materials modeling. However, with conventional implementation of Kohn-Sham DFT, one is usually limited to systems containing at most several hundred atoms. In recent years, tremendous progress towards relaxing the time and lengthscale limitations has been made in the DFT community. This symposium will address these new exciting advances in DFT such as orbital-free DFT, time-reversible ab-initio molecular dynamics, quasi-continuum DFT, hybrid quantum/classical modeling and machine learning approaches. At the other end of the spectrum, Molecular Dynamics (MD) algorithms based on empirical or semi-empirical potentials allow for greatly extended simulation sizes and times. However, these traditional algorithms are not suitable to study long time phenomena, such as defect diffusion, as they become communication bound. In systems where the dynamics is activated, advanced simulation techniques, such as accelerated molecular dynamics and kinetic Monte Carlo methods, can be leveraged to extend the simulation times up to experimentally relevant scales. These methods often provide invaluable insight into the microstructural evolution of materials. The symposium will focus on recent advances in the development of these accelerated techniques, such as adaptive KMC methods, and on the new physics that can be learned as the timescale horizon is pushed further. Atomistic to continuum approaches and their recent coupling with accelerated MD models, and the phase field crystal method are promising methodologies under development with the potential of extending the time and size scales of the atomistic systems under consideration. Another active field of research is the development of accurate and efficient interatomic potentials based on Machine Learning approaches, which combined with accelerated MD, KMC or Quasi-continuum methods provide powerful tools to study materials behavior.

Topics will include:

- Addressing size and time limitations in DFT-based methods - Orbital-free DFT, Time-reversible Ab-Initio Molecular Dynamics, Quasi-continuum DFT and hybrid quantum/classical modeling, and Adaptive kinetic Monte Carlo
- Long-time atomistic simulation methods - Accelerated Molecular Dynamics, Adaptive kinetic Monte Carlo and Acceleration techniques for Kinetic Monte Carlo
- Atomistic-Continuum Approaches - Linking scales (Quasi-Continuum and related developments), Accelerated methods coupled to quasicontinuum approaches and Phase Field Crystal methods
- Machine Learning Interatomic Potentials - Development and Combination with accelerated methods

Invited speakers include:

Manuel Athenes	Commissariat à l'énergie atomique et aux énergies alternatives, France
Livia Bartók-Pártay	The University of Warwick, United Kingdom
Laurent Beland	Queen's University, USA
Youping Chen	University of Florida, USA
William Curtin	École Polytechnique Fédérale de Lausanne, Switzerland
Claudia Draxl	Humboldt-Universität zu Berlin, Germany
Kristen Fichthorn	The Pennsylvaia State University, USA
Vikram Gavini	University of Michigan, USA
Hannes Jonsson	University of Iceland, Iceland
Steven Kenny	Loughborough University, United Kingdom
James Kermode	The University of Warwick, United Kingdom
Tony Lelievre	École des Ponts ParisTech, France
Ju Li	Massachusetts Institute of Technology, USA
Laura J.S. Lopez	Los Alamos National Laboratory, USA
Gang Lu	California State University, Northridge, USA
Mitchell Luskin	University of Minnesota, USA
Manon Michel	Clermont Auvergne University, France
Yuri Mishin	George Mason University, USA
Marco Nardelli	University of North Texas, USA
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Christoph Ortner	The University of Warwick, United Kingdom
Danny Perez	Los Alamos National Laboratory, USA
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Symposium DS03: Combining Machine Learning with Simulations for Materials Modeling

The advent of high-speed computation has significantly accelerated the materials modeling and simulation paradigm in the past few decades. These simulations cover wide length-and time-scales using ab-initio first principle, atomistic, mesoscale, and continuum simulations. Despite the economical nature of the simulations in comparison to experiments, they still suffer from the major deficiencies, namely, limitations on the systems size, simulation time, accuracy of simulations, transferability of a simulation to different scenarios, to name a few. For example, while first principle simulations can provide accurate predictions on the material response to the electronic level, they are limited to a few hundreds of atoms. Recently, machine learning has shown promising means to address some of these challenges successfully. Some of these developments include machine-learned interatomic potentials, physics-informed neural networks, convolutional neural network based microstructure modeling, and graph neural networks for structure–property correlations. This symposium will highlight the latest development in machine learning for simulations with specific focus in three major areas: (i) supporting and accelerating simulations using machine learning (for example, machine learned potentials), (ii) interpreting and decoding simulations and high-throughput data using machine learning, (iii) replacing traditional differential equation-based simulations with machine-learned simulations.

Topics will include:

- Development of machine learned inter-atomic potentials
- Physics-informed machine learning models for materials simulation
- Graph neural networks for material modeling
- Development of realistic material models using image processing
- Transfer learning for material modeling
- Topology optimization using machine learning
- Reduced order machine learning models for atomistic simulations
- Development of tailored microstructure using machine learning
- Machine learning for continuum simulations
- Using natural language processing for materials modeling
- Active learning-based hybrid simulations
- Inferring material descriptors from simulations through machine learning

Invited speakers include:

Jörg Behler	Georg-August-Universität Göttingen, Germany
Markus Buehler	Massachusetts Institute of Technology, USA
Michelle Ceriotti	École Polytechnique Fédérale de Lausanne, Switzerland
Mathew Cherukara	Argonne National Laboratory, USA
Jacqueline Cole	University of Cambridge, United Kingdom
Ekin Cubuk	Google Brain, USA
Marivi Fernández-Serra	Stony Brook University, The State University of New York, USA
Shirley Ho	Flatiron Institute, USA
James Kermode	University of Warwick, United Kingdom
Heather Kulik	Massachusetts Institute of Technology, USA
Kristin Persson	University of California, Berkeley, USA
Abhishek Singh	Indian Institute of Science, Bengaluru, India
Yizhou Sun	University of California, Los Angeles, USA

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Symposium EN01: Materials for Sustainable Electronics

A strategic goal of social development is an increasing use of resources. Key for the future is a sustainable use of these resources, which ultimately requires a non-destructive resource lifecycle. Although complete recycling is impossible from the entropy point of view, the nearly "inexhaustible" combination of solar, wind and geothermal energy sources can be the driver for sustainability for the foreseeable future. This will facilitate the evolution of a true circular economy. However, this still leaves significant materials research needs, required to be able to access and use the energy sources and make them truly sustainable, as well as for the systems that use that energy. To truly realize the circular economy given the complex interplay of materials, electronics and energy makes 100% recycling a true challenge. This will demand a development of new materials and technology designed up front with this in mind.

Condition to be met by such materials include increasing the percent of recyclability, minimizing peripheral waste all through the manufacturing processes and to extend lifetimes for end products made with the materials. Such goal can be achieved by using sturdier materials, self-repairing materials, programmable self-destroying and recyclable materials, where all options need to continue to allow for innovation and dynamics in technology development. At the next level, materials combinations must be chosen that minimize unwanted chemical and non-chemical processes. Importantly, materials combinations and devices need to be designed for high yield, minimal environmental impact and end-of-life component & material separation and recycling.

Topics will include:

- Programmable lifetime materials
- Defect chemistry
- Recyclable composition design
- Electronics in extreme environments and accessing new processing environments
- Composite hybrid materials with new functionality, designed for recyclability
- Develop and apply methods to measure and identify emerging and legacy chemicals in plastic and organic products and waste stream and recycling material flows
- Seek safer substitute chemicals for materials manufacturing and processing
- Understand toxicity of materials and chemical additives to humans and ecosystems
- Analysis of materials as contaminants in wastewater treatment plants and landfills.

Joint sessions are being considered with **SB02 - From Hydrogel Fundamentals to Novel Applications via Additive Manufacturing**.

Invited speakers include:

Gregg Beckham	National Renewable Energy Laboratory, USA	**Satyajit Majumdar**	Tata Institute of Social Sciences, India
Allison Beese	The Pennsylvaia State University, USA	**Toru Okabe**	The University of Tokyo, Japan
Fenna Blomsma	Technische Universität Denmark, Denmark	**Elsa Olivetti**	Massachusetts Institute of Technology, USA
Michael Braungart	Lueneburg Leuphana University, Germany	**Armin Reller**	Universität Augsburg, Germany
Peter Fiske	Lawrence Berkeley National Laboratory, USA	**Veena Sahajwalla**	The University of New South Wales, Australia
Martin Geissdoerfer	University of Cambridge, United Kingdom	**Bill Tumas**	National Renewable Energy Laboratory, USA
Oliver Gutfleisch	Technische Universität Darmstadtt, Germany	**John Warner**	University of Massachusetts, USA
Igor Lubomirsky	Weizmann Institute of Science, Israel	**Naoko Yoshie**	The University of Tokyo, Japan

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Symposium EN02: Solid-State Batteries—Electrodes, Electrolytes and Interphases

Rechargeable batteries have succeeded in powering portable electronics and small electric tools, but they face the challenges of safety, cost, and energy density for the needs of electrification of transportation and large-scale energy storage. With the energy density of the conventional lithium ion batteries approaching its physicochemical limit, tremendous efforts are being made to revive solid state batteries that can potentially offer high safety, high energy density and high power density. Over the past few years, there have been significant efforts to understand and address the key challenges in each component of solid-state batteries, including solid electrolytes, cathode composites, lithium metal anodes, and electrode/electrolyte interphases. Meanwhile, good progress has also been made in understanding the failure mechanisms of solid-state batteries with the aid of advanced characterization techniques and computation/modeling. However, key challenges remain unsolved for the full-scale commercialization of solid-state batteries including materials, interfaces, characterization, manufacturing, etc.

The aim of the symposium is to highlight and discuss recent advances in fundamental materials science that focuses on solid state batteries. This symposium covers materials discovery and innovation (electrolytes, electrodes, and interphases), device integration, advanced characterizations, and predictive computation and modeling. The symposium will promote a multi-disciplinary approach to understand the degradation mechanism of SSBs and to develop safer and more reliable batteries for various applications.

Topics will include:

- Interfaces and Interphases
- Solid Electrolytes
- Cathode Composites
- Li Anodes
- Cell Architecture and Fabrication
- Advanced Characterization
- Computational Modeling and Design

Invited speakers include:

Javier Carrasco	CIC energiGUNE, Spain
Neil P. Dasgupta	University of Michigan, USA
Nancy Dudney	Oak Ridge National Laboratory, USA
Kelsey B. Hatzell	Vanderbilt University, USA
Akitoshi Hayashi	Osaka Prefecture University, Japan
M. Saiful Islam	University of Bath, United Kingdom
Yoon Seok Jung	Yonsei University, Republic of Korea
Hong Li	Institute of Physics, Chinese Academy of Sciences, China
Ping Liu	University of California, San Diego, USA
Dongping Lu	Pacific Northwest National Laboratory, USA
Steve Martin	Iowa State University, USA
Matthew T. McDowell	Georgia Institute of Technology, USA
Y. Shirley Meng	University of California, San Diego, USA
Linda Nazar	University of Waterloo, Canada
Yue Qi	Brown University, USA
Andy Xueliang Sun	University of Waterloo, Canada
Eric D. Wachsman	University of Maryland, USA
Marnix Wagemaker	Delft University of Technology, Netherlands
Chunsheng Wang	University of Maryland, USA
Donghai Wang	The Pennsylvaia State University, USA
Yan Wang	Samsung Research America, USA
Jihui Yang	University of Washington, USA
Xiayin Yao	Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences, China
Yan Yao	University of Huston, USA
Wolfgang Zeier	Justus-Liebig-Universität Giessen, Germany
Pu Zhang	Solid Power, USA

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Symposium EN03: Thermal Materials, Modeling and Technoeconomic Impacts for Thermal Management and Energy Application

This symposium will broadly cover current and emerging thermal materials, with aspects bridging fundamental understanding of materials' thermal properties to applications. The symposium will focus on emerging materials and systems for solar thermal, thermophotovoltaic, thermoelectric, thermo-electrochemical, thermo-acoustic, thermo-ferroelectric, and thermo-magnetic energy harvesting, storage, and multiscale (from nano to macro) materials with extreme thermal conductivity for thermal management. Discussions include both the experimental and theoretical aspects, such as rational design, synthesis, fabrication processes, property optimization and external field control, modelling of material thermal properties, including new fundamental science breakthroughs.

Broad Impacts: This symposium will present state-of-the-art research on thermal materials, device, and theory for various applications, bringing together scientists and engineers from various disciplines and diverse backgrounds, as well as women and minority researchers. We will also coordinate a tutorial session on thermal materials to educate a more general MRS audience. Student awards will be organized to facilitate younger researcher participation in this symposium. The symposium will bring exciting opportunities in the education and training of the next generation of materials researchers, public outreach, career and professional development, impact of materials research on the global economies, and efforts to broaden diversity and inclusion of underrepresented groups.

Topics will include:

- Thermal energy storage materials
- Emerging high thermal conductivity materials
- Thermal interface materials and thermal boundary resistance
- Phononic, thermochromic, thermal-mechanical, and -acoustic metamaterials
- Advanced techniques for measurements of thermal properties
- Thermal management of electronics and photonics
- Thermoelectric and thermophotovoltaic energy conversion
- Radiative cooling and thermal radiation in the near-field or involving sub-wavelength objects such as metamaterials
- Modelling and simulations of thermal transport from atomic scale to micrometer scale
- Machine learning for phonon transport and thermal materials discovery

Joint sessions are being considered with **EN10 - Advanced Materials for Thermal Energy Management and Harvesting**.
Also, a **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in September.

Invited speakers include:

David Cahill	University of Illinois at Urbana-Champaign, USA
Gang Chen	Massachusetts Institute of Technology, USA
Renkun Chen	University of California, San Diego, USA
Chris Dames	University of California, Berkeley, USA
Timothy Fisher	University of California, Los Angeles, USA
Kenneth Goodson	Stanford University, USA
Samuel Graham	Georgia Institute of Technology, USA
Olle Hellman	Linköping University, Sweden
Asegun Henry	Massachusetts Institute of Technology, USA
Kedar Hippalgaonkar	Nanyang Technological University, Singapore
Bolin Liao	University of California, Santa Barbara, USA
Jonathan Malen	Carnegie Mellon University, USA
Alan McGaughey	Carnegie Mellon University, USA
Ravi Prasher	Lawrence Berkeley National Laboratory, USA
Ali Shakouri	Purdue University, USA
Li Shi	The University of Texas at Austin, USA
Junichiro Shiomi	The University of Tokyo, Japan
Avi Shultz	Office of Energy Efficiency & Renewable Energy, USA
G. Jeffrey Snyder	Northwestern University, USA
Zhiting Tian	Cornell University, USA
Jeffrey Urban	Lawrence Berkeley National Laboratory, USA
Sebastian Volz	Institute of Industrial Science, The University of Tokyo, France
Evelyn N. Wang	Massachusetts Institute of Technology, USA
Xiaojia Wang	University of Minnesota, USA
Junqiao Wu	University of California, Berkeley, USA
Xianfan Xu	Purdue University, USA
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Symposium EN04: Silicon for Photovoltaics

Silicon has enjoyed an enduring majority share of the terrestrial photovoltaic market. Despite the apparent maturity of this technology, the last five years have seen a string of efficiency records in mono- and multi-crystalline cells, perovskite/silicon and III-V/silicon tandems, as well as mono- and bi-facial modules. These improvements have relied on innovations in materials science at the cell and module level that further increased yield, reduced cost and extended reliability. To maintain this trend, sustained material research in key and emerging areas along the value chain is vital, including: (*i*) understanding and mitigation of bulk absorber material defects and the exploration of new silicon-based absorbers; (*ii*) development of carrier-selective, passivating contact layers and interfaces for high voltage devices; (*iii*) high efficiency device concepts including multi-junction solar cells, advanced light trapping and metallization schemes, as well as 3rd generation concepts relevant to silicon photovoltaics; and (*iv*) silicon PV module and integrated system related material research including reliability, stability and recycling. The *Silicon for Photovoltaics* symposium focuses on these topics but more generally seeks to encompass any materials research with the potential to advance silicon photovoltaics.

Topics will include:

- Absorbers—Research focused on the development of new silicon-based absorbers that could offer higher absorption, bandgap tunability and/or lower bulk recombination, such as silicon-germanium and barium-disilicide. Alternative absorber fabrication methods such as layer separation/transfer, epitaxial wafer processes, and silicon nanowire/nanocrystal growth techniques for photovoltaic applications. Research related to bulk silicon defects analysis, gettering, bulk hydrogenation, and lifeti
- Surface Passivation and Passivating Contacts—Research exploring new material systems or improvements in performance of existing passivated contacts such as those based on amorphous and polycrystalline silicon, as well as metal oxides, fluorides etc. Innovative deposition techniques and doping methods, contact hydrogenation, and new functionalities (temperature stability) of passivated contacts. Characterization and modeling of the structural, mechanical, electrical, and optical properti
- High Efficiency Device Concepts—Contributions towards improved silicon cell performance, including the development of novel photon management strategies (e.g. advanced surface textures, up- and down-conversion), new metallization technologies, and back-contacted or other novel device architectures. Development in multi-junction architectures featuring silicon as one of the absorbers (e.g. III-V/Si or Perovskite/Si tandems).
- Module and System—Advancement of module- and integrated system-related material aspects ranging from the interconnection and encapsulation of silicon solar cells to optical design of silicon modules. Integration of silicon modules into systems (e.g. PV-battery interface, building integration, vehicle integration) and recycling strategies.

Joint sessions are being considered with **EQ17 - Emerging Materials for Contacts and Interfaces in Optoelectronics**, and **EN05 - Emerging Energy and Materials 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 September.

Invited speakers include:

Mathieu Boccard	École Polytechnique Fédérale de Lausanne, Switzerland
Kristopher Davis	University of Central Florida, USA
Weiwei Deng	Canadian Solar, Canada
David Fenning	University of California, San Diego, USA
Giso Hahn	Universität Konstanz, Germany
Matthew Halsall	The University of Manchester, United Kingdom
Susan Huang	Office of Energy Efficiency & Renewable Energy, USA
Brett Kamino	Swiss Center for Electronics and Microtechnology, Switzerland
Andreas Lambertz	Forschungszentrum Jülich GmbH, Germany
Daniel MacDonald	The Australian National University, Australia
Patrizio Manganiello	Delft University of Technology, Netherlands
Monica Morales-Masis	University of Twente, Netherlands
John Murphy	The University of Warwick, United Kingdom
Bonna Newman	TNO, Netherlands
Ingrid Repins	National Renewable Energy Laboratory, USA
Michael Rienaecker	Institute for Solar Energy Research, Germany
Hele Savin	Aalto University, Finland
Heping Shen	The Australian National University, Australia
Fatima Toor	The University of Iowa, USA
Michelle Vaqueiro Contreras	The University of New South Wales, Australia
David Young	National Renewable Energy Laboratory, USA
Xinyu Zhang	Jinko Solar, China

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Symposium EN05: Emerging Energy and Materials Sciences in Halide Perovskites

The introduction of halide perovskites (HPs) have led to an unprecedented development in the energy field. As This new family of crystalline materials embraces numerous members with highly tunable chemical and physical properties. Especially, HPs can be made with truly hybrid compositions, where organic molecular cations are localized in ordered inorganic framework. This creates an interesting 'playground' for discovering functional materials and novel properties. As such, HPs have demonstrated the promise for various energy applications. Also important is the low-temperature, low-vacuum processability of these materials, making them highly suitable for both fundamental studies and real-world applications.

This proposed symposium will focus on linking basic sciences to energy technology commercialization. The topics will include new crystal/defect theories, multiscale structures, advanced characterizations, unusual carrier dynamics, solution or vapor phase synthesis, emerging interface sciences, (de)coupling of ionic and electronic behaviors, chemical stability, and quantum information sciences. The goal is to stimulate broad efforts in understanding basic perovskite sciences and their importance to the commercialization of perovskite-based energy technologies.

Topics will include:

- Synthesis and characterization of halide perovskites
- Emerging perovskite and perovskite-inspired materials
- Physical properties and phenomena of halide perovskites
- High-throughput computation and experimental materials screening
- (De)coupling of ionic and electronic behaviors in halide perovskites
- Light-matter interaction in halide perovskites
- Chemical (in)stability in halide perovskites
- Surface and interface science of halide perovskites
- Quantum information science in halide perovskites
- Multifunctional device innovation driven by basic sciences

Joint sessions are being considered with **EQ17 - Emerging Materials for Contacts and Interfaces in Optoelectronics**, and **EN04 - Silicon for 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 September.

Invited speakers include:

Joseph Berry	National Renewable Energy Laboratory, USA
Silvana Botti	Friedrich-Schiller-Universität Jena, Germany
Christoph J. Brabec	Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany
Wallace Choy	University of Hong Kong, China
Juan-Pablo Correa-Baena	Georgia Institute of Technology, USA
Aldo Di Carlo	Università degli Studi di Roma Tor Vergata, Italy
Letian Dou	Purdue University, USA
Joanne Etheridge	Monash University, Australia
Jacky Even	Université de Rennes 1, France
Zhiyong Fan	Hong Kong University of Science and Technology, Hong Kong
Ana Flavia Nogueira	The University of Campinas, Brazil
Feng Gao	Linköping University, Sweden
Anita Ho-Baillie	The University of Sydney, Australia
Mercouri Kanatzidis	Northwestern University, USA
Biwu Ma	Florida State University, USA
Subodh Mhaisalkar	Nanyang Technological University, Singapore
David Mitzi	Duke University, USA
Tom Miyasaka	Toin University of Yokohama, Japan
Selina Olthof	University of Cologne, Germany
Nitin P. Padture	Brown University, USA
Annamaria Petrozza	Istituto Italiano di Tecnologia, Italy
Laura T. Schelhas	National Renewable Energy Laboratory, USA
Byungha Shin	Korea Advanced Institute of Science and Technology, Republic of Korea
Hairen Tan	Nanjing University, China
Hin-Lap Yip	City University of Hong Kong, Hong Kong
Jingbi You	Institute of Semiconductors, Chinese Academy of Sciences, China
Qiuming Yu	Cornell University, USA
Huanping Zhou	Peking University, Hong Kong

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Symposium EN06: Sustainable Electronics—Green Chemistry, Circular Materials, End-of-Life and Eco-Design

Consumer electronics offer the potential to improve quality of life and broaden education and access to information. Unfortunately, the rapidly growing demand of consumer electronics has led to unsustainable amounts of waste electrical & electronic equipment (WEEE), which contain hazardous substances that pose health and environmental concerns. On the other hand, the presence of valuable metals in the WEEE stream constitutes economic opportunities for the recycling industry. Based on the foregoing, we propose a symposium along three main thrusts, as follows: (i) Tackling the urgent WEEE issue through Recovery and Recycling of components from existing WEEE; (ii) Incorporating Sustainability Principles in Current practices; (iii) Re-envisioning Electronics Design. We will therefore feature talks (both invited and contributed) on Sustainable urban mining practices and plastic waste treatment to recover and recycle materials found in WEEE; Opportunities, within Current Practices, for the Development of New Circular Processes in the Electronics Industry, towards more energy-efficient and green chemistry principles-based processes; New Eco-Centric Paradigm for Electronics Component and Device Design. According to the Ellen McArthur Foundation, new electronics must be designed from the get-go for sustainability. These strategies can range from “designing for durability” to “designing for adaptability and repairability”. One sustainable technology platform of particular interest for IoT, smart packaging, flexible and wearable electronics is based on biodegradable materials.

Topics will include:

- Sustainable (Green) Electronics
- Powering Elements (e.g. Batteries and Supercapacitors)
- Electronic Materials
- Device Performance
- Eco-Design
- Life Cycle Analysis
- Critical Materials
- Greener Microfabrication
- Green Chemistry
- Eco-Toxicity
- Circular Materials
- Biodegradability
- Recycling
- Urban Mining
- Health Effects of Informal Recycling

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

Invited speakers include:

Callie Babbitt	Rochester Institute of Technology, USA	**Mario Leclerc**	Université Laval, Canada
Zhenan Bao	Stanford University, USA	**Manuele Margni**	Polytechnique Montréal, Canada
Cinzia Casiraghi	The University of Manchester, United Kingdom	**Tobin Marks**	Northwestern University, USA
Jamal Chaouki	Polytechnique Montréal, Canada	**Paul Meredith**	Swansea University, United Kingdom
Tomislav Friščic	McGill University, Canada	**Audrey Moore**	McGill University, Canada
Praveena Gangadharan	Indian Institute of Technology Palakkad, India	**Thuc-Quyen Nguyen**	University of California, Santa Barbara, USA
Carol Handwerker	Purdue University, USA	**Ange Nzihou**	IMT Mines Albi, France
Gerardo Hernandez-Sosa	Karlsruhe Institute of Technology, Germany	**Jujun Ruan**	Sun Yat-sen University, China
		Tatiana Scarazzato	Universidade Federal do Rio Grande do Sul, USA
Maria Holuszko	The University of British Columbia, Canada		
Rongrong Hu	South China University of Technology, USA	**Eleni Stavrinidou**	Linköping University, Sweden
Xian Huang	Tianjin University, USA	**Bozhi Tian**	The University of Chicago, USA
Mihai Irimia-Vladu	Johannes Kepler Universität Linz, Austria	**Cristina Trois**	University of KwaZulu-Natal, South Africa
Leo Kenny	Intel Corporation, USA	**Lan Yin**	Tsinghua University, China
Hamid Kharbasi	Conestoga College, Canada		

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Symposium EN07: Mechano-Thermal and Electrical Coupling in Emerging Energy Materials

This symposium will broadly cover emerging energy conversion materials that exhibit ubiquitous mechano-thermo-electrical coupling effects. Emerging thermoelectric, baro/elasto/electrocaloric, and piezoelectric materials have shown great promises in energy conversion applications, in addition to mechanically-tunable thermal and electrical performance. Although these materials originate differently in their energy conversion pathways, they share fundamental similarities as reflected from the inherent mechano-thermo-electrical coupled effects among them. The first part of the symposium will focus on the state-of-art theoretical and computational methods in understanding these coupled effects, and the second part will focus on new experimental characterization techniques. A key focus in the first part will be on significant renaissance in theoretical approaches to understand, predict, and optimize the coupling between two or more effects in energy materials, with an ultimate goal to enhance the energy conversion performance. Theoretical and computational tools involving electronic, atomic, molecular, and continuum-level simulations are welcomed. A key focus in the second part will be on new experimental characterization techniques to interrogate the mechano-thermo-electrical coupled effects. *In situ* or ultrahigh spatiotemporal resolution experimental characterizations to advance our understanding of mechano-thermo-electrical coupling to improve energy conversion performance are welcomed.

Topics will include:

- New Mechanisms in Thermoelectric, Piezoelectric, and Baro/Elasto/Electrocaloric Materials
- *In situ* Characterizations of Mechano-Thermo-Electrical Coupling at Ultrahigh Resolutions
- New Strain-Engineering Strategies in Thermal and Electrical Materials

Invited speakers include:

Hao Bai	Zhejiang University, China
Bing-Yang Cao	Tsinghua University, China
Jie Chen	Tongji University, China
Liang Guo	Southern University of Science and Technology, China
Qing Hao	The University of Arizona, USA
Run Hu	Huazhong University of Science & Technology, China
Xiaoting Jia	Virginia Tech, USA
Miso Kim	Korea Research Institute of Standards and Science, Republic of Korea
Bing Li	Institute of Metal Research, Chinese Academy of Sciences, China
Weigang Ma	Tsinghua University, China
Francisco Martin-Martinez	Swansea University, United Kingdom
Alessandro Mattoni	Istituto Officina dei Materials of the Italian National Research Council, Italy
Raffaele Mezzenga	ETH Zürich, Switzerland
Tingting Miao	China University of Petroleum, China
Arun Nair	University of Arkansas, Fayetteville, USA
Wee-Liat Ong	Zhejiang University, China
Guangzhao Qin	Hunan University, China
Byungki Ryu	Korea Electrotechnology Research Institute, Republic of Korea
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Symposium EN08: Low-Dimensional Halide Perovskites—From Fundamentals to Applications

Hybrid perovskites are a remarkable class of materials that have found application in a range of optoelectronic devices, such as solar cells, light-emitting diodes, photodetectors, and displays. While research has predominantly focused on the study of 3D perovskites, recent efforts have been devoted to lower dimensional perovskites (LDP), such as 2D perovskites and perovskite quantum dots. LDP offer a range of advantages in device applications, most significantly, an enhancement in the device stability. In 3D/2D structures, synergistic interactions lead to a reduction in the charge trapping losses and favorable interfacial processes. However, the efficiencies of emerging technologies based on LDP still lag behind due to a lack of understanding of their physico-chemical properties, and how these change over time. In particular, 2D/3D perovskite structures are very interesting for high performance, stable opto-electronics, however the complex interfacial phenomena remain elusive.

This symposium seeks to highlight the recent progress made in addressing the current open questions regarding the fundamental properties of LDP and their application in opto-electronic devices with a special focus on: 1. advances in material design, emphasizing the importance of synthetic chemistry in tuning the material properties to obtain the desired functionality; 2. recent developments on the link between material processing, film morphology, structure and optoelectronic properties; 3. Understanding of photophysical processes in the active layer and at material interfaces at various length and time scales, accompanied by an in-depth computational analysis; 4. Studies on device structure and processes therein. The interdisciplinary character of the topics, ranging from material science, physical-chemistry, to device physics and engineering, and theory will attract broad academic interest, with the final aim to integrate the newest fundamental and applied results, to close the gap between fundamental insights and commercially-driven applications.

Topics will include:

- Material development: synthesis and processing
- Composition engineering of low dimensional perovskites
- Relationships between processing and film structure
- Relation between film morphology, optoelectronic properties and device performance (including solar cells and light-emitting diodes)
- Photoinduced processes: exciton dissociation / charge generation, recombination and transport
- Mapping the photoinduced processes at nanometer scale in inhomogeneous thin films
- Link between chemical structure, properties and stability of materials and devices
- Device physics of solar cells and light-emitting diodes based on low dimensional perovskites
- Engineering, properties and processes at device interfaces

Invited speakers include:

Thomas Anthopoulos	King Abdullah University of Science and Technology, Saudi Arabia
Osman Bakr	King Abdullah University of Science and Technology, Saudi Arabia
Artem Bakulin	Imperial College London, United Kingdom
Jean-Christophe Blancon	Rice University, USA
David Cahen	Bar-Ilan University, Israel
Letian Dou	Purdue University, USA
Lioz Etgar	The Hebrew University of Jerusalem, Israel
Laura Hertz	Oxford University, United Kingdom
Eline Hutter	Utrecht University, Netherlands
Mercouri Kanatzidis	Northwestern University, USA
Maksym Kovalenko	ETH Zürich, Switzerland
Maria Antonietta Loi	University of Groningen, Netherlands
Sergei Vladimirovich Makarov	ITMO University, Russian Federation
Liberato Manna	Istituto Italiano di Tecnologia, Italy
Ana Flavia Nogueira	University of Campinas, Brazil
Ajay Ram Kandada	Wake Forest University, USA
Ted Sargent	University of Toronto, Canada
Sam Stranks	University of Cambridge, United Kingdom
Shuxia Tao	Eindhoven University of Technology, Germany
Eva Unger	Lund University, Sweden
Lianzhou Wang	The University of Queensland, Australia

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Symposium EN09: Metal Sulfides for High Performance Electrochemical Batteries

Li-ion batteries have revolutionized the portable electronics industry but may not be able to satisfy the rising demands on high safety and high energy density. Beyond Li-ion battery chemistry, such as alkali-metal batteries and solid-state batteries are promising candidates for next-generation high energy battery systems. In these systems, metal sulfides are important materials (electrolytes or electrodes) to realize high performance batteries. For examples, sulfide solid electrolytes (i.e. $Li_7P_3S_{11}$, $Li_{10}GP_2S_{12}$) show the impressively high ionic conductivity above 10 mS cm^{-1} at room temperature; metal sulfide cathodes (i.e. FeS_2) exhibit outstanding specific capacity in assembled batteries. So far, there have been extensive research efforts devoted on sulfide-based electrolytes or transition metal sulfide electrodes. This symposium will provide updates on the state-of-the-art research on metal sulfides on new materials chemistry, synthesis methods, interface studies, characterizations, manufacturing, device demonstration, bringing together numerous scientist and engineers across multi-disciplines from national and international.

Topics will include:

- Novel sulfide-based solid electrolytes (SE) design and synthesis
- Theoretical simulations (DFT, MD) on new materials design, and ion diffusion dynamics
- Interface studies and stabilization between SE with alkali metal anode or cathode materials
- Advanced manufacturing and processing for electrodes and electrolytes (i.e. sheet-type)
- Operando characterizations (TEM, Raman, XPS, etc)
- Dendrite formation and suppression in the metal sulfide solid state batteries
- Electrochemomechanics of sulfide solid-state batteries
- Metal sulfide electrodes in batteries
- Metal-sulfur batteries with high performance

Invited speakers include:

Karsten Albe	Technische Universität Darmstadt, Germany
Gerbrand Ceder	University of California, Berkeley, USA
Hailong Chen	Georgia Institute of Technology, USA
Jang Wook Choi	Seoul National University, Republic of Korea
Kyung Yoon Chung	Korea Institute of Science and Technology, Republic of Korea
Olivier Delaire	Duke University, USA
Brian Francisco	Solid Power LLC, USA
Akitoshi Hayashi	Osaka Prefecture University, Japan
Dongmin Im	Samsung Advanced Institute of Technology, Republic of Korea
M. Saiful Islam	University of Bath, United Kingdom
Jürgen Janek	Justus-Liebig-Universität Giessen, Germany
Ryoji Kanno	Tokyo Institute of Technology, Japan
Jim Yang Lee	National University of Singapore, Singapore
Hong Li	Institute of Physics, Chinese Academy of Sciences, China
Jun Liu	Pacific Northwest National Laboratory, USA
Bettina V. Lotsch	Max Planck Institute for Solid State Research, Germany
Xiong Wen (David) Lou	Nanyang Technological University, Singapore
Jun Lu	Argonne National Laboratory, USA
Arumugam Manthiram	The University of Texas at Austin, USA
Y. Shirley Meng	University of California, San Diego, USA
Yifei Mo	University of Maryland, USA
Linda F. Nazar	University of Waterloo, Canada
Shyue Ping Ong	University of California, San Diego, USA
Yue Qi	Brown University, USA
Xueliang (Andy) Sun	Western University, Canada
Chunsheng Wang	University of Maryland, USA
Donghai Wang	The Pennsylvania State University, USA
Martin Wilkening	Graz University of Technology, Austria
Qiang Zhang	Tsinghua University, China

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Symposium EN10: Advanced Materials for Thermal Energy Management and Harvesting

Thermal energy transport and utilization play crucial roles in applications ranging from water harvesting, low-energy buildings, power generation, thermoelectrics for waste heat recovery, energy storage, to thermal management for electronics, personal and energy systems. Thermal management is the key enabling further miniaturization of electronic system, improving the reliability and efficiency of high-power electronics and energy conversion and storage systems. Novel materials and characterization techniques have enabled new performance regimes and mechanisms for thermal transport beyond Fourier's law and phonon gas picture.

This symposium will focus on opportunities and strategies that utilize advancement in materials research for thermal energy management and harvesting applications. Common themes will include but not limited to thermoelectric materials, radiative cooling, thermal management using phase change and solid-state transport processes, materials for personal and building thermal management, and thermal energy conversion and storage. The symposium will combine simulations, characterizations and material designs to advance science and technology in thermal energy management and harvesting.

Topics will include:

- Thermoelectric materials
- Thermal energy conversion and storage
- Thermal radiation
- Phase change and solid-state thermal transport
- Computational methods for next-generation thermal materials
- Emerging approaches for thermal management and harvesting
- Novel Characterizations of thermal materials

Joint sessions are being considered with **EN03 - Thermal Materials, Modeling and Technoeconomic Impacts for Thermal Management and Energy Application**.

Invited speakers include:

David Cahill	University of Illinois at Urbana-Champaign, USA	**Aaswath Raman**	University of California, Los Angeles, USA
Yi Cui	Stanford University, USA	**Junichiro Shiomi**	The University of Tokyo, Japan
Ryan Enright	Nokia Bell Labs, Ireland	**Jeff Snyder**	Northwestern University, USA
Samuel Graham	Georgia Institute of Technology, USA	**Ying Sun**	Drexel University, USA
Asegun Henry	Massachusetts Institute of Technology, USA	**Doris Vollmer**	Max Planck Institute for Polymer Research, Germany
Patrick Hopkins	University of Virginia, USA	**Evelyn N. Wang**	Massachusetts Institute of Technology, USA
Nenad Miljkovic	University of Illinois at Urbana-Champaign, USA	**Zuankai Wang**	City University of Hong Kong, Hong Kong
Pamela Norris	University of Virginia, USA	**Yoonjin Won**	University of California, Irvine, USA
Georgia Papadakis	ICFO–The Institute of Photonic Sciences, Spain	**Tiejun Zhang**	Khalifa University, United Arab Emirates
Dimos Poulikakos	ETH Zürich, Switzerland	**Jia Zhu**	Nanjing University, China
David Quéré	École Supérieure de Physique et de Chimie Industrielles, France		

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Symposium EN11: Electrocatalytic Materials to Sustainably Convert Atmospheric C, H, O and N into Fuels and Chemicals

Converting atmospheric molecules, including H_2O, CO_2, N_2, O_2, etc., into valuable chemicals or fuels driven by renewable electricity or sunlight represents a green and sustainable route compared to traditional chemical engineering processes. Those molecules have C, H, O, N as the most basic elements, which can be reconstructed to a variety of commodity chemicals. As the chemical conversions require different electrocatalysts to improve the energy efficiencies and production rates, rational designs of catalytic materials and deep understandings or reaction mechanisms therefore play the central role in driving the development of this field. This proposed symposium will mainly focus on C, H, O, N elements' cycles driven by electrochemical and photoelectrochemical catalysis, including 1) CO_2 conversion and fuel molecule oxidation; 2) water splitting and fuel cell electrocatalysis; 3) H_2O_2 electrolysis; 4) N_2 reduction and ammonia oxidation; and 5) catalyst/bacteria nexus. Each topic will include catalytic materials design, characterizations, and experimental/theoretical reaction mechanism studies.

Topics will include:

- Electrochemical and photoelectrochemical CO_2 conversion and fuel molecule oxidation
- Water splitting and fuel cell catalysis
- Electrochemical and photoelectrochemical synthesis of H_2O_2 from O_2 or water
- Electrochemical and photoelectrochemical ammonia synthesis and oxidation
- Catalyst/bacteria nexus
- Theoretical study of reaction mechanisms in electrocatalysis
- In-*Operando* characterization of electrochemical and photoelectrochemical catalysis

Invited speakers include:

Caroline Ajo-Franklin	Rice University, USA
Elizabeth Biddinger	The City College of New York, USA
Rafaella Buonsanti	École Polytechnique Fédérale de Lausanne, Switzerland
Yi Cui	Stanford University, USA
Marta Hatzell	Georgia Institute of Technology, USA
Yu Huang	University of California, Los Angeles, USA
Feng Jiao	University of Delaware, USA
Paul Kenis	University of Illinois at Urbana-Champaign, USA
Nikolay Kornienko	Université de Montréal, Canada
Nuria Lopez	Institute of Chemical Research of Catalonia, Spain
Shelley Minteer	The University of Utah, USA
Carlos Morales-Guio	University of California, Los Angeles, USA
Daniel Nocera	Harvard University, USA
Camille Petit	Imperial College London, United Kingdom
Ted Sargent	University of Toronto, Canada
Yang Shao-Horn	Massachusetts Institute of Technology, USA
Ifan Stephens	Imperial College London, United Kingdom
Jin Suntivich	Cornell University, USA
Hailiang Wang	Yale University, USA
Gang Wu	University at Buffalo, The State University of New York, USA
Peidong Yang	University of California, Berkeley, USA
Jenny Zhang	University of Cambridge, United Kingdom

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Symposium EN12: Advanced Materials and Chemistries for Low-Cost and Sustainable Batteries

Fast-growing energy needs and depleting fossil fuels urge the development of sustainable energy solutions, including both renewable energy resources and low cost storage technologies for a reliable, resilient and flexible energy future. Although lithium (Li)-ion batteries have enabled a rechargeable world and are one of widely applied techniques for electromobility and grid application, they are relatively expensive and raise concern on the sustainability because of the use of many critical elements. In contrast, battery chemistries based on earth-abundant and eco-efficient elements, such as sodium (Na), aluminum (Al), magnesium (Mg) and zinc (Zn), are promising options for battery applications. Nonetheless, such novel batteries are still at the research stage, where both electrochemistry investigation and material development require fundamental understanding. The goal of this symposium is to explore the common themes about low cost and sustainable batteries, and inspire new materials, chemistry, and functions through dialog between scientists and engineers engaged in both fundamental and applied research. To achieve this goal, this symposium will be organized around three thematic aspects: The first theme will be centered on the electrochemistry of eco-efficient and renewable battery techniques beyond the Li-based technologies. Second, the focus also will be on the engineering of advanced electrode/electrolyte materials that could prolong the cycle-life and sustainability of electrochemical reactions. Third, emphasis also will be on simulation and computation including machine learning and artificial intelligence that can harness the molecular and atomic-scale insights in the electrochemical processes to accelerate the discovery of new materials.

We believe that this symposium will provide a venue for fruitful interaction and exchange of ideas surrounding the unique material development, distinctive chemistry evaluation, and theoretical investigation in the context of low cost and sustainable batteries. The symposium will help to educate students and researchers nationally and globally in this important field of energy storage and conversion.

Topics will include:

- Batteries beyond lithium-ion
- Aqueous batteries
- Solid-state batteries
- Green battery materials and devices
- Simulation and computation of battery chemistry
- Machine learning and artificial intelligence-guided battery material development
- Battery reliability and safety

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

Invited speakers include:

Lynden Archer	Cornell University, USA
Oleg Borodin	U.S. Army Research Laboratory, USA
Laurence Croguennec	Centre National de la Recherche Scientifique, France
Yi Cui	Stanford University, USA
Marca Doeff	Lawrence Berkeley National Laboratory, USA
Robert Dominko	National Institute of Chemistry, Slovenia
Bruce Dunn	University of California, Los Angeles, USA
Kristina Edström	Uppsala University, Sweden
Maria Forsyth	Deakin University, Australia
Alejandro Franco	Université de Picardie Jules Verne, France
Joel Gaubicher	Institut des Materiaux Jean Rouxel, France
Liangbing Hu	University of Maryland, USA
Shinichi Komaba	Waseda University, Japan
Hyun-Wook Lee	Ulsan National Institute of Science and Technology, Republic of Korea
Jun Lu	Argonne National Laboratory, USA
Yunfeng Lu	University of California, Los Angeles, USA
Arumugam Manthiram	The University of Texas at Austin, USA
Y. Shirley Meng	University of California, San Diego, USA
David Mitlin	The University of Texas at Austin, USA
Shyue Ping Ong	University of California, San Diego, USA
Stefano Passerini	Karlsruhe Institute of Technology, Germany
Mauro Pasta	University of Oxford, United Kingdom
Debra Rolison	U.S. Naval Research Laboratory, USA
Xueliang Sun	Western University, Canada
Esther Takeuchi	Stony Brook University, The State University of New York, USA
Margret Wohlfahrt-Mehrens	Center for Solar Energy and Hydrogen Research Baden-Württemberg, Germany
Guiliang Xu	Argonne National Laboratory, USA
Yan Yao	University of Houston, USA
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Symposium EN13: Climate Change Mitigation Technologies

Negative emissions technologies to remove greenhouse gases from the atmosphere is an important part of the climate responses. Technologies as a means to remove CO_2 or other greenhouse gases from the earth's atmosphere is now even more crucial to limit total global warming below two degrees Celsius. Technical approaches to capture CO_2 from air involve membranes and absorbents. The goal of this symposium is to address the challenges in scientific and technical understanding and the research needed for negative emission technologies up to scale by bringing experts from leading industries, federal government, academia, institutes and national laboratories from around the world. More specifically, this symposium will explore emerging negative emission technologies such as direct air or ocean capture of CO_2, direct air capture of methane and other greenhouse gases, enabling capturing, storing and re-use technologies, materials, methods, chemistries, and reuse of chemicals for sustainability of proposed methods. Removal of greenhouse gases from the atmosphere, deployment of negative emissions technologies and their potential physical and economic limitations are also of interest.

Topics will include:

- Removal of greenhouse gases from the atmosphere; chemical-looping
- Carbon captured from combustion or synthesized hydrocarbons
- Amine and other absorbents; membranes; ionic liquids; chemisorption
- Low cost direct air and ocean capture of CO_2;hydroxide capture of CO_2 from air
- Ways to increase CO_2 removal; adsorbents; sorbent enhancement
- Producing Synthetic gas and fuels from captured CO_2
- Direct air capture of methane technologies
- Chemical reactions, extraction of the carbon dioxide
- Bioenergy with carbon capture and storage (BECCS)
- Emerging carbon storage methods; carbon mineralization technologies
- Use of captured CO_2 in various applications
- Recycling and removal of carbon from the atmosphere, carbon management
- Carbon engineering, negative emission technologies and their economics

Invited speakers include:

Edda Aradottir	Reykjavik Energy, Iceland
Christoph Beuttler	Climeworks, Switzerland
Chris Busch	Energy Innovation, USA
Ken Caldeira	Stanford University, USA
Sue Carter	University of California, Santa Cruz, USA
Paul Fennell	Imperial College London, United Kingdom
Shigenori Fujikawa	Kyushu University, Japan
Chris Greig	Princeton University, USA
Selmiye Gursel	Sabanci University, Turkey
Carlos Haertel	Climeworks, Germany
John Holmes	The National Academy of Sciences, USA
Andrew Jones	U.S. Department of Energy National Energy Technology Laboratory, USA
Etsushi Kato	The Institute of Applied Energy, Japan
Michelle Kidder	Oak Ridge National Laboratory, USA
Nathan Lewis	California Institute of Technology, USA
Zhimin Liu	Institute of Chemistry, Chinese Academy of Sciences, China
Sean McCoy	University of Calgary, Canada
Alton Romig	The National Academy of Engineering, USA
Miles Sakwa-Novak	Global Thermostat, USA
Paul Sanberg	The National Academy of Inventors, USA
Pete Smith	University of Aberdeen, United Kingdom
Xin Sun	Oak Ridge National Laboratory, USA
Vijay Swarup	ExxonMobil, USA
Simon Weston	ExxonMobil, USA
Jennifer Wilcox	U.S. Department of Energy—Office of Fossil Energy and Carbon Management, USA

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Symposium EN14: Advanced Materials for Hydrogen and Fuel Cell Technologies

Hydrogen is a versatile energy carrier that has the potential to decarbonize traditional energy sectors, including manufacturing (e.g. chemicals, steelmaking), heating (e.g. hydrogen blending in natural gas pipelines), power generation, and transportation. R&D advancements have led to steady growth in commercial deployments of hydrogen and fuel cell technologies worldwide over the past decade. In 2020, analysis of the H2@Scale vision estimated the economic potential of hydrogen demand in the U.S. as over 2X current values by 2050.

R&D priorities to enable affordable hydrogen supply include: cost-competitive green hydrogen production at scale; bulk storage of hydrogen for extended periods of time; low-cost, reliable hydrogen infrastructure technologies; and end-use technologies that can efficiently convert hydrogen fuel to heat or electricity. In all of these aspects, there is a need to design and develop materials that reduce technology cost and improve performance.

This symposium will provide an opportunity for researchers across multiple disciplines such as materials science, mechanical engineering, chemical engineering, chemistry and physics to come together and present their current understanding of issues and challenges in developing materials for the hydrogen industry. These materials developments would enable advanced water splitting technology (e.g., electrolysis, photoelectrochemical [PEC], solar thermochemical [STCH]), physical and chemical storage strategies, energy conveyance (e.g., pipelines), and energy conversion (fuel cells and hydrogen turbines).

In particular, this symposium seeks to highlight integrated multi-scale modeling and experimental studies that bridge the classical relationships between "processing - structure - properties - applications" paradigm in the “materials for hydrogen economy” space.

Topics will include:

- Advanced water splitting materials – electrolysis, PEC, STCH
- Materials compatibility- pipelines, storage vessels, polymers used in infrastructure
- Hydrogen storage materials- hydrides, sorbents, carriers
- Materials issues in hydrogen use – fuel cells, turbines, building appliances

Invited speakers include:

Shaun Alia	National Renewable Energy Laboratory, USA
Coleman Alleman	Sandia National Laboratories, USA
Shannon Boettcher	University of Oregon, USA
Mark Bowden	Pacific Northwest National Laboratory, USA
Sylvie Castagnet	École Nationale Supérieure de Mécanique et D’Aérotechnique, France
William Curtin	École Polytechnique Fédérale de Lausanne, Switzerland
Dong Ding	Idaho National Laboratory, USA
Sophia Haussener	École Polytechnique Fédérale de Lausanne, Switzerland
Zenyuk Iryna	University of California, Irvine, USA
Jessica Krogstad	University of Illinois at Urbana-Champaign, USA
Daniel Merkel	Pacific Northwest National Laboratory, USA
Deborah Myers	Argonne National Laboratory, USA
Kenneth Neyerlin	National Renewable Energy Laboratory, USA
Neha Rustagi	U.S. Department of Energy, USA
Donald Siegel	University of Michigan, USA
Ellen Stechel	Arizona State University, USA
Cem Tasan	Massachusetts Institute of Technology, USA
Matthew Witman	Sandia National Laboratories, USA
Brandon Wood	Lawrence Livermore National Laboratory, USA

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Symposium EN15: Materials Research Opportunities for Energy Efficient Computing

With the explosion of data and processing required to turn that data into useful information, there is an unprecedented need for energy efficient computation. In the last decade, the rate at which data was generated outpaced improvements in compute efficiency, leading to high energy consumption. For perspective, data centers consume 200 TWh+ each year which exceeds the total energy consumption of some entire countries. Expanded use of the Internet, smart phones, and more sophisticated computation is causing all of those numbers to escalate. Making computation more energy-efficient would reduce computation cost, energy consumption, and enable batteries to run longer or be smaller for mobile computing. There has been a collective effort among academia, industry, and government to explore multi-faceted approaches for advancing low energy computing. Making computation more energy-efficient would save money, reduce energy use, and permit batteries that provide power in mobile devices to run longer and/or be smaller.

Materials are the building blocks of the compute hardware stack. Starting at the smallest scale, there are switching elements that comprise logic and/or memory. These elements are put together at the package level with passives, thermal management solutions, and interconnects to form the integrated chip. As materials touch every one of these components, the goal of this Symposium is to focus on the materials challenges and opportunities that will accelerate solutions for energy efficient computation. There is already a substantial body of knowledge in this field spanning multiple approaches. The Symposium Co-Organizers have decided to focus specifically on the important areas described below.

Topics will include:

- Fundamental limits for computation driving materials solutions
- Charge based energy efficient devices
- Non-charge based energy efficient devices
- Future low energy memory solutions
- Low energy interconnects
- Efficient thermal management materials solutions
- Microelectronic packaging (advanced solutions with materials emphasis only)
- Neuromorphic computing (with materials thrust)

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

Invited speakers include:

Jeong-Hoon Ahn	Samsung Advanced Institute of Technology, Republic of Korea
Inge Asselberghs	imec, Belgium
Nazanin Bassiri-Gharb	Georgia Institute of Technology, USA
Zhihong Chen	Purdue University, USA
Judith Driscoll	University of Cambridge, United Kingdom
Saurav Dutta	University of Notre Dame, USA
Ru Huang	Peking University, China
Daniele Ielmini	Politecnico di Milano, Italy
Jean Anne Incorvia	The University of Texas at Austin, USA
Xiuling Li	University of Illinois at Urbana-Champaign, USA
Matthieu Luisier	ETH Zürich, Switzerland
Matt Marinella	Sandia National Laboratories, USA
Ramesh Ramamoorthy	University of California, Berkeley, USA
Heike Riel	IBM Research-Zurich, Switzerland
Tania Roy	University of Central Florida, USA
Uwe Schröder	NaMLab gGmbH, Germany
Aida Todri-Sanial	Laboratoire d'Informatique, de Robotique et de Microélectronique de Montpellier, France
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Symposium EQ01: Quantum Optical Materials and Devices Based on Impurity Systems

Quantum optical materials and related devices based on impurity systems are promising building blocks for quantum-communication and quantum-sensing networks. Over the last few years, this field has witnessed enormous progress and has stimulated the development of designer quantum materials with the potential to achieve improved entanglement rates, distance, and quantum sensitivity. Most significantly, innovative material synthesis and device design are being actively pursued to address the challenges associated with controllable and a priori design of materials to achieve high fidelity, high purity and indistinguishable photon states. The latest scientific and technical advances have broadened the palette of material platforms for quantum optics, which spans wide bandgap semiconductors, 2D materials, rare-earth ion doping, perovskites, and molecule-tethered 1D structures. Moreover, theoretical and computational efforts seek desirable atomic and electronic structures of materials for various quantum states. Device fabrication utilizing cavity quantum electrodynamics opens up applications in manipulating designer quantum photonic states for distributed quantum computing and communication platforms.

This symposium provides a forum to discuss various theoretical, computational and experimental approaches to realize designer quantum materials. The invited talks and presentations will cover interdisciplinary fields including quantum science and technology, materials science, physics, chemistry, mechanical and electrical engineering.

Topics will include:

- Coherent spin-photon interfaces: quantum dots, single defects, molecules (joint with Symposium EQ14)
- Quantum defects in insulators and wide-gap semiconductors (joint with Symposium EQ14)
- Controlled creation and manipulation of quantum defects in low-dimensional materials
- Designer rare-earth doped quantum materials and systems
- Novel approaches for deterministic coupling of optical materials with photonic structures
- Light-matter interaction and cavity quantum electrodynamics
- Novel methods for synthesis, processing, and characterization of quantum materials
- Computational tools for quantum material design

Joint sessions are being considered with **EQ14 - Materials and Devices for Controlling Quantum-Coherent Spin Dynamics**.

Invited speakers include:

Audrius Alkauskas	Center for Physical Sciences and Technology, Lithuania
Edward Bielejec	Sandia National Laboratories, USA
Nazar Delegan	Argonne National Laboratory, USA
Vladimir Dyakonov	University of Würzburg, Germany
Andrei Faraon	California Institute of Technology, USA
Kai-Mei Fu	University of Washington, USA
Adam Gali	Budapest University of Technology and Economics, Hungary
Giulia Galli	The University of Chicago, USA
Weibo Gao	Nanyang Technological University, Singapore
Bert Hecht	Julius-Maximilians-Universität Würzburg, Germany
Atac Imamoglu	ETH Zürich, Switzerland
Song Jin	University of Wisconsin–Madison, USA
Mehran Kianinia	University of Technology Sydney, Australia
Richard Layfield	University of Sussex, United Kingdom
Jieun Lee	Ajou University, Republic of Korea
Prineha Narang	Harvard University, USA
Jay Narayan	North Carolina State University, USA
Peter Pauzauskie	University of Washington, USA
Aleksandra Radenovic	École Polytechnique Fédérale de Lausanne, Switzerland
James Schuck	Columbia University, USA
Ajit Srivastava	Emory University, USA
Jeff Thompson	Princeton University, USA
Niek van Hulst	ICFO – The Institute of Photonic Sciences, Spain
Jelena Vuckovic	Stanford University, USA
Michael Wasielewski	Northwestern University, USA

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Symposium EQ02: Heterostructures of Various Dimensional Materials

Mixed dimensional heterostructures formed by stacking 0D, 1D, 2D, and 3D materials together can offer exciting multifunctionalities that cannot be otherwise obtained by pure 1D or 2D or 3D materials. Heterogenous integration can substantially alter the electrical, magnetic, optical, and thermal properties and result in tremendous intriguing functionalities. A great deal of efforts has been made to form unprecedented device architectures via heterostructuring various dimensional materials. To obtain heterostructured systems with high quality interfaces, significant progress has been made on in-situ growth or ex-situ transfer techniques. These are critical to obtain extensive and flexible designs of heterostructures. In this symposium, we provide the opportunity for speakers and audience to share the progress in research of various dimensional material heterostructures which include the methods for synthesis, growth, transfer, lift-off, and even scale-up. The goal of the symposium is to allow the community to come together to advance the heterostructuring concept from the existing 2D heterostructures to various dimensional heterostructures for electronic, photonic, and electrochemical applications.

The symposium will cover a complete range of topics related to heterogeneous integration of various dimensional materials from fundamentals to applications. Interdisciplinary topics related to physics, materials science and engineering will be connected by invited talks in order to accelerate the development of manufacturing of various dimensional heterostructures and their applications. The session will also be dedicated to motivate discussions toward emerging technology to develop new types of heterogeneously integrated structures using 0D, 1D, 2D, and 3D materials.

Topics will include:

- Remote epitaxy and van der Waals epitaxy of semiconductors, complex oxides, and 2D materials
- Lift-off technology (mechanical, optical, chemical)
- Freestanding membrane technology
- Large-scale synthesis of various dimensional materials (0D, 1D, 2D, 3D) and their hetero-structures
- Heterogeneous integration and their applications
- Heterogeneous integration of mixed dimensional materials
- Optical, electrical and magnetic interaction at the hetero-interface

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

Invited speakers include:

Jong-Hyun Ahn	Yonsei University, Republic of Korea
Sang-hoon Bae	Washington University in St. Louis, USA
Alexander Balandin	University of California, Riverside, USA
Yi Cui	Stanford University, USA
Xiangfeng Duan	University of California, Los Angeles, USA
Peng Gao	Peking University, China
Wanlin Guo	Nanjing University of Aeronautics and Astronautics, China
Yue Hao	Xidian University, China
Young Joon Hong	Sejong University, Republic of Korea
Berangere Hoyt	Commissariat à l'énergie atomique et aux énergies alternatives, France
Harold Hwang	Stanford University, USA
Jason Kawasaki	University of Wisconsin–Madison, USA
Wei Kong	Westlake University, China
Hyunseong Kum	Yonsei University, Republic of Korea
Ludovic Largeau	Université Paris-Saclay, France
Chun Ning (Jeanie) Lau	The Ohio State University, USA
Jinmin Li	Institute of Semiconductors, Chinese Academy of Sciences, USA
Abdallah Ougazzaden	Georgia Institute of Technology, USA
Jiwoong Park	The University of Chicago, USA
Lianmao Peng	Peking University, USA
Joshua Robinson	The Pennsylvania State University, USA
Jian Shi	Rensselaer Polytechnic Institute, USA
Stephanie Tomasulo	U.S. Naval Research Laboratory, USA
Rachael L. Myers Ward	U.S. Naval Research Laboratory, USA
Mona Zebarjadi	University of Virginia, USA
Yuanbo Zhang	Fudan University, China

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Symposium EQ03: Spin-Based Sensing at the Nanoscale and Hyperpolarization with NV-Diamond and Beyond

Point defects like nitrogen vacancy centers (NV) in diamond can serve as highly sensitive and atomically small sensors making them ideal for localized measurements on the nanoscale. The spin state of a single NV center can be controlled and read-out optically enabling the detection of magnetic fields. Spin-based analytical methods like nuclear magnetic resonance spectroscopy are non-destructive and obtain information on a molecular level. They are routinely used for structure determination and quality control. The measurement principle is based on the interaction of individual nuclear spins under a strong magnetic field causing spin alignment. NV centers in close proximity to the analyte drastically decrease the sample volume simultaneously increasing spatial resolution. In addition, by hyperpolarization, spin polarization can be transferred e.g., from NV centers to other nuclei, beyond the thermal equilibrium, increasing the measurement signal. The material plays a key role for these techniques as material quality (defect density, contaminations, etc.) strongly influence decoherence times effectively reducing measurement time and hence increasing uncertainty. Apart from diamond, other materials like SiC and BN can host usable vacancy defects and are gaining more and more attention. Defects close to the surface show higher sensitivity to the adjacent magnetic field, however, in liquids fermi level shifts can result in discharging, i.e., sensor deactivation.

In this symposium, we want to address the challenges in spin-based sensing and hyperpolarization from the material synthesis to the application with a strong focus on diamond materials. This includes advanced defect and material characterization, diamond technology, surface treatments, spin manipulation protocols, biological applications and many more. Joint sessions on general diamond growth and doping will be organized to strenghten scientific exchange.

Topics will include:

- Synthesis of NV-doped and Ultrapure Diamond
- Other NV-like systems and materials
- Creation of Color Centers
- Defect Analysis and Material Characterization
- Surface Treatments and Enhancement
- Diamond Technology and Device Fabrication
- Defect-based NMR Metrology
- Hyperpolarization
- NMR Techniques
- Applications in Materials Science, Analytical Chemistry, Biology and Medicine

Joint sessions are being considered with **EQ19 - Diamond and Diamond Heterojunctions—From Growth to Applications**.

Invited speakers include:

Jocelyn Achard	Centre National de la Recherche Scientifique, France
Ashok Ajoy	University of California, Berkeley, USA
Lee Bassett	University of Pennsylvania, USA
Ania Bleszynski Jayich	University of California, Santa Barbara, USA
Dmitry Budker	Johannes Gutenberg-Universität Mainz, Germany
Andrew M. Edmonds	Element Six UK Ltd., United Kingdom
Fedor Jelezko	Ulm University, Germany
Hiromitsu Kato	National Institute of Advanced Industrial Science and Technology, Japan
Anke Krüger	Julius-Maximilians-Universität Würzburg, Germany
Patrick Maletinsky	University of Basel, Switzerland
Liam McGuinness	The Australian National University, Australia
Mark Newton	University of Warwick, United Kingdom
Alexander Pines	University of California, Berkeley, USA
Romana Schirhagl	University Medical Center Groningen, Netherlands
Matthias Schreck	Universität Augsburg, Germany
Ilay Schwarz	NVISION IMAGING Technologies GmbH, Germany
Ronald L. Walsworth	Harvard University, USA
Jörg Wrachtrup	Universität Stuttgart, Germany

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Symposium EQ04: Machine Learning on Experimental Data for Emergent Quantum Materials

For the past decade, quantum materials, where complex phenomena emerge from complex orbital, charge, lattice and spin interactions, have been a source of enormous fundamental breakthroughs. Quantum materials are difficult if not impossible to understand solely using existing simulation and analytical techniques, therefore, insights from experimental data are of critical importance. Machine learning continues to advance as a powerful tool for understanding and designing materials. These methods have been highly successful in improving atomistic simulations, materials design and discovery, literature information extraction, and quantum information systems. However, the following challenges remain unresolved when merging machine learning methods with experimental data: 1) Experimental data can have noise from various sources. 2) In comparison to high-throughput computational results, experimental data is often small and scattered. 3) Experimental data often disagree with simulation or computational results.

Given the vast opportunities that machine learning may bring experimental investigations of quantum materials, we feel it obligatory and timely to organize a symposium to address the following challenges and bottlenecks of applying state-of-the-art machine learning architectures to address key open questions in quantum materials: How do we apply machine learning to noisy, scarce experimental data, especially when there is disagreement with computational data? How do we extract key insights on quantum materials from experimental data that cannot be accessed from conventional manual data analysis?

This symposium will highlight recent progress in applying machine learning to various types of materials characterization techniques: neutron and x-ray scattering, optical spectroscopies, angular-resolved photoemission spectroscopy (ARPES), free electron laser, among other emerging novel spectroscopies. We will cover diverse quantum materials, such as novel topological insulators, semimetals and metals, in bulk, thin film, 2D and 1D form. We will emphasize recent progress in machine learning techniques relevant to noise reduction and inferring missing or the corruption of data. We will focus on applications of machine learning to augment experimental data for novel quantum materials, as well as “hot off the press” characterization and analysis tools for quantum materials. This symposium will provide an interactive, widely-accessible forum for materials scientists to get up to speed on the exciting recent progress of machine learning and quantum materials. To ensure cross-fertilization of these new techniques and approaches, sessions will be organized by scientific theme rather than material category. Additional sessions will focus on recent methodological advances of the machine learning capabilities to probe the charge, spin or lattice degrees of freedom.

Topics will include:

- Bridging the gap between computational and experimental data
- Convolutional neural network-based architectures for 2D and higher-dimensional spectra
- Recursive neural network-based architectures for time-resolved spectra
- State-of-the-art X-ray scattering to explore the interplay between the charge, spin and orbital degrees of freedom
- Neutron scattering measurement to study the magnetic properties and exotic excitations in materials
- Femtosecond to attosecond ultrafast free electron laser for materials properties far away from equilibrium
- Graphical models and other non-neural network methods in addressing experimental data
- Machine learning methods for inverse design (properties -> geometry) over experimentally accessible parameters / structures

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

Invited speakers include:

Joshua Agar	Lehigh University, USA	**Anubhav Jain**	Lawrence Berkeley National Laboratory, USA
Ilke Arslan	Argonne National Laboratory, USA	**Heather Kulik**	Massachusetts Institute of Technology, USA
Andrei Bernevig	Princeton University, USA	**Sean Lubner**	Lawrence Berkeley National Laboratory, USA
Silvana Botti	Friedrich-Schiller-Universität Jena, Germany	**Nicolas Regnault**	École Normale Supérieure, France
Maria Chan	Argonne National Laboratory, USA	**Robert-Jan Slager**	University of Cambridge, United Kingdom
Cheng-Chien Chen	The University of Alabama at Birmingham, USA	**Alan Tennant**	Oak Ridge National Laboratory, USA
Nikolas Claussen	University of California, Santa Barbara, USA	**Yao Wang**	Clemson University, USA

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Symposium EQ05: Plasmonics, Nanophotonics and Metaphotonics—Design, Materials and Applications

The symposium seeks to provide a general overview of recent advances in new material platforms and structure design, including fabrication techniques and promising applications. It will address emerging topics of hybrid nanophotonics including plasmonics, metaphotonics, metasurfaces, and two- dimensional materials to overcome existing limitations that prevent the development of practical photonic devices. Novel approaches in plasmonics and nanophotonics promise the generation, processing, sensing, and detection of signals at the nanometer scale with great potential in a wide range of fields, such as photovoltaics, optical communications, quantum information technology, biophotonics, lighting, sensing, chemistry, and medicine. Two obstacles that are holding back fundamental advances and the broad application of plasmonic-based technologies originate from inherent material losses in constitutive plasmonic components and the lack of efficient tunability. The recent discovery of new plasmonic materials, as well as 2D materials and low-dimensional materials with low loss, tunable optical properties, and CMOS compatibility, can enable a breakthrough in the field of nanophotonics and their applications.

Topics will include:

- Plasmonics, advanced nanophotonics, metasurfaces, quantum plasmonics and metaphotonics
- Alternative plasmonic and epsilon-near-zero materials, all-dielectric photonics in 2D Materials
- Tunable metasystems, nonlinear optics and ultrafast dynamics in metaphotonics and plasmonics
- Topological photonic and parity-time symmetric materials
- Biological and chemical sensing with plasmonics and nanophotonics
- Terahertz devices and applications - Imaging, sensing, and communications
- Photovoltaic applications, efficient light harvesting, and thermoplasmonics
- Waveguides, devices and systems from plasmonics and metaphotonics
- Plasmonic hot-carriers for photodetection and energy storage

Joint sessions are being considered with **SB01 - Engineered Functional Multicellular Circuits, Devices and Systems**.
Also, a **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in September.

Invited speakers include:

Hatice Altug	École Polytechnique Fédérale de Lausanne, Switzerland
Andrea Alù	The City University of New YorkCenter, USA
Harry Atwater	California Institute of Technology, USA
Alexandra Boltasseva	Purdue University, USA
Igal Brener	Sandia National Laboratories, USA
Mark Brongersma	Stanford University, USA
Federico Capasso	Harvard University, USA
Artur Davoyan	University of California, Los Angeles, USA
Jennifer Dionne	Stanford University, USA
Nader Engheta	University of Pennsylvania, USA
Harald Giessen	University of Stuttgart, Germany
Shangjr Gwo	National Tsing Hua University, Taiwan
Naomi Halas	Rice University, USA
Ortwin Hess	Trinity College Dublin, Ireland
Yuri Kivshar	The Australian National University, Australia
Renmin Ma	Peking University, China
Stefan Maier	Ludwig-Maximilians-Universität München, Germany
Andrea Marini	University of L'Aquila, Italy
Jeremy Munday	University of California, Davis, USA
Teri W. Odom	Northwestern University, USA
Roberto Paiella	Boston University, USA
Stephanie Reich	Freie Univeristät Berlin, Germany
Vladimir M. Shalaev	Purdue University, USA
Din Ping Tsai	The Hong Kong Polytechnic University, Hong Kong
Jason Valentine	Vanderbilt University, USA
Pin-Chieh Wu	National Cheng Kung University, Taiwan
Ta-Jen Yen	National Tsing Hua University, Taiwan
Anatoly Zayats	King's College London, United Kingdom
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Symposium EQ06: Innovative Fabrication and Processing Methods for Organic and Hybrid Electronics

Fabrication methods of organic electronics can be generally divided into solution processing and vapor processing. Solution based methods at the laboratory scale are typically spin coating and doctor blading. For vapor deposition, the most common approaches include thermal evaporation and chemical vapor phase deposition of small molecules. These methods have been widely adapted for processing organic electronic devices including solar cells, light emitting diodes and transistors.

Recently, a number of novel processing approaches have been developed that act to enhance device performance, gain insight into device and material physics, and improve compatibility with scalable low-cost manufacturing. These newly developed processing methods allow one to dictate the morphology of the organic electronic active layers with unprecedented ability, providing better understanding of material and device properties.

This symposium will explore organic electronic device physics and applications enabled by novel processing methods and techniques for large area device integration. The symposium will cover various organic devices such as solar cells, transistors and light emitting diodes, as well as emerging devices such as temperature/bio sensors. The symposium will consider a range of organic and organic/inorganic hybrid material systems and their associated processing, microstructure and device performance.

The meeting will provide a forum for interaction among university and industry, researchers and practitioners, representing different perspectives across the value chain. The discussion will focus on the new paradigms for small molecule and polymer semiconductor processing methods emerging from research laboratories, as well as the continuous improvements to more traditional printing techniques and their intersection with electronics and optics. This symposium will assist in accelerating the adoption of processing methods between universities and industry and speed up the development of organic electronics.

Topics will include:

- Organic electronics
- Printed electronics
- Hybrid electronics
- Thin film transistors
- Thin film sensors

Invited speakers include:

John Anthony	University of Kentucky, USA
Derya Baran	King Abdullah University of Science and Technology, Saudi Arabia
Emily Bittle	National Institute of Standards and Technology, USA
Michael Chabinyc	University of California, Santa Barbara, USA
Suchi Guha	University of Missouri, USA
Hagen Klauk	Max Planck Institute for Solid State Research, Germany
JJ Lee	eLux, Inc., USA
Chuan Liu	Sun Yat-sen University, China
Christine Luscombe	University of Washington, USA
Bjorn Lussem	Kent State University, USA
Conor Madigan	Kateeva, USA
Tina Ng	University of California, San Diego, USA
Barry Rand	Princeton University, USA
Natalie Stingelin	Georgia Institute of Technology, USA
Gregory Whiting	University of Colorado Boulder, USA

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Symposium EQ07: Defects and Strain Potential Enabled Emergent Behavior in Two-Dimensional Materials

Strain and defect are effective means to achieve versatile functionalities in materials. Due to their weak interlayer coupling, several physical properties of van der Waals (vdW) solids show high sensitivity to strain modulation, *e.g.* bandgap change and phonon spectra shift. Recently, the moiré superlattice and the atomic reconstruction were observed under periodic strain potential, which can lead to some emergent and intriguing properties, such as unconventional superconductivity and unique optoelectronic behaviors. Strain tuning of 2D materials is not limited by mechanical stretching/bending approach, wrinkling/crumpling of 2D materials or transferring onto patterned substrates. The hydrostatic compressive strain generated in a diamond anvil cell can reach to more than 10%, making possible the study of phenomena under extremely nonequilibrium conditions. Rich forms of defects are present in 2D materials, such as foreign atoms, wrinkles, grain boundaries, etc. Besides as carrier traps and/or recombination center, recent discoveries suggest that defects can also serve as quantum emitters or spin trappers, and enable new quantum phenomena such as hydrodynamic electron transport.

This symposium will cover a broad range of emergent properties in 2D materials enabled by strain and defect, including thermal, optical, electrical, magnetic properties, enabling the applications for electronics, plasmonics, spintronics, straintronics and valleytronics. The materials will include not only graphitic materials, transition metal dichalcogenides, but also some emerging families of ferromagnetic materials.

Topics will include:

- Experimental investigation of thermal, electrical, optical and magnetic properties of 2D materials under strain
- Theoretical and computational predictions of thermal, electrical, optical and magnetic transport of emerging 2D materials under strain
- Emergence of new phases under extreme strain
- Straintronics - Engineering 2D electronics through strain
- Quantum defects in 2D materials
- Defect-engineered 2D electronics
- Reconstructed moiré and soliton effects in 2D materials
- Emergent/collective behavior with periodic strain potential modulation
- Emerging applications of defect and strain potential engineered 2D materials in clean energy, environment, and advanced health care, etc.
- New physics and properties associated with interfacial defect and strain engineering, including intercalation, adhesion, encapsulation, superlubricity, van der Waals confinement for chemical reaction, *etc*.

Joint sessions are being considered with **EQ20 - Beyond Graphene 2D Materials—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 September.

Invited speakers include:

Vikas Berry	University of Illinois at Chicago, USA	**Nadya Mason**	University of Illinois at Urbana-Champaign, USA
Corey Dean	Columbia University, USA	**Feng Miao**	Nanjing University, China
Hui Deng	University of Michigan, USA	**Kayla Nguyen**	Cornell University, USA
Andrea Ferrari	University of Cambridge, United Kingdom	**Ruth Pachter**	Air Force Research Laboratory, USA
Dorri Halbertal	Columbia University, USA	**Tereza Porozova**	HeXalayer, LLC, USA
Han Htoon	Los Alamos National Laboratory, USA	**Matthew Rosenberger**	University of Notre Dame, USA
Pinshane Huang	University of Illinois at Urbana-Champaign, USA	**Siddharth Saxena**	University of Cambridge, United Kingdom
Philip Kim	Harvard University, USA	**Qing Hua Wang**	Arizona State University, USA
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Symposium EQ08: New Frontiers in the Design, Fabrication and Applications of Metamaterials and Metasurfaces

Metamaterials and metasurfaces are artificial composite materials (3D) and surfaces (2D) that through structural design enable exotic properties not easily obtainable or unavailable in nature. Metamaterials have achieved remarkable progress in the optical region by using 2D and 3D nanostructures, and the concept has been rapidly expanded to other fields including mechanics, acoustics, and thermodynamics. Most recently, quantum metamaterials and topological metamaterials have been demonstrated, which allow us to explore intriguing phenomena beyond the classical regime. The further development of metamaterials requires collective effort in many aspects, ranging from fundamental physics to new design approaches, novel fabrication techniques, and practical applications. This symposium aims at bringing together researchers with diverse backgrounds from physics, materials science, engineering, and manufacturing, to share recent breakthroughs in metamaterials across different disciplines, identify critical issues, and exchange ideas for future directions.

Topics will include:

- Nonreciprocal and non-Hermitian photonic metamaterials and metasurfaces
- Topological, quantum and dielectric metamaterials and metasurfaces
- Multi-functional metamaterials and metasurfaces with desired optical, mechanical, thermal and acoustic properties
- Machine learning, deep learning, and other optimization methods for metamaterials and metasurfaces
- Design of metamaterials and metasurfaces across different scales
- Atomically-thin metasurfaces using 2D materials
- Scalable fabrication and borrom-up fabrication of metamaterials and metasurfaces
- Additive and subtractive manufacturing of metamaterials and metasurfaces
- Active and tunable metamateruals and metasurfaces
- Super-resolution imaging and biomedical diagnostics and sensing applications
- Structural colors, holography, and anticounterfeiting

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

Invited speakers include:

Andrea Alu	The City University of New York, USA
Che Tlng Chan	Hong Kong University of Science and Technology, Hong Kong
Debashis Chanda	University of Central Florida, USA
Xianzhong Chen	Heriot-Watt University, United Kingdom
Patrice Genevet	Centre National de la Recherche Scientifique, France
Harald Giessen	Universität Stuttgart, Germany
Su-Hyun Gong	Korea University, Republic of Korea
Lingling Huang	Beijing Institute of Technology, China
Seong Chan Jun	Yonsei University, Republic of Korea
Cherie Kagan	University of Pennsylvania, USA
Yuri Kivshar	The Australian National University, Australia
Arseiny Kuznetsov	Agency for Science, Technology and Research, Singapore
Byoungho Lee	Seoul National University, Republic of Korea
Howard Lee	University of California, Irvine, USA
Guixin Li	Southern University of Science and Technology, China
Jensen Li	The Hong Kong University of Science and Technology, Hong Kong
Yongmin Liu	Northeastern University, USA
Bumki Min	Korea Advanced Institute of Science and Technology, Republic of Korea
Ki Tae Nam	Seoul National University, Republic of Korea
Cheng-Wei Qiu	National University of Singapore, Singapore
Ranjan Singh	Nanyang Technological University, Singapore
Takuo Tanaka	RIKEN, Japan
Din Ping Tsai	The Hong Kong Polytechnic University, Hong Kong
Jason Valentine	Vanderbilt University, USA
Jinkyu Yang	University of Washington, USA
Lan Yang	Washington University in St. Louis, USA
Shuang Zhang	University of Birmingham, United Kingdom
Yuebing Zheng	The University of Texas at Austin, USA

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Symposium EQ09: Cutting-Edge Plasma Processes for Next-Generation Materials Science Applications

Plasmas play a crucial role in a vast range of processes for materials synthesis and processing, from industrial settings to cutting-edge laboratory investigations. Plasma-based techniques can be deployed in a wide range of experimental conditions, varying from low- to high-pressure (vacuum, atmospheric and above), temperature and including diverging degrees of equilibrium (from thermal equilibrium to non-equilibrium). These features are key to develop next generation materials and their potential integrations for advanced applications. Due to the wide range of processing conditions and the characteristic energy coupling, the unique reaction pathways of plasmas have enabled the establishment of important and widespread techniques (e.g. PECVD, physical sputtering, reactive etching). These characteristic plasma features are now creating cutting edge next-generation material processes, which include the potential of many plasma-enhanced techniques (e.g. plasma-assisted 3D printing and atomic layer etching) as well as novel evolving approaches (e.g. flow-through nucleation, hybrid plasma-liquid processes, 'plasma catalysis').

This symposium is a forum that brings together experts in different fields that encompass different areas of plasma-based synthesis, processing and applications. Specifically, the symposium aims to highlight how plasmas can greatly contribute to innovative 3D printing, the development of biosensors, processes for flexible/textile and unconventional surfaces. It will emphasize materials with unique and tailored properties for energy applications, materials for extreme conditions and structural composites. Further, the complexity of plasmas ideally lends itself to data-driven materials research. Therefore, the symposium will also include topics that relate to artificial intelligence and machine learning allowing optimization of material synthesis and treatment and efficient exploration in the parameter space.

Topics will include:

- Plasma processes for biosensors and biomaterials synthesis
- Plasmas for 3D printing, bioprinting and additive manufacturing
- Machine Learning, artificial intelligence etc. applied to plasma processes
- Plasma for e-textiles, flexible electronics and other unconventional surfaces
- Light-Weight/High-Strength Composites synthesis by plasmas
- Plasma synthesis and processing of materials for energy harvesting and storage systems
- 'Plasma catalysis' and plasma synthesis of materials for catalysis
- Plasma synthesis and treatment of materials for extreme conditions
- Plasmas for nanomaterials
- Diagnostics and fundamental plasma science for materials processes

Invited speakers include:

Himashi Andaraarachchi	University of Minnesota, USA
Tony Belcher	Boeing, USA
Zheng Bo	Zhejiang University, China
Ageeth Bol	Eindhoven University of Technology, Netherlands
Peter Bruggeman	University of Minnesota, USA
Maria Carreon	South Dakota School of Mines & Technology, USA
I-Chun Cheng	National Taiwan University, Taiwan
Paul K. Chu	City University of Hong Kong, Hong Kong
Fiorenza Fanelli	Consiglio Nazionale delle Ricerche, Italy
Chris Hardacre	The University of Manchester, United Kingdom
Tsuyohito Ito	Tokyo University, Japan
Eva Kovacevic	CNRS/Université d'Orléans, France
Paul Maguire	Ulster University, Ireland
Lorenzo Mangolini	University of California, Riverside, USA
Itagaki Naho	Kyushu University, Japan
David Pai	Université de Poitiers, France
Angela Violi	University of Michigan, USA
Ming Xu	Huazhong University of Science & Technology, China

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Symposium EQ10: Multiferroics and Magnetoelectrics

As the electronics reaching the physical limits to scaling, the integration of multi-functional materials has never been more important. Multiferroics, in which two or more ferroic (ferroelectric, ferro/anti-ferro magnetic, ferroelastic, etc.) orders co-exist, enables non-volatile voltage control of spin degrees of freedom that is crucial for the ultra-low-power computing, spin transistors and the universal memory. Evidently, these materials also offer a remarkable platform to study new phenomena in materials science, condensed matter physics and electronics. Our symposium will highlight the recent progress in this continuously growing field including the predictions of new multiferroics, multiscale modeling of the magnetoelectric interfaces, new emergent phenomena, heterogenous integration, direct imaging of ferroic domains, voltage control of spin-to-charge conversion and chiral spin textures (e.g., vortices, Skyrmions), magnetoelectric antennas and magnetic field sensors, and new concepts in magnetoelectric memory. This interdisciplinary symposium will bring together a diverse host of experts across academia, national laboratories and industry to discuss the recent development in theory, synthesis, characterizations, devices as well as the opportunities and challenges in the on-chip integration of multiferroic and magnetoelectric materials. The symposium aims to promote communications and discussions among material scientists, physicists, and electrical engineers for accelerating the development of multiferroic materials for electronic, spintronic and sensoric applications.

Topics will include:

- Computation-guided discovery of new multiferroics
- Hybrid spin-orbit torque magnetoelectric structures and device applications
- Magnetoelectric sensors, antennas, and energy harvesters
- New concepts for magnetoelectric memory devices
- Multiscale modeling of multiferroic and magnetoelectric materials and devices
- Magnon-phonon interactions in multiferroics and magnetoelectrics
- Magnetoelectric thin-films, nanostructures and membranes
- Advanced imaging techniques for multiferroics and magnetoelectrics
- Voltage control of magnetization and spin textures

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

Invited speakers include:

Agnès Barthélémy	CNRS/Thales, France
Laurent Bellaiche	University of Arkansas, Fayetteville, USA
Manuel Bibes	CNRS/Thales, France
Christian Binek	University of Nebraska-Lincoln, USA
Longqing Chen	The Pennsylvaia State University, USA
Sang-wook Cheong	Rutgers University, USA
Kathrin Dörr	Martin-Luther-Universität-Halle-Wittenberg, Germany
Judith Driscoll	University of Cambridge, United Kingdom
Changbeom Eom	University of Wisconsin–Madison, USA
Manfred Fiebig	ETH Zürich, Switzerland
Peter Fischer	Lawrence Berkeley National Laboratory, USA
Martina Gerken	Kiel University, Germany
Quanxi Jia	University at Buffalo, The State University of New York, USA
Hwaider Lin	Winchester Technologies, USA
Ming Liu	Xi'an Jiaotong University, China
Jing Ma	Tsinghua University, China
Sasikanth Manipatruni	Intel Corporation, USA
Lane Martin	University of California, Berkeley, USA
Jeffrey McCord	Kiel University, Germany
Julia Mundy	Harvard University, USA
Yoshichika Otani	The University of Tokyo, Japan
Michael Page	Air Force Research Laboratory, USA
Xiaoqing Pan	University of California, Irvine, USA
Ramamoorthy Ramesh	University of California, Berkeley, USA
Caroline Ross	Massachusetts Institute of Technology, USA
Christine Selhuber-Unkel	Heidelberg University, Germany
Jean-Marc Triscone	University of Geneva, Switzerland
Evgeny Tsymbal	University of Nebraska-Lincoln, USA
Kang L. Wang	University of California, Los Angeles, USA

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Symposium EQ11: Materials, Processes and Device Structures Enabling Next-Generation High-Frequency Flexible Electronics

The vision of flexible electronics is to enable light-weight, cost-effective, power-efficient, and versatile electronic devices to become our daily companions – or in brief, electronics anywhere and anytime. However, despite significant progress in printing techniques, roll-to-roll fabrication, circuit design, and the development of new electronic materials, there is still a large gap between the performance of conventional silicon-based and flexible electronics. This gap is caused by various problems related to processing on flexible substrates, e.g., thermal, mechanical, and chemical stability of flexible substrates, deteriorated charge transport, increased alignment tolerances due to thermal expansion, and many more. In consequence, commercially attractive applications such as wireless communication with flexible sensor tags or high-resolution flexible displays are still a vision of the future. In order to tackle these problems, a joint approach combining material, process, and device development specifically for flexible substrates, is required. In particular, achieving transistors operating above 300 MHz, e.g., needed for medium-range wireless communication, necessitates an effective charge carrier mobility above 20 $cm^2/(Vs)$ for a channel length and overlap of electrodes of <1 µm at voltages lower than 5 V. These targets can only be reached if innovative semiconductor materials are combined with tailor-made integration processes and device architectures.

This symposium aims at bringing together researchers from different communities that are concerned with high-performance flexible transistors, printable functional materials, surface engineering, and processing on flexible substrates to elaborate on strategies for next-generation flexible electronic devices.

Topics will include:

- Printable semiconductor materials with the potential to exceed a mobility of 20 cm^2/(Vs), e.g. (but not limited to) organic semiconductors, transparent conductive oxides, perovskites, metal halides, etc..
- Charge transport, injection, and doping in thin-film devices
- Surface crystallization methods, e.g., meniscus-guided shear-coating
- Interface engineering (Electrodes and dielectric interfaces)
- Advanced thin-film transistor architectures
- Characterization of flexible devices at Ultra-High-Frequencies
- Heat management for high power devices on flexible substrates
- High throughput processes for large-area manufacturing of high-frequency and ultra-high-frequency flexible electronics
- Modeling of high-frequency flexible transistors

Invited speakers include:

Aram Amassian	North Carolina State University, USA
Thomas Anthopoulos	King Abdullah University of Science and Technology, Saudi Arabia
Annalisa Bonfiglio	Università di Cagliari, Italy
Oana Jurchescu	Wake Forest University, USA
Chang-Hyun Kim	Gachon University, Republic of Korea
Masatoshi Kitamura	Kobe University, Japan
Hagen Klauk	Max Planck Institute for Solid State Research, Germany
Maria Antonietta Loi	University of Groningen, Netherlands
Iain McCulloch	King Abdullah University of Science and Technology, Saudi Arabia
Nico Münzenrieder	Free University of Bozen-Bolzano, Italy
Kris Myny	imec, Belgium
Thuc-Quyen Nguyen	University of California, Santa Barbara, USA
Yong-Young Noh	Pohang University of Science and Technology, Republic of Korea
Simon Ogier	Smartkem, United Kingdom
Henning Sirringhaus	University of Cambridge, United Kingdom
Barbara Stadllober	JOANNEUM RESEARCH Forschungsgesellschaft mbh, Austria
Tse Nga Tg	University of California, San Diego, USA
Shu-Jen Wang	Technische Universität Dresden, Germany
Jana Zaumseil	Universität Heidelberg, Germany

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Symposium EQ12: Optical Probes of Nanostructured, Organic and Hybrid Materials

The central objective of this symposium is to discuss the use of light to induce and to probe processes in nanostructured, organic, and hybrid semiconductor materials. Advanced spectroscopies, that not only give temporal, spectral, and/or spatial insight into optoelectronic materials, but also permit manipulation of light-matter interactions via nonlinear optical response, are now critical characterization tools in materials science. This symposium emphasizes optical spectroscopy as a key probe of fundamental material properties, as well as the leading tool to explore materials where emergent light-matter interactions form the basis of practical applications. It provides a platform for material scientists to explore the convergence of established and emerging spectroscopic techniques for contemporary material characterization and development.

Topics will include:

- Photophysical processes at interfaces
- Strong light-matter interactions and quantum phenomena
- Excited states in nanocrystals, nano-platelets and low-dimensional materials
- Light-induced phenomena in hybrid perovskites
- Excitonic processes in organic materials
- Spectroscopic insights to bioelectronics
- Insights from advanced spectroscopic tools
- Spatio-temporally resolved optical probes of materials
- Novel theoretical approaches to many-body phenomena
- Theoretical frameworks for excited-state dynamics

Invited speakers include:

Matthew Beard	National Renewable Energy Laboratory, USA
Jenny Clark	The University of Sheffield, United Kingdom
Elisabetta Collini	Università degli Studi di Padova, Italy
Steven Cundiff	University of Michigan, USA
David Ginger	University of Washington, USA
Naomi Ginsberg	University of California, Berkeley, USA
Feliciano Giustino	Oxford University, United Kingdom
Matthew Graham	Oregon State University, USA
Sophia Hayes	University of Cyprus, Cyprus
Felipe Herrera	Universidad de Santiago de Chile, Chile
Libai Huang	Purdue University, USA
Cherie Kagan	University of Pennsylvania, USA
Stéphane Kéna-Cohen	Polytechnique Montréal, Canada
Jenny Nelson	Imperial College London, United Kingdom
Tammie Nelson	Los Alamos National Laboratory, USA
John Reynolds	Georgia Institute of Technology, USA
Jiri Vanicek	École Polytechnique Fédérale de Lausanne, Switzerland
Cathy Wong	University of Oregon, USA
Kaifeng Wu	Dalian Institute of Chemical Physics, Chinese Academy of Sciences, China
Nobuhiro Yanai	Kyushu University, Japan
Joel Yuen-Zhao	University of California, San Diego, USA
Xiao-Yang Zhu	Columbia University, USA

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Symposium EQ13: Nitride Materials—Synthesis, Characterization and Modeling

Nitride materials feature diverse properties ranging from metals and superconductors to semiconductors and insulators. Because of this broad range of properties, nitrides are researched for numerous applications including (opto)electronics, (electro)catalysts, chemical sensors, energy storage, piezo- and ferroelectrics, protection coatings, high-temperature ceramics, as well as quantum and photonic devices. Unfortunately, these sub-fields of nitrides rarely overlap at conferences and in literature, representing a missed opportunity for cross-pollination. However, these distinct nitride topics feature several cross-cutting themes, also of interest to broader material science community. These themes include synthesis approaches (physical and chemical), characterization methods (for chemical composition and nanoscale structure), and computational techniques (thermodynamic stability and electronic structure)

This symposium will focus on exploratory synthesis, advanced characterization and theoretical modeling of nitride materials. The goal of this cross-cutting symposium is to bridge distinct sub-fields of nitride materials research, such as semiconductors and heterostructures; piezoelectric and ferroelectric nitrides; superconducting and photonic nitrides; nitride coatings and ceramics; as well as nitrides for catalytic, battery and sensing applications. Contributions on other applications of nitrides, and on basic science of nitride materials are also welcome. Particular emphasis will be on discovery and design of novel nitrides, with the focus on theoretical predictions of structure and properties, thermodynamically-driven and kinetically-controlled synthesis science, and materials chemistry of synthesis-composition-structure-property relationships.

Topics will include:

- Synthesis: vacuum deposition, epitaxial growth, high-pressure, chemical routes
- Characterization: composition (e.g. nitrogen), structure (e.g. atom probe), and properties
- Computations: structure prediction, property calculation, data mining, materials genome
- Materials chemistry and synthesis science of metastable nitride compounds and alloys
- Emerging semiconductors such as cubic and ternary nitrides, boron and rare-earth nitrides
- Traditional III-N semiconductors and their heterostructures with e.g. superconductors.
- Dielectric, piezoelectric, ferroelectric, thermoelectric nitrides for electronics and energy
- Quantum and superconducting electronic applications of nitrides, and quantum materials
- Photonic, plasmonic, waveguide and other optical applications of nitride materials
- Corrosion-, thermal- and wear-resistant coatings, ceramics and composites based on nitrides
- Photoelectrocatalysis, energy storage, and chemical sensing with nitride materials

Joint sessions are being considered with **CH02 - Solid-State Chemistry of New Materials**.

Invited speakers include:

Igor Abrikosov	Linköping University, Sweden
Paul Attfield	The University of Edinburgh, United Kingdom
Sage Bauers	National Renewable Energy Laboratory, USA
Geoff Brennecka	Colorado School of Mines, USA
Ana Cros	Universitat de València, Spain
Francis DiSalvo	Cornell University, USA
Alan Doolittle	Georgia Institute of Technology, USA
Per Eklund	Linköping University, Sweden
Amparo Fuertes	Institut de Ciència de Materials de Barcelona, Spain
Hiroshi Funakubu	Tokyo Institute of Technology, Japan
Daniel Gall	Rensselaer Polytechnic Institute, USA
Yuri Gogotsi	Drexel University, USA
Ann Greenaway	National Renewable Energy Laboratory, USA
Debdeep Jena	Cornell University, USA
Kathleen Kash	Case Western Reserve University, USA
Hiroshi Kegeyama	Kyoto University, Japan
Eva Monroy	Commissariat à l'énergie atomique et aux énergies alternatives, France
Joerg Neugebauer	Max-Planck-Institut für Eisenforschung, Germany
Rainer Niewa	Universität Stuttgart, Germany
Fumiyasu Oba	Tokyo Institute of Technology, Japan
Panos Patsalas	Aristotle University of Thessaloniki, Greece
Wenhao Sun	University of Michigan, USA
Grace Xing	Cornell University, USA
Hongping Zhao	The Ohio State University, USA
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Symposium EQ14: Materials and Devices for Controlling Quantum-Coherent Spin Dynamics

Quantum information science relies on the isolation and control of complex, many-body configurations of quantum-mechanical states. Electronic and nuclear spins in solid-state materials are natural building blocks for quantum technologies, whether as memory or processing elements (qubits), transducers of classical fields (sensors), or coherent interfaces for quantum fields (e.g., as light-matter interfaces or magnonic quantum buses). Materials and device design principles that enable these quantum applications also underlie recent advances in efficient classical information technologies such as magnetic memory and spin logic. Quantum-coherent spin phenomena occur in various materials spanning semiconductors, metals, and insulators, and in morphologies spanning bulk three-dimensional crystals, two-dimensional sheets, optoelectronic devices and heterostructures, down to individual molecules. In all these materials, spins interact in complex ways with photons, phonons, and charge carriers, and they can be controlled using external fields in nanoscale devices amenable to realizing new technologies at scale. Improvements in materials synthesis, theory, computation, fabrication, and measurement techniques will facilitate the realization of increasingly complex heterostructure materials, devices, and experimental protocols that use spins to store, manipulate, and transduce quantum or classical information.

This symposium will bring together scientists researching spin dynamics across these diverse materials platforms, with an emphasis on emerging materials, new experimental and theoretical techniques, and cross-cutting device concepts that enable the control of spin dynamics for rapidly evolving information technologies.

Topics will include:

- Quantum defects in insulators and wide-gap semiconductors
- Coherent spin-photon interfaces: quantum dots, single defects, molecules
- Spin and valley dynamics in two-dimensional semiconductors and van der Waals heterostructures
- Spin and information transfer through hybrid materials interfaces
- Quantum sensing and magnetometry with spin defects
- Optically or electrically induced spin dynamics in nano-structures
- Networks of coherent nuclear spins
- Molecular magnets and nanomagnets
- Coherent magnonics and coherent magnon/spin and magnon/photon coupling
- Spin transport in oxides, semiconductors, and metals
- Spin torque and spin torque devices
- Manipulation of spin coherence and singlet/triplet dynamics in organic materials and devices

Joint sessions are being considered with **EQ01 - Quantum Optical Materials and Devices Based on Impurity Systems**.

Invited speakers include:

Igor Aharonovich	University of Technology Sydney, Australia	**Ezekiel Johnston-Halperin**	The Ohio State University, USA
Guido Burkard	Universität Konstanz, Germany	**Shun Kanai**	Tohoku University, Japan
Sam Carter	U.S. Naval Research Laboratory, USA	**Helena Knowles**	University of Cambridge, United Kingdom
Nathalie de Leon	Princeton University, USA	**John Morton**	University College London, United Kingdom
Vladimir Dyankonov	Julius-Maximilians-Universität Würzburg, Germany	**Yoshichika Otani**	RIKEN, Japan
Sophia Economou	Virginia Tech, USA	**Tim Taminiau**	Delft University of Technology, Netherlands

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Symposium EQ15: Soft Matter Materials and Mechanics for Haptic Interfaces

Haptic devices create or measure tactile sensations for the human perception of touch. Applications for haptic devices are far-reaching, from virtual or augmented reality to prosthetics, telesurgery, rehabilitation, and education. However, there are technical and scientific challenges behind fabricating lightweight and flexible devices, measuring or mimicking natural tactile stimuli, and fundamental knowledge between material properties and tactile sensations. The human-machine interface in haptic devices is mechanically complex and currently poorly served by materials innovations. The goal of this symposium is to bring together experts in haptics devices and systems with experts in soft matter chemistry, mechanical actuation and contact mechanics.

This symposium will cover applied and fundamental haptics materials research. Topics include the device engineering of soft robotics to actively create or measure tactile sensations, stimuli-responsive materials for actuation, and fundamental work on connecting material properties and mechanical stimuli to human perception. Advances in haptic interfaces will require an interdisciplinary team representing materials sciences, contact mechanics, robotics, device engineering, human psychophysics, and neuromechanics. We hope that this symposium will bridge haptics and materials innovation to generate new interdisciplinary ideas and collaborations.

Topics will include:

- Haptic displays and sensors
- Soft actuators
- Stimuli-responsive polymers
- Soft robotics
- E-textiles and wearables
- Flexible and stretchable electronics
- Biointerfaces and biomaterials
- Bioelectronics
- Contact and adhesion mechanics
- Microelectromechanical systems
- Biological and thin-film sensors

Invited speakers include:

Lucy Dunne	University of Minnesota, USA
Greg Gerling	University of Virginia, USA
Laure Kayser	University of Delaware, USA
Rebecca Kramer-Bottiglio	Yale University, USA
Darren Lipomi	University of California, San Diego, USA
Nanshu Lu	The University of Texas at Austin, USA
Yigit Menguc	Facebook Reality Labs, USA
Allison Okamura	Stanford University, USA
John Rogers	Northwestern University, USA
Rob Shepherd	Cornell University, USA
Hong Tan	Purdue University, USA
Benjamin Tee	National University of Singapore, Singapore
Hayward Vincent	Sorbonne Université, France
Yon Visell	University of California, Santa Barbara, USA

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Symposium EQ16: Infrared and Thermal Photonic Materials and Their Applications

This symposium addresses emerging material challenges in the field of infrared and thermal photonics. The symposium overviews recent cutting-edge advances in emergent material properties, photonic design, light-materials interaction at the nanoscale, and novel device platforms across mid and far infrared wavelength spectra. The symposium covers fundamental materials science, promising applications, and novel fabrication techniques.

Infrared radiation harnessing plays an increasingly important role in a diverse range of applications from energy harvesting to imaging and spectroscopy to heat management. Further progress necessitates novel material platforms for more efficient control of radiation across this part of electromagnetic spectrum to enable systems with higher performance, smaller size, increased speed, tunability, and lower energy. The recent discoveries of two-dimensional materials, materials with tunable optical properties, advances with metamaterials, polaritonic crystals, electronic bad engineering and doped semiconductors can enable breakthrough solutions for infrared photonic applications.

Topics will include:

- Graphene and other 2D materials with strong mid-IR responses
- Small band gap and topological materials
- Infrared materials with near-zero permittivity and hyperbolic dispersion
- Dynamically switchable and phase change materials
- Materials and structures for radiative heat management
- Near-field radiative heat transfer
- Surface phonon polaritons and other excitations
- Advances in thermophotovoltaics
- Infrared imaging and spectroscopy
- Sources and detectors of infrared radiation
- Thermally emissive materials
- Energy harvesting and sustainability

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

Invited speakers include:

Hatice Altug	École Polytechnique Fédérale de Lausanne, Switzerland
Harry Atwater	California Institute of Technology, USA
Viktoriia Babicheva	The University of New Mexico, USA
Philippe Ben-Abdallah	Institut d'Optique, France
Alexandra Boltasseva	Purdue University, USA
Igal Brenner	Sandia National Laboratories, USA
Juan Carlos Cuevas	Universidad Autónoma de Madrid, Spain
Sheila Edalatpour	University of Maine System, USA
Stavroula Foteinopoulou	The University of New Mexico, USA
Francisco Javier Garcia de Abajo	Institut de Ciències Fotòniques, Spain
Jean-Jacques Greffet	Institut d'Optique, France
Tony Heinz	Stanford University, USA
Rainer Hillenbrand	CIC nanoGUNE, Spain
Frank Koppens	ICFO – The Institute of Photonic Sciences, Spain
Alexey Kuzmenko	Université de Genève, Switzerland
Andrej Lenert	University of Michigan, USA
Tony Low	University of Minnesota, USA
Laurent Pilon	University of California, Los Angeles, USA
Michelle Povinelli	University of Southern California, USA
Pramod Reddy	University of Michigan, USA
Aaron Sternbach	Columbia University, USA
Giulia Tagliabue	École Polytechnique Fédérale de Lausanne, Switzerland
Jason Valentine	Vanderbilt University, USA
Virginia Wheeler	U.S. Naval Research Laboratory, USA
Zongfu Yu	University of Wisconsin–Madison, USA
Mona Zebarjadi	University of Virginia, USA
Bo Zhao	Stanford University, USA

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Symposium EQ17: Emerging Materials for Contacts and Interfaces in Optoelectronics

Optoelectronic devices – including a wide variety of solar cells, smart windows, light emitting diodes, but also photoelectrochemical cells for solar-driven fuel generation – have become increasingly important in our society. These devices are also driving important innovations in materials and device architectures to enable multiple functionalities. In these optoelectronic devices, contacts and interfaces between two adjacent layers are taking a dominant role in their performance. Indeed, for many of these applications, modern contacts increasingly need to fulfill multiple electrical functions such as surface passivation, carrier collection/injection, lateral conductivity, and effective contact to the outer device terminals, while being as broadband transparent as possible or exhibiting anti-reflective properties. Additional constraints may be present such as processing compatibility, overall device stability and reliability, and use of abundant and non-toxic materials. Overall, material design aided by computational and machine learning methods, precision synthesis, the use of hybrid organic-inorganic materials, interfacial engineering and smart integration of contacts in these devices will open the way to new functionality and improved efficiency. Together with contact material innovation, novel characterization methods to elucidate the role of the interfaces in device performance will be required to design of the next generation of optoelectronic devices. The goal of this symposium is to continue the dialogue in a multidisciplinary community of organic and inorganic material and device scientists, physicists, chemists, material modeling and prediction researchers working on optoelectronic materials, interface characterization and devices. We will discuss the current and future needs in contacting materials and interfaces, including those used in high-efficiency solar cells based on hybrid halide perovskites, silicon, organic, thin-film and III-V materials.

Topics will include:

- Functional transparent conducting oxides (TCO) and transparent electrodes.
- Inorganic, organic and hybrid materials for charge transport and extraction layers.
- Buffer layer and contact passivation for solar cells and light emitting devices (CIGS, hybrid perovskites, silicon, CdTe, organic semiconductors).
- Nanomaterials, nanocomposites and 2D materials as interlayers.
- Advanced fabrication processes, damage-free layer growth and post-treatment techniques of nanolayers and thin film contact materials.
- Scalable synthesis and deposition techniques of contact materials (from lab to fab).
- Density functional theory (DFT) and first-principle calculations of optoelectronic materials and interfaces.
- Defect science and stability with respect to external and internal stress factors of contact materials and interfaces.
- *In situ*, *ex situ* and *operando* characterization of contact materials and interfaces via spectroscopy and microscopy methods (TEM, XPS, UPS, SPM, EXAFS, RIXS, STXM).
- Interface engineering and modeling to assess fundamental optoelectronic properties, e.g., charge transfer, band bending, and passivation.
- High throughput computational materials prediction and machine learning approaches for design and modeling of contacts and interfaces in optoelectronic devices.

Joint sessions are being considered with **EN04 - Silicon for Photovoltaics**, and **EN05 - Emerging Energy and Materials 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 September.

Invited speakers include:

Joel Ager	Lawrence Berkeley National Laboratory, USA
Marcus Bär	Helmholtz-Zentrum Berlin, Germany
Henk Bolink	Universitat de València, Spain
Annalisa Bruno	Nanyang Technological University, Singapore
James Bullock	University of Melbourne, Australia
Todd Deutsch	National Renewable Energy Laboratory, USA
Steffen Duhm	Soochow University, China
Elvira Fortunato	Universidade Nova de Lisboa, Portugal
Fan Fu	Empa–Swiss Federal Laboratories for Materials Science and Technology, Switzerland
Giulia Grancini	Università di Pavia, Italy
Robert Hoye	Imperial College London, United Kingdom
Monica Lira-Cantu	Catalan Institute of Nanoscience and Nanotechnology, Spain
Barry Rand	Princeton University, USA
Anna Regoutz	University College London, United Kingdom
Thomas Riedl	Bergische Universität Wuppertal, Germany
Dipankar Das Sarma	Indian Institute of Science, Bengaluru, India
Laura T. Schelhas	National Renewable Energy Laboratory, USA
Nathanaelle Schneider	Centre National de la Recherche Scientifique, France
Adele Tamboli	National Renewable Energy Laboratory, USA
Aron Walsh	Imperial College London, United Kingdom
Nadine Witkowski	Sorbonne Université, France

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Symposium EQ18: Emerging Materials for Quantum Information

To achieve useful application, quantum information systems must increase in size and incorporate more complex control schemes, while also becoming more robust. Tackling these challenges requires a multidisciplinary approach, as diverse as the different physical implementations of qubits themselves. Materials research remains one of the fundamental ways to develop the understanding that can drive progress in both performance and complexity, forming the basis for the engineered quantum systems of the future. Cornerstones of quantum information research include: understanding the link between material properties and the key metrics for quantum information devices; improving the quality of key materials and interfaces in a meaningful way; and discovery of materials and interfaces that enable novel quantum states and manipulation schemes. This symposium will bridge the gap between researchers in the materials science and quantum information device communities by providing a forum that addresses understanding and connections of structure-property relationships for semiconductor spin qubits, superconducting qubits, ion traps, and exotic quasiparticles.

Topics will include:

- Identification of materials or interface issues that limit the performance of quantum information devices
- Advances in technologies for growth, fabrication, and characterization of materials that hold promise for improving quantum state robustness or system size
- Application of numerical modeling to the materials used in quantum information systems to better understand qubit behavior
- Emerging quantum states of matter, such as topological states and others, that hold the promise of encoding quantum information
- New combinations of materials and interface engineering that can enable quantum state transduction between dissimilar quantum systems
- Investigations into structure-property relationships of quantum information devices and materials
- Advances in key technologies underlying control systems for quantum devices, including state preparation, manipulation, and detection

Invited speakers include:

Todd Barick	Sandia National Laboratories, USA
Maya Berlin-Udi	University of California, Berkeley, USA
Maja Cassidy	The University of Sydney, Australia
Elham Fadaly	Eindhoven University of Technology, Netherlands
Mark Gyure	University of California, Los Angeles, USA
Frances Hellman	University of California, Berkeley, USA
Nico Hendrickx	Delft University of Technology, Netherlands
David Jamieson	The University of Melbourne, Australia
Jelena Klinovaja	University of Basel, Switzerland
Corey Rae McRae	National Institute of Standards and Technology, USA
John Nichol	University of Rochester, USA
Ravi Pillarisetty	Intel Corporation, USA
Sven Rogge	University of New South Wales, Australia
Javad Shabani	New York University, USA
Richard Silver	National Institute of Standards and Technology, USA
Stephanie Simmons	Simon Fraser University, Canada
Kenta Takeda	RIKEN, Japan
Anne-Marije Zwerver	Delft University of Technology, Netherlands

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Symposium EQ19: Diamond and Diamond Heterojunctions—From Growth to Applications

Due to its unique properties diamond is a material that enables applications in challenging environments. Recent development in the areas of high power electronics, heat spreaders, MEMs, room temperature quantum applications, tissue engineering and catalysis at extreme potentials are among the most promising. This was fueled by achievements such as major improvements in single crystalline diamond homo- and hetero-epitaxial growths following demand for high quality single crystalline diamond films with large and smooth (opto-electronics, waveguides), defect free surfaces, which can be bonded to III-V-materials and 3D-device architectures for power electronics. Selective doping enables the development of high quality electronic components made out of diamond such as vertical and lateral devices, Schottky junctions, pin-diodes and FETs. In addition, diamond based electron emitters for the generation of solvated electrons in buffer solutions are currently being developed to reduce CO_2 or N_2 into fuels, chemical building blocks or ammonia, as a means to cope with greenhouse gas emissions and the increasing demand for fuels and fertilizers. Further, the application of lattice defects such as NV, GeV and SnV for magnetometry gains increasing momentum for the generation of new devices related to navigation, local current sensing, geology, MRI and many more. Hybrid electronic systems that combine diamond's excellent thermal properties with materials such as GaN based MMICs have been demonstrated. Beyond monocrystalline diamond, applications of functionalized nanodiamonds as biomarkers and for drug delivery, cancer diagnosis and therapy as well as in tissue engineering and catalysis. Diamond coatings are biocompatible and can be functionalized for in-vivo applications ranging from tissue engineering to neuron interfaces and stimulants. This symposium will bring together researchers from academia and industry, to discuss and introduce the perspectives and possibilities of diamond and diamond hybrid materials development as well as diamond hetero-junctions to stimulate new applications, new ideas and collaborations in the science communities ranging from biology, quantum technology to electronic applications all over the world.

Topics will include:

- Advances in homo- and hetero-epitaxial-growth of single-crystalline diamond.
- Novel bonding approaches to manufacture diamond to III/V and other materials
- Diamond optical applications in high power laser systems.
- Synthesis of diamond with defects, impurities and doping of diamond and correlated electrical, optical and mechanical properties.
- Diamond materials for magnetometry and single photon-generation, e.g. supporting architectures, wave-guides, couplers, etc.
- High performance diamond-based electronic devices, including delta-doped devices, hydrogen-terminated 2D hole-gas devices, high power devices, GaN/diamond hybrids, high frequency devices and IGFETs.
- Efficient diamond-based electron and UV emitters and detectors and particle detectors.
- Diamond and diamond based hetero-structures in thermionic, photo-induced and field-emission.
- Diamond electrode arrays on rigid or flexible substrates for assessing neural signaling and plasticity
- Nanoscopic diamond powders/films and their functionalization for sensing, imaging and separations, including SAW, MEMS/NEMS and photonic devices as well as for medical applications as biomarkers and for drug delivery monitoring.
- Nanoscopic diamond powders/films for photocatalytic and electrocatalytic applications

Joint sessions are being considered with **EQ03 - Spin-Based Sensing at the Nanoscale and Hyperpolarization with NV-Diamond and Beyond**.

Invited speakers include:

Jocelyn Achard	Centre National de la Recherche Scientifique, France
Amanda Barnard	The Australian National University, Australia
Ania Bleszynski Jayich	University of California, Santa Barbara, USA
Shery Chang	University of New South Wales, Australia
Nathalie de Leon	Princeton University, USA
Yasuaki Einaga	Keio University, Japan
Adam Gali	Wigner Fizikai Kutatóközpont, Hungary
Robert Hamers	University of Wisconsin–Madison, USA
Mutsuko Hatano	Tokyo Institute of Technology, Japan
Quan Li	The Chinese University of Hong Kong, Hong Kong
Renbao Liu	The Chinese University of Hong Kong, Hong Kong
Elke Neu-Ruffing	Technische Universität Kaiserslautern, Germany
Julien Pernot	Centre National de la Recherche Scientifique, France
Bohuslav Rezek	Czech Technical University in Prague, Czech Republic
Olga Shenderova	Adámas Nanotechnologies, USA
Norio Tokuda	Kanazawa Institute of Technology, Japan
Pilar Villar	University of Cádiz, Spain

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Symposium EQ20: Beyond Graphene 2D Materials—Synthesis, Properties and Device Applications

Beyond graphene two-dimensional (2D) materials are extreme surfaces that offers the ultimate flexibility and scaling potential for device miniaturization, as well as, a remarkable platform to study new phenomena in chemistry, biology and condensed matter physics. These materials exhibit a compellingly wide range of exotic properties such as large exciton binding energies, valley polarization, magnetism and non-trivial topologies that can be strongly coupled to produce correlated properties. These compelling properties are observed in individual atomic layers that can be stacked and/or twisted into synthetic heterostructures that are susceptible to physical, electrical and/or chemical modifications. All of these physical properties are intricately dependent on the composition, structure, layer number and phase. These layers can be exfoliated from bulk crystals or developed into large area, high purity grown synthetic heterojunctions with atomically clean interfaces. As the design space of synthetic 2D materials continues to expend, new functionalities and applications will emerge. This interdisciplinary symposium brings together a diverse host of researchers to capture the latest developments in synthesis, properties, characterization and applications of “beyond graphene” 2D materials, with emphasis on elemental (phosphorene, silicene, tellurene, etc.), 2D compounds (MXenes, oxides, nitrides and carbides) and 2D layered (transition-metal di-/tri-chalcogenides, group-III/-IV chalcogenides) materials, alloys and van der Waals heterostructures. This symposium will also focus on recent progress of novel devices enabled by 2D materials, particularly with recent developments in viable routes for large scale synthesis, doping and integration of monolayers, lateral and vertical heterostructures, and the emergence of 2D perovskites and hybrid organic-inorganic 2D heterostructures.

Topics will include:

- Largescale Synthesis, Doping and Alloying of 2D Materials and van der Waals Heterostructures.
- Fundamental Physical Properties in van der Waals Heterostructures.
- Processing of Elemental and Other 2D Materials (i.e. Oxides, Nitrides, MXenes, etc.) Beyond Graphene.
- 2D Materials for Neuromorphic Computing and Quantum Technologies.
- Recent Advances in Sensors, Detectors, Actuators and Energy Storage.
- Applications in Novel Electronics, Optics and Photonic Devices.
- New Discoveries in 2D Materials and Heterostructures from First Principles Modeling.
- Atomic Scale (Structural, Electrical and Optical, etc.) Characterization.
- Emerging 2D Perovskites, MOFs, COFs and Hybrid Organic-Inorganic 2D Heterostructures.
- Recent Advances in 2D Magnetism, Ferroelectrics and Phase Change Materials.
- 2D Materials Produced by Wet Chemistry for Flexible Devices.

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

Invited speakers include:

Deji Akinwande	The University of Texas at Austin, USA
Kwabena Bediako	University of California, Berkeley, USA
Federico Capasso	Harvard University, USA
Andres Castellano-Gomez	Instituto de Ciencia de Materiales de Madrid, Spain
Manish Chhowalla	University of Cambridge, United Kingdom
Michael Crommie	University of California, Berkeley, USA
Cory Dean	Columbia University, USA
Mircea Dinca	Massachusetts Institute of Technology, USA
Aaron Franklin	Duke University, USA
Tony Heinz	Stanford University, USA
Mark Hersam	Northwestern University, USA
Shengxi Huang	The Pennsylvania State University, USA
Deep Jariwala	University of Pennsylvania, USA
Jieun Lee	Ajou University, Republic of Korea
Lain-Jong Li	The University of Hong Kong, Hong Kong
Allan McDonald	The University of Texas at Austin, USA
Hongkun Park	Harvard University, USA
Aleksandra Radenovic	École Polytechnique Fédérale de Lausanne, Switzerland
Iuliana Radu	imec, Belgium
Joan Redwing	The Pennsylvania State University, USA
Frances Ross	Massachusetts Institute of Technology, USA
Nahid Talebi	Christian Albrechts University in Kiel, Germany
Ursula Wurstbauer	Technische Universität München, Germany
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Symposium SB01: Engineered Functional Multicellular Circuits, Devices and Systems

Living cells ranging from bacteria to those derived from plants and animals have become universal engineering materials for constructing artificial or biomimetic multicellular systems for application in a variety of societal sectors, including biomedicine, energy, agriculture, and environment. Engineers now not only have this new class of materials to play with, but also the opportunity to explore a whole new set of engineering principles leveraging biology. Tremendous opportunities exist for both experimental and theoretical innovations. This symposium thus intends to capture this critical moment and help promote this emerging field, by offering an international forum for discussion on the design principles and theories, fabrication methods, and particular applications of engineered multicellular constructs that may take the form of a circuit, device or subsystem. Abstracts are also sought for (1) engineering functional cellular interfaces with the goal of facilitating a larger scale multicellular assembly and wiring, and (2) applying these engineered constructs in the context of a large system, e.g. implantation into an organism.

This symposium will be of interest to a diverse population of interdisciplinary scientists involved with the development, characterization and application of cell-based constructs for a variety of bioinspired or biorelevant applications. This symposium is open to those engineering efforts that intend to build entirely biological constructs bearing a rational design. Also of interest are the use of non-biological/non-living materials for assisting fabrication of the biological constructs, as well as approaches and studies on biointegration of these engineered constructs in an organism. In addition, this symposium will provide an integrated forum to facilitate coherent interdisciplinary discussions among participants on the basis of applied living materials research toward addressing major challenges in this emerging field. It will also provide a medium to motivate discussions of the societal and economic connections that together will shape this fast-evolving field.

Topics will include:

- Design principles and theories
- Synthetic cell parts, cellular interface engineering
- 2D and 3D tissue microfabrication techniques, microdevices to facilitate structure and functional bioconstruction
- Developmental and regenerative engineering, self-assembly and self-organization
- Genetic engineering to facilitate self-assembly and self-organization
- Biocircuits, biocomputers, biofuel cells, biodevices and biobots
- Living neural implants, living bioelectronics, neuro-electronic hybrids, hybrid devices and systems
- Cortical neural tissue engineering, retinal engineering
- Synthetic morphology, artificial life

Invited speakers include:

Rashid Bashir	University of Illinois at Urbana-Champaign, USA	**Manu Mannoor**	Alabama State University, USA
Itzhaq Cohen-Karni	Carnegie Mellon University, USA	**Josep Samitier Martí**	Institute for Bioengineering of Catalonia, Spain
Leroy Cronin	University of Glasgow, United Kingdom	**Joseph Najem**	The Pennsylvaia State University, USA
Tara Deans	The University of Utah, USA	**Yoonkey Nam**	Korea Advanced Institute of Science and Technology, USA
Rylie Green	Imperial College London, United Kingdom	**Kevin Parker**	Harvard University, USA
Hanlee Ji	Stanford University, USA	**Ada Poon**	Stanford University, USA
Ali Khademhosseini	University of California, Los Angeles, USA	**Jacob Robinson**	Rice University, USA
YongTae Kim	Georgia Institute of Technology, USA	**Shoji Takeuchi**	The University of Tokyo, Japan
Cecilia Leal	University of Illinois at Urbana-Champaign, USA	**Tsachy Weissman**	Stanford University, USA
Michael Levin	Tufts University, USA	**Lingchong You**	Duke University, USA
Carmel Majidi	Carnegie Mellon University, USA		

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Symposium SB02: From Hydrogel Fundamentals to Novel Applications via Additive Manufacturing

This symposium focuses on fundamental aspects and advanced applications of polymer gels, and provides an overview of this emerging field of materials science. Exciting developments of soft materials, including bio-inspired design principles and their applications will be discussed. Our ability to develop functional soft materials with tailored mechanical and biomedical properties is limited by the lack of understanding the relationship between the macroscopic properties and molecular architecture. Even with the most advanced experimental techniques, it is challenging to predict the macroscopic behavior, physical, chemical and biological properties of complex gel systems. State-of art multi-scale modeling in combination with high performance computation enables us to overcome this limitation. Over the past decade hydrogel-based printing/bioprinting became a vital method in emerging technologies ranging from engineering to life sciences. It will be demonstrated that 3D/4D printing can be used in the design and fabrication of advanced functional materials in a customizable way. The meeting will focus on new design approaches and development of new types of materials for rapid prototyping.

The symposium will cover areas from basics research to applications (e.g., tissue engineering, regenerative medicine, soft robotics). The invited presentations will be given by leading researchers from academia, government laboratories, and industry. An important goal of the conference is to promote collaboration across different disciplines such as materials science, physics, chemistry and engineering.

Topics will include:

- Neutral and polyelectrolyte gels
- Responsive gels
- Structure property relationship in polymer networks
- Nanostructures in gels
- Gel-Concrete materials
- Transport and dynamic properties
- Modeling and simulation of networks
- Gels as biomaterials
- 3D/4D printing (additive manufacturing and rapid prototyping)
- Soft Robotics
- Self-healing hydrogels

Invited speakers include:

Peter J. Basser	National Institutes of Health, USA	**Paul Janmey**	University of Pennsylvania, USA
Christopher Bettinger	Carnegie Mellon University, USA	**Nir Kampf**	Weizmann Institute of Science, Israel
Lawrence Bonassar	Cornell University, USA	**Richard D. Leapman**	National Institutes of Health, USA
Jason Burdick	University of Pennsylvania, USA	**Jennifer A. Lewis**	Harvard University, USA
Preethi Chandran	Howard University, USA	**Gaio Paradossi**	Università degli Studi di Roma Tor Vergata, Italy
Namita Choudhury	University of South Australia, Australia	**Hang (Jerry) Qi**	Georgia Institute of Technology, USA
Elizabeth Cosgriff-Hernandz	The University of Texas at Austin, USA	**Sandra Van Vlierberghe**	Ghent University, Belgium
Emilios K. Dimitriadis	National Institutes of Health, USA	**Orlin D. Velev**	North Carolina State University, USA
Jack F. Douglas	National Institute of Standards and Technology, USA	**Joost Vlassak**	Harvard University, USA
Jian Ping Gong	Hokkaido University, Japan	**Gordon G. Wallace**	University of Wollongong, Australia
Alan J. Grodzinsky	Massachusetts Institute of Technology, USA	**Xuanhe Zhao**	Massachusetts Institute of Technology, USA
Juergen Groll	Julius-Maximilians-Universität Würzburg, Germany	**Jie Zheng**	The University of Akron, USA

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Symposium SB03: Transformative Nanostructures with Therapeutic and Diagnostic Modalities

Application of nanomaterials and nanotechnology to medical diagnosis and therapy has brought tremendous advances in the development of targeted drug-delivery and bioanalytical systems. Chemically engineered nanostructures tagged with appropriate biomolecules such as antibodies, proteins, DNAs, drug molecules, etc. offer multifunctional nanoprobes enabling transport across biological barriers making cellular and subcellular delivery of poorly soluble drugs possible. Moreover, nanostructures are optimally suited for combination of therapeutic and imaging modalities on a single nanocarrier to deliver dual-vectors that make drug-delivery and cellular diagnostics more effective. Recent advances have shown the potential of biofunctional nanoparticles in stimuli-responsive and site-specific delivery of therapeutic payloads, tracking of intracellular processes and visualization of endocytosis and uptake processes. Moreover, the sensitive extraction and detection of prognostic and diagnostic biomarkers such as microRNAs, proteins and other biomolecules, including those encapsulated in extracellular vesicles, using nanotechnology-based approaches represents a key advancement on the way to early disease diagnosis.

The promises of nanomedicine to improve medical diagnosis and tumor therapy emphasizes the need of an interdisciplinary dialogue at the interface of materials science, biology and medicine. This is especially crucial to address the bottlenecks associated with the translation of proof-of-concept studies into clinically tested and approved products. The major motivation behind this symposium is to bring together scientists exploring nanomaterials for biological and medical applications with experts from regulatory agencies.

Topics will include:

- Materials for targeted delivery of drugs and chemical therapeutics
- Multifunctional nanoprobes with diagnostic, imaging and therapeutic units
- New approaches to image biological processes at nanometer scale
- Nanozyme-based biosensors and therapies
- Neuronanotherapeutics
- Magnetic nanoparticles for hyperthermia applications
- Nanobio-conjugates for advanced sensing and detection
- Cellular uptake and localization studies in animal models
- Pharmacokinetic and dynamics of nanoprobes in biological systems
- Kinetic studies on release of therapeutic cargos
- Nano-biocatalysis

Invited speakers include:

Souad Ammar	Université de Paris, France
Polina Anikeeva	Massachusetts Institute of Technology, USA
Eric Appel	Stanford University, USA
Rizia Bardhan	Iowa State University, USA
Divya Maitreyi Chari	Keele University, United Kingdom
Chia-Liang Cheng	National Dong Hwa University, Taiwan
Catherine Dendrinou-Samara	Aristotle University of Thessaloniki, Greece
Laura Fabris	Rutgers University, USA
Chunhai Fan	Shanghai Institute of Applied Physics, Chinese Academy of Sciences, China
Alessandra Fierabracci	Bambino Gesù Children's Hospital, Italy
Emmanuel Flahaut	Université Paul Sabatier, France
Yao He	Soochow University, China
Eva Hemmer	University of Ottawa, Canada
Inge Hermann	ETH Zürich, Switzerland
Claire Hoskins	University of Strathclyde, United Kingdom
Twan Lammer	RWTH Aachen University, Germany
Verónica Lassalle	Universidad Nacional del Sur, Argentina
Rafik Naccache	Concordia University, Canada
Ines Neundorf	University of Cologne, Germany
Paras N. Prasad	University at Buffalo, The State University of New York, USA
Jae-Chul Pyun	Yosea University, Republic of Korea
Hélder Santos	University of Helsinki, Finland
Kohei Soga	Tokyo University of Science, Japan
Petra Specht	University of California, Berkeley, USA
Orazio Vittorio	Children's Cancer Institute Australia & Australian Centre for Nanomedicine, Australia
Nianqiang Wu	University of Massachusetts Amherst, USA
King Lun Yeung	The Hong Kong University of Science and Technology, Hong Kong

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Symposium SB04: Materials and Algorithms for Neuromorphic Computing and Adaptive Bio-Interfacing, Sensing and Actuation

It is becoming well-known that traditional computing systems are unable to capture the efficiency of the brain in information processing. The computational primitives of biological neural networks on device and circuit level is the first step towards efficient neuromorphic computing systems that are able to analyze, interpret, perceive and act upon a dynamic, real-world environment. Thus, a new era of smart sensor and actuation applications is emerging with systems that perceive and interact with the world and efficiently couple with biological environments. Nevertheless, such intelligent agents also require novel algorithmic support in a co-design fabric. Allowing actual biological substrates to compute is an even longer-term approach to directly harness the biological level of computational efficiency. However, this approach requires materials, devices and systems that would be able to interface biology in a smart and dynamic way beyond signal acquisition. In this symposium, the latest advancements of inorganic and organic materials for bio-inspired information processing and bio-computation will be covered. Emerging applications will be showcased in neuromorphic computing, sensing, actuation and bio-interfacing along with recent advancements in algorithmic development. This symposium aspires to bring together world-wide experts in the fields of neuromorphic computing, bioelectronics and neuroscience in order to enhance transdisciplinary interactions and thus bridge the gaps between materials science, computing and neuroscience by initiating a dialogue around the proposed emerging topic.

Topics will include:

- Bio-inspired information processing
- Neuromorphic computing
- Computational primitives for neuromorphic engineering
- Inorganic and organic materials for neuromorphic devices
- Neuromorphic sensing and actuation
- Adaptive bio-interfacing
- Neural interface devices
- Memristive materials / devices at the interface with biology
- Bioelectronics
- Systems neuroscience
- Algorithmic advances for neuro-inspired computing and smart sensing
- Algorithm-hardware co-design for neuro-inspired computing

Joint sessions are being considered with **SB08 - Bioelectronics—Materials and Interfaces**.

Invited speakers include:

Magnus Berggren	Linköping University, Sweden
Kevin Cao	Arizona State University, USA
Bianxiao Cui	Stanford University, USA
Jullie Grollier	CNRS/Thales, France
Daniele Ielmini	Politecnico di Milano, Italy
Sahika Inal	King Abdullah University of Science and Technology, Saudi Arabia
Dion Khodagholy	Columbia University, USA
Hans Kleemann	Technische Universität Dresden, Germany
Tae-Woo Lee	Seoul National University, Republic of Korea
Hai Li	Duke University, USA
George Malliaras	University of Cambridge, United Kingdom
Robert Nawrocki	Purdue University, USA
Emre Neftci	University of California, Irvine, USA
Beatriz Noheda	University of Groningen, Netherlands
Andreas Offenhäusser	Forschungszentrum Jülich GmbH, Germany
Jonathan Rivnay	Northwestern University, USA
Jacob Robinson	Rice University, USA
Tajana Rosing	University of California, San Diego, USA
Kaushik Roy	Purdue University, USA
Jennifer Rupp	Massachusetts Institute of Technology, USA
Alberto Salleo	Stanford University, USA
Molly Stevens	Imperial College London, United Kingdom
Benjamin Tee	National University of Singapore, Singapore
Fabrizio Torricelli	Università degli Studi di Brescia, Italy
Stefano Vassanelli	Università degli Studi di Padova, Italy
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Symposium SB05: Antimicrobial Materials Against Coronaviruses and Other Nosocomial Pathogens

The COVID-19 pandemic has put a spotlight on the need for antimicrobial materials, not just specifically against the SARS-CoV-2 coronavirus, but against nosocomial pathogens (e.g., hospital acquired infections or HAIs) as well. Functional antimicrobial materials with self-disinfecting properties will play an increasingly important role over the coming years for pandemic prevention. Beyond these outbreaks, the need for antimicrobial products for infection prevention and control within hospitals is well-known: costing upwards of 100,000 deaths annually and $30-45 billion in health-care costs just in the United States, nosocomial infections are an ongoing major health threat that is often overlooked by the public. Dual-purpose antimicrobial materials that can be developed and deployed rapidly in response to an acute health emergency will also have significant benefit to the chronic problem of healthcare-associated infections in hospitals, while also protecting critical supply chains (e.g., food and goods) as well as transportation infrastructure. As no single approach will be able to address such societal needs, this symposium will focus attention on a variety of material design paradigms, spanning frontier research to more mature technologies, that address the need for self-disinfecting materials to prevent pathogen transmission.

Topics will include:

- Materials designed specifically to address a single pathogen (e.g., SARS-CoV-2)
- Broad-spectrum anti-infective materials against a wide variety of pathogens
- Chemical functionalization of polymers to impart antimicrobial properties
- Additives (e.g., antibiotics) for self-disinfecting materials
- Photodynamic and photothermal approaches (e.g., TiO(2), photosensitizers) for antimicrobial materials
- Surface functionalization (e.g., superhydrophobic) to prevent pathogen transmission
- High throughput methods for screening new materials for antimicrobial properties
- Antimicrobial materials for personal protection equipment (PPE)
- Materials for use to prevent pathogen transmission in hospitals and related healthcare settings

Invited speakers include:

Adelaide Almeida	Universidade de Aveiro, Portugal	**Ivan Parkin**	University College London, United Kingdom
William DeGrado	University of California, San Francisco, USA	**Rahim Rahimi**	Purdue University, USA
Elizabeth Dickey	Carnegie Mellon University, USA	**Xuehong Ren**	Jiangnan University, USA
Julie Goddard	Cornell University, USA	**Vincent Sol**	Université de Limoges, France
Kenichi Kuroda	University of Michigan, USA	**Richard Spontak**	North Carolina State University, USA
Catherine Mullié	Université de Picardie Jules Verne, France	**Chuanbing Tang**	University of South Carolina, USA
Sonal Padalkar	Iowa State University, USA	**Nathalie Tufenkji**	McGill University, Canada
Edmund Palermo	Rensselaer Polytechnic Institute, USA	**Qingqing Wang**	Jiangnan University, China

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Symposium SB06: Graphene and Related 2D Materials for Bioelectronics and Healthcare

Both *graphene* and *bioelectronics* are distinctly new and rapidly expanding fields of applied science. Graphene's progression from pure nanoelectronics and fundamental science related material, into an application-related material, has occurred over unprecedented time frames, with many applications nearing market readiness. In this symposium, we will cover the consolidation of these two impactful scientific fields with the core thesis on the use of graphene as a springboard technology for the production of new bioelectronics forms and functions. Symposium content will include, but not limited to, the application of graphene as an active and passive material for neuroelectronic interfaces, production and operation of novel biosensors and bioelectronics architectures, development of wearable devices, and future perspectives of 2D material-based bioelectronics toward device ready technologies. The symposium will also include contributions addressing the fundamental principles of graphene's interaction with biological matter and the practical advantages of it. Present trends in the biocompatibility and cytotoxicity of graphene and related materials will be explored, through formal presentations and discursive forums. This symposium will provide a uniquely comprehensive experimental overview of graphene' and related 2D materials used for diverse bioelectronic, healthcare, neuroscience, and biosensing applications. The symposium will provide a portal to attendees on the present state-of-the-art in research on graphene-based devices, including the production, operation, and integration of 2D material based transistors, electrode arrays, optical biosensors, or *in vivo* probes. The symposium will consider and endorse contributions of works that utilize novel materials beyond *graphene* , including the emerging family of TMDs and related 2D materials (MoS2, MoSe2, hBN, WS2, WSe2, PtSe2, PtTe2, PtS2, etc.) and their heterostructures for bioelectronic applications. This timely symposium will disseminate the findings of this in the vogue research field to a broad audience. It will enable and stimulate the wider academic community to explore the development of 2D-material based bioelectronics towards supporting future on-body, real-time health care monitoring in times of urgently required growth in remote, user-specific healthcare monitoring of the elderly and vulnerable groups.

Topics will include:

- 2D materials for detection and diagnostics of virus infections
- 2D materials for cellular electrophysiology
- Biophysics of graphene and related 2D materials
- Graphene and related 2D materials for brain-computer-interface technologies
- Production of advanced 2D material based biosensors
- Graphene and related 2D materials based wearables
- 2D materials for cancer research
- Optical biosensors enabled by 2D materials
- Graphene based neurosurgical tools

Joint sessions are being considered with **SB08 - Bioelectronics—Materials and Interfaces**.

Invited speakers include:

Jong-Hyun Ahn	Yonsei University, Republic of Korea
Rashid Bashir	University of Illinois at Urbana-Champaign, USA
Cinzia Casiraghi	The University of Manchester, United Kingdom
Monica Craciun	University of Exeter, United Kingdom
Lucia Gemma Delogu	University of Padua, Italy
Jose Garrido	Catalan Institute of Nanoscience and Nanotechnology, Spain
Brett Goldsmith	Cardea Bio Inc., USA
Mark Hersam	Northwestern University, USA
Frank Koppens	ICFO – The Institute of Photonic Sciences, Spain
Duygu Kuzum	University of California, San Diego, USA
Nanshu Lu	The University of Texas at Austin, USA
Arben Merkoci	Catalan Institute of Nanoscience and Nanotechnology, Spain
Tomas Palacios	Massachusetts Institute of Technology, USA
Deblina Sarkar	Massachusetts Institute of Technology, USA
Amaia Zurutuza	Graphenea Nanomaterials, Spain

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Symposium SB07: Soft, Healable Materials and Devices for Biological Interfaces and Wearables

Soft and healable materials and devices are highly demanded for a better biological interfacing and for wearables. However, despite recent advances, their synthesis, development, and fabrication remain challenging due to the difficulty of combining properties that are inherently and mutually exclusive, such as high conductivity, high stretchability, and viscoelasticity. Besides, the applications at the biological interface require these materials and devices to work in humid or environments, as well as excellent biocompatibility with cells and tissues. The symposium will address both fundamental and applied research on current trends, advances, and perspectives for such materials and devices. The symposium will be tentatively divided into four parts: i) emerging soft and healable materials, ii) emerging soft and healable devices, iii) materials processing and advanced manufacturing, and iv) applications at the biological interface, including in vitro and in vivo demonstrations, and sensors for wearables and robots skin etc.

Topics will include:

- Soft, healable electronic materials and devices
- Bioinspired materials and biological interfaces
- Epidermal electronics, e-skin, e-textile materials and devices
- Healable ionic materials
- Conducting materials, hydrogels, composites and fibers
- Advanced manufacturing, 3D, 4D, DLP
- Human-machine interface, soft robots

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

Invited speakers include:

Zhenan Bao	Stanford University, USA
Tricia Breen Carmichael	University of Windsor, Canada
Michael Dickey	North Carolina State University, USA
Alessandro Grattoni	Houston Methodist, USA
Sahika Inal	King Abdullah University of Science and Technology, Saudi Arabia
Jaeyoung Jang	Hanyang University, Republic of Korea
Martin Kaltenbrunner	Johannes Kepler Universität Linz, Austria
Laure Kayser	University of Delaware, USA
Stéphanie Lacour	École Polytechnique Fédérale de Lausanne, Switzerland
Pooi See Lee	Nanyang Technological University, Singapore
Jennifer A. Lewis	Harvard University, USA
Darren Lipomi	University of California, San Diego, USA
Tse Nga Ng	University of California, San Diego, USA
Jin Young Oh	Kyung Hee University, Republic of Korea
Erin Ratcliff	The University of Arizona, USA
Alberto Salleo	Stanford University, USA
Peyman Servati	The University of British Columbia, Canada
Takao Someya	The University of Tokyo, Japan
Junqi Sun	Jilin University, China
Benjamin Tee	National University of Singapore, Singapore
Jadranka Travas-Sejdic	The University of Auckland, New Zealand
Cunjiang Yu	University of Houston, USA
Ting Zhang	Suzhou Institute of Nano-Tech and Nano-Bionics, Chinese Academy of Sciences, China
Xuanhe Zhao	Massachusetts Institute of Technology, USA

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Symposium SB08: Bioelectronics—Materials and Interfaces

Bioelectronics, a field intended to advance healthcare and to provide tools to further understand physiology and pathology, addresses the interface of biological systems with traditional (opto)electronic materials and devices made thereof. 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. Bridging the worlds of biology and electronics, this interdisciplinary symposium will bring together the chemical, physical and biological aspects of the current state-of-the-art bioelectronic interfaces.

Topics will include:

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

Invited speakers include:

Polina Anikeeva	Massachusetts Institute of Technology, USA	**Róisín Owens**	University of Cambridge, United Kingdom
Zhenan Bao	Stanford University, USA	**Jacob Robinson**	Rice University, USA
Magnus Berggren	Linköping University, Sweden	**John Rogers**	Northwestern University, USA
Christopher Bettinger	Carnegie Mellon University, USA	**Francesca Santoro**	Istituto Italiano di Tecnologia, Italy
Kaitlyn Crawford	University of Central Florida, USA	**Takao Someya**	The University of Tokyo, Japan
Bianxiao Cui	Stanford University, USA	**Eleni Stavrinidou**	Linköping University, Sweden
Michele Dipalo	Istituto Italiano di Tecnologia, Italy	**Molly Stevens**	Imperial College London, United Kingdom
Mary Donahue	Linköping University, Sweden	**Bozhi Tian**	The University of Chicago, USA
Laure Kayser	University of Delaware, USA	**Brian Timko**	Tufts University, USA
Stéphanie Lacour	École Polytechnique Fédérale de Lausanne, Switzerland	**Luisa Torsi**	Universita degli Studi di Bari Aldo Moro, Italy
Nanshu Lu	The University of Texas at Austin, USA	**Bernhard Wolfrum**	Technische Universität München, Germany
George Malliaras	University of Cambridge, United Kingdom	**Chong Xie**	Rice University, USA
Andreas Offenhäusser	Forschungszentrum Jülich GmbH, Germany		

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Symposium SB09: Biological and Bioinspired Functional Materials—From Nature to Applications

Morphologically and compositionally structured materials enable new functionalities in a broad range of fields, including optics, electronics, and mechanics. Structuring matter for performance enhancement is a key concept not only in synthetic materials but also in natural systems. Biological materials are often structured across various length scales, which imparts specific functionality vital to the host organism. These materials have provided rich inspiration for scientists and engineers to develop new technologies with optimized performance. The emerging scientific intersection of engineered metamaterials and biological structured matter, bringing together experts in materials science, chemistry, physics, biology, and engineering, will lead to new fundamental understanding, design approaches, novel fabrication techniques, and practical applications.

The proposed symposium will focus on emerging biological and bioinspired materials (nano- to mesoscale, 2D and 3D, soft and hard, or hybrid configuration), their working principle and fundamental properties, multiscale formation processes, fabrication strategies (self-assembly, additive, scalable), and advanced functionalities for electronic, photonic and mechanical applications. This symposium aims at bringing together leading scientists from diverse backgrounds and technical fields across academia and industry to share cutting-edge progress on theoretical and experimental fundamental research, highlight the latest innovations, and stimulate discussions on the impact and challenges of manmade and biological structured materials.

Topics will include:

- Biological and biomimetic materials: multifunctionality, adaptive, and dynamic properties
- Complex, disordered and multiscale materials formation and phenomena
- Theory and modelling of novel properties of biological and bioinspired materials
- Prediction of bioinspired material properties and design using machine learning and AI
- Scalable fabrication: multiscale structuring, self-assembly, additive manufacturing
- Characterization, imaging and spectroscopy of biological and bioinspired materials
- Applications of bioinspired materials in photonics, electronics, mechanics, sensing, energy and medicine

Invited speakers include:

Joanna Aizenberg	Harvard University, USA
Esther Amstad	École Polytechnique Fédérale de Lausanne, Switzerland
Eric Appel	Stanford University, USA
Hyuck Choo	Samsung Advanced Institute of Technology, Republic of Korea
Leila Deravi	Northeastern University, USA
Hendrik Hoelscher	Karlsruhe Institute of Technology, Germany
Ling Li	Virginia Polytechnic Institute and State University, USA
Admir Masic	Massachusetts Institute of Technology, USA
Rox Middleton	University of Bristol, United Kingdom
Benjamin Palmer	Ben-Gurion University of the Negev, Israel
Yael Politi	Technische Universität Dresden, Germany
Gerd Schroeder-Turk	Murdoch University, Australia
Jan Totz	Massachusetts Institute of Technology, USA
Daniel Wagner	Weizmann Institute of Science, Israel
Li Wen	Beihang University, China
Lauren Zarzar	The Pennsylvaia State University, USA

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Symposium SB10: Micro- and Nanoengineering of Biomaterials—From Precision Medicine to Precision Agriculture and Enhanced Food Security

The engineering of biomaterials using micro- and nano-fabrication tools in medicine, food and agriculture has enabled the development of advanced materials that can be interfaced with living systems to bridge the biotic/abiotic interface and as therapeutics. Precision medicine has capitalized on the design of new biomaterials to enhance diagnostic and therapeutic treatments. Recent advances in biomaterials processing have also set the foundations for their uses in agriculture and in food processing, indicating that a material-based innovation can have a large reach to positively impact society. In this symposium, we bring together the most recent advances in modeling, characterization and fabrication of biomaterials and show their successful applications from regenerative medicine to food security.

Topics will include:

- Biomaterials
- Food
- Agriculture
- Food security
- Food safety
- Modeling
- Characterization
- Nanotechnology
- Nanomanufacturing
- Microfabrication
- Biofabrication
- Tissue engineering for food

Invited speakers include:

Athanassia Athanassiou	Istituto Italiano di Tecnologia, Italy	**Lamfeddal Kouisni**	Mohammed VI Polytechnic University, Morocco
Antje Baeumner	Cornell University, USA	**Markita Landry**	University of California, Berkeley, USA
Adam Behrens	Mori, USA	**Joachim Loo**	Nanyang Technological University, Singapore
Francesca Cavalieri	The University of Melbourne, Australia	**Marisa Masumi Beppu**	University of Campinas, Brazil
Mary Chan	Nanyang Technological University, Singapore	**Tony McNally**	The University of Warwick, United Kingdom
Philip Demokritou	Harvard University, USA	**Showan Nazhat**	McGill University, Canada
Lola Eniola-Adefeso	University of Michigan, USA	**Fiorenzo Omenetto**	Tufts University, USA
Margaret Frey	Cornell University, USA	**Kit Parker**	Harvard University, USA
Carmen Gomes	Iowa State University, USA	**Milica Radisic**	University of Toronto, Canada
Alon Gorodetsky	University of California, Irvine, USA	**Jelena Rnjak-Kovacina**	University of New South Wales, Australia
David Kalpan	Tufts University, USA	**Michael Strano**	Massachusetts Institute of Technology, USA
Efrosini Kokkoli	Johns Hopkins University, USA	**Joyce Wong**	Boston University, USA
Ryan Koppes	Northeastern University, USA		

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Symposium SB11: Photo/Electrical Phenomena at the Interface with Living Cells and Bacteria

The utility of electrical and optical phenomena occurring at the interface of materials and living systems is becoming increasingly popular for diagnosis, therapeutics, other clinical procedures, and energy conversion. For instance, the possibility to modulate neuronal excitation and inhibition on demand via external electro/optical stimuli has opened promising perspectives for curing neurological disorders. While the use of electrical stimuli has been the conventional and well-established approach to excite cells and living organisms, the use of light as a spatially precise stimulation tool has emerged during the last decade. It has also been recently shown that bacteria can electrically communicate within their community, in analogy with the extended electrical signaling in neurons and neuronal networks. Moreover, exogenous modulation of bacterial signaling or inherent microbial processes have been seen to play an important role in cellular proliferation, development of antibiotic resistance, and even for the advancement of biofuel cells. Therefore, controlling biological signals and utilizing the photo/electrical processes in excitable eukaryotic and prokaryotic cells in a precise and non-invasive fashion would represent an immense benefit for medical- and energy-related technologies.

The scope of this highly interdisciplinary symposium is to cover the bridge between scientific approaches encompassing electrophysiology, biology, optical spectroscopy, chemistry and materials science, for applications toward biostimulation, sensors, and biofuel cells.

Topics will include:

- Bacterial electrophysiology and signal propagation in bacterial communities
- Extracellular electron transfer
- Optical and electrical sensing across biotic-abiotic interfaces
- Neuronal photostimulation
- Electrical forces, electrochemical gradients, and electrocatalysis in prokaryotic and eukaryotic cells
- Light-matter interaction for modulation of cells signaling
- Biophysics of the cell membrane
- Novel molecular systems and nanotransducers for optical stimulation and bioelectronics

Invited speakers include:

Guillermo Bazan	University of California, Santa Barbara, USA
Richard Cogdell	University of Glasgow, United Kingdom
Moh El-Naggar	University of Southern California, USA
Sahika Inal	King Abdullah University of Science and Technology, Saudi Arabia
Guglielmo Lanzani	Istituto Italiano di Tecnologia, Italy
Jia Liu	Harvard University, USA
Jintao Liu	Tsinghua University, China
Shelley Minteer	The Univeristy of Utah, USA
Róisín Owens	University of Cambridge, United Kingdom
Petra Paiè	Politecnico di Milano, Italy
Christine Payne	Duke University, USA
Teuta Pilizota	The University of Edinburgh, United Kingdom
Ann Rajnicek	University of Aberdeen, United Kingdom
Gurol Suel	University of California, San Diego, USA
Bozhi Tian	The University of Chicago, USA
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Symposium SB12: Biomaterials for Regenerative Engineering

Regeneration of damaged tissues represents a major medical need. A promising approach for development of properly functioning tissue replacements is to utilize engineered biomaterials. Regenerative engineering aims to repair and regenerate damaged or diseased tissues and organs by converging materials science, developmental biology, stem cell incorporation, and clinical approaches. This symposium will cover interdisciplinary topics such as materials science, chemistry, cell biology, physics, engineering, and medicine. The sessions of this symposium will emphasize material properties and applications of biomaterials (polymers, hydrogels, ceramics, metals, elastomers, fibers, composites, gradients) for regenerative tissue engineering. Additionally, we will cover delivery of small molecules (proteins, peptides, growth factors, drugs, micro/nanoparticles, DNA, RNA), and applications of micro- nano-technologies to control cell behavior. We will also emphasize the importance of translation of bench information into patient care by facilitating discussions between engineers, clinicians, and medical device companies. Professionals from different areas of expertise including materials scientists, members of national laboratories, professors, students (undergraduate/gradate), early career scientists, industry members, biotechnology experts, and medical practitioners will be interested in this symposium. This multidisciplinary symposium will serve towards the objectives of the MRS by contributing to education and training of the next generation of materials researchers, providing opportunities for career and professional development of materials scientists, and helping broaden diversity.

Topics will include:

- Hydrogels to control and direct cellular behavior
- Synthetic biomaterials for fabrication of implantable scaffolds
- Scaffolds from biomaterials of natural origin
- Stimuli-responsive polymers and intelligent materials for regenerative medicine
- Rapid prototyping and 3D bioprinting approaches to generate tissue-mimetics
- Biomaterials as artificial tissue replacements
- Cardiovascular biomaterials
- Instructive materials to modulate stem cell behavior
- Micro- nano- technologies for fabrication of tissue scaffolds
- Clinical translation of bench information into bed-side care
- High-throughput approaches for synthesis and screening of biomaterials
- Biomaterials for musculoskeletal tissue engineering
- Poster session: Biomaterials for regenerative engineering
- Poster session: Hydrogel-based materials for tissue regeneration
- Poster session: Synthesis and characterization of biomaterials

Invited speakers include:

Brian Aguado	University of California, San Diego, USA	**Cato Laurencin**	University of Connecticut Health Center, USA
Ipsita Banarjee	University of Pittsburgh, USA	**Chelsea Magin**	University of Colorado Denver, USA
Danielle Benoit	University of Rochester, USA	**Sedat Odabas**	Ankara University, Turkey
Carlos Estrada	Boston Children's Hospital, USA	**Murugan Ramalingam**	Vellore Institute of Technology, India
Eileen Gentleman	King's College London, United Kingdom	**Kaushal Rege**	Arizona State University, USA
Brendan Harley	University of Illinois at Urbana-Champaign, USA	**Rui Reis**	University of Minho, Portugal
Sarah Heilshorn	Stanford University, USA	**Cherie Stabler**	University of Florida, USA
Seda Kizilel	Koc University, Turkey	**Joyce Wong**	Boston University, USA
Abigail Koppes	Northeastern University, USA		

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Symposium SF01: Advanced Atomic Layer Deposition and Chemical Vapor Deposition Techniques and Applications

Chemical vapor deposition (CVD), and its surface limited and self-terminated version atomic layer deposition (ALD) were originally used for depositing uniform thin films. However, in recent years they have developed to enable patterning through selective area deposition methods. The capabilities of CVD and ALD were further enhanced with a wider range of deposited materials such as metals, organic materials, hybrid materials, complex oxides, and doped oxides; deposition parameters such as plasmas sources and atmospheric operation. Modelling and simulation of reaction mechanisms have further increased the understanding and optimization of these processes, assisted by new in situ characterization tools.

As a result of these developments, a wide range of application has bloomed to include energy storage, sensing, protective coatings for extreme conditions, interface-tailoring in advanced composites and surface tailoring in smart textiles, catalysis, photovoltaics, and more. Notably, the ALD and CVD materials often act as enabling components in these applications. This symposium, focused on the ALD and CVD processes rather than their resultant materials, will bring together ALD and CVD researchers often dispersed amongst different, more material focused symposia, to highlight and discuss recent advancements in the field of ALD and CVD, and the technologies they are enabling.

Topics will include:

- Deposition of 2D and metamaterials
- New ALD/CVD precursors and reaction mechanisms
- Simulation and modelling of reaction mechanisms
- Advanced ALD/CVD characterization techniques
- Deposition of organic and hybrid materials
- Energy activated ALD/CVD
- Area Selective ALD/CVD
- Spatial ALD, atmospheric processing, and high throughput
- Devices and applications enabled by ALD/CVD

Invited speakers include:

Sumit Agarwal	Colorado School of Mines, USA	**Sung Gap Im**	Korea Advanced Institute of Science and Technology, Republic of Korea
Sean Barry	Carleton University, Canada	**Gozde Ince**	Sabanci Univeristy, Turkey
Stacey F. Bent	Stanford University, USA	**Maarit Karppinen**	Aalto University, Finland
Anna Maria Coclite	Graz University of Technology, Austria	**Alexander C. Kozen**	University of Maryland, College Park, USA
Adrianna Creatore	Eindhoven University of Technology, Netherlands	**Jeorg Lahann**	University of Michigan, USA
Simon Elliott	Schrödinger, Inc., USA	**Ken Lau**	Drexel University, USA
Steven George	University of Colorado Boulder, USA	**Jessie Mao**	Oklahoma State University, USA
Karen K. Gleason	Massachusetts Institute of Technology, USA	**David Muñoz-Rojas**	Université Grenoble Alpes, France
Robert Hoye	University of Cambridge, United Kingdom	**Daniel Nessim**	Bar-Ilan University, Israel

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Symposium SF02: Additive Manufacturing—From Material Design to Emerging Applications

Additive manufacturing (AM), or 3D printing, has the potential to revolutionize manufacturing by enabling low-cost rapid prototyping, facile customizability, design flexibility, and multimaterial complexity that are not possible with conventional manufacturing technologies. The combination of novel additive manufacturing technologies with advances in materials and processing have enabled fabrication of materials and devices for structural and functional applications that outperform traditional material process-structure-property relations, opening new frontiers in materials design, development, and applications.

This symposium will broadly cover recent advances and developments in additive manufacturing (AM), including material design, processing, characterization, process modeling, and applications. The aim of this symposium is to highlight the unique areas of materials research that are enabled by the emerging approaches of additive manufacturing, and the potential opportunities for future structural and functional materials development. The first part of the symposium will focus on advances of materials, structures, and techniques of AM. The second part of the symposium will focus on the advances of characterization, data science and machine learning, and computational design and modeling for AM.

Topics will include:

- Advances in additive manufacturing of polymers, metals, ceramics, biomaterials and composites
- Advances in additive manufacturing of multi-scale and multi-material components and structures (e.g., multi-scale 3D printing, multi-material 3D printing, hierarchical structures, and architected materials)
- Advances in additive manufacturing techniques (e.g., FFF, SLA, SLS, DIW, and Hybrid AM)
- Advances in characterization and analysis of parts fabricated by additive manufacturing
- Computational design in additive manufacturing
- Additive manufacturing in structural applications (e.g., light-weight, energy-absorbing)
- Additive manufacturing in functional applications (e.g., bio-applications, energy, environment, electronics, robotics)
- New materials, new techniques, and emerging applications in additive manufacturing
- Data science and machine learning in additive manufacturing

Invited speakers include:

Jian Cao	Northwestern University, USA	**Chad Mirkin**	Northwestern University, USA
Yong Chen	University of Southern California, USA	**Hang (Jerry) Qi**	Georgia Institute of Technology, USA
Micheal Dickey	North Carolina State University, USA	**Christopher Spaddaccini**	Lawrence Livermore National Laboratory, USA
Julia R. Greer	California Institute of Technology, USA	**Hayden Taylor**	University of California, Berkeley, USA
Timothy Long	Arizona State University, USA	**Christopher Williams**	Virginia Tech, USA
Wojciech Matusik	Massachusetts Institute of Technology, USA	**Xuanhe Zhao**	Massachusetts Institute of Technology, USA
Michael McAlpine	University of Minnesota, USA	**Xiaoyu Zheng**	University of California, Los Angeles, USA

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Symposium SF03: 3D Printing of Functional Materials and Devices

Materials and methods for printing functional devices represent a critical frontier in additive manufacturing that has attracted a growing number of researchers worldwide. The materials compatibility and inherent versatility of 3D printing methods enable rapid prototyping and scalable, low-cost manufacturing for multiscale and multifunctional devices. The future development of this field requires multidisciplinary communication and collaboration from experts across a broad range of science and engineering fields, with materials occupying a central role. This symposium will span several important and interconnected topics, including but not limited to materials and ink development, printing and post-processing methods, and novel device applications, with a unifying theme of controlling and integrating functionality in printed components and systems.

Topics will include:

- Novel materials, inks, and printing methods for functional devices
- Printed devices for energy conversion and storage
- Printed electronics, optoelectronics, and sensors
- Printed flexible/stretchable devices for wearable applications
- Printed programmable materials, soft robotics and autonomous systems
- Printed devices for harsh and extreme environment
- Hybrid and multi-material printing platforms for advanced integration
- Process simulation and control of functional additive manufacturing technologies
- 3D printing of soft functional materials for biological applications
- 3D conformal printing on nonplanar surfaces
- New approaches to improve printing throughput, scale, fidelity, and function
- Emerging areas of functional printing

Invited speakers include:

Ana Arias	University of California, Berkeley, USA	**Jennifer A. Lewis**	Harvard University, USA
Cinzia Casiraghi	The University of Manchester, United Kingdom	**Michael McAlpine**	University of Minnesota, USA
Michael Dickey	North Carolina State University, USA	**Rahul Panat**	Carnegie Mellon University, USA
Michael Durstock	Air Force Research Laboratory, USA	**Jae Sung Son**	Ulsan National Institute of Science and Technology, Republic of Korea
Mark Hersam	Northwestern University, USA	**Christopher Spaddacini**	Lawrence Livermore National Laboratory, USA
Liangbing Hu	University of Maryland, USA	**Andre Studart**	ETH Zürich, Switzerland
Jessica Koehne	NASA Ames Research Center, USA	**Cheng Sun**	Northwestern University, USA
Rebecca Kramer-Bottiglio	Yale University, USA	**Skylar Tibbits**	Massachusetts Institute of Technology, USA
Vlastimil Kunc	Oak Ridge National Laboratory, USA	**Xuanhe Zhao**	Massachusetts Institute of Technology, USA

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Symposium SF04: New Types of Polymers, Composites and Hybrid Materials for Additive Manufacturing

3D printing, also known as additive manufacturing and solid freeform fabrication, involves layer-by-layer fabrication of a three-dimensional structure through joining of material; structures are created according to the design of a computer-aided design model. In recent years, fused deposition modeling, stereolithography apparatus, inkjet printing, selective laser sintering, and bioprinting technologies have been used to create process polymers, composites, and hybrid materials for high performance applications. For example, data obtained from computed tomography, magnetic resonance imaging, or other medical imaging modalities is currently used as input data for 3D printers to prepare prostheses out of polymers and hybrid materials with patient-specific features. Current challenges associated with the use of 3D printing of polymers, composites, and hybrid materials include (a) the development of novel polymers, composites, and hybrid materials that can be processed rapidly, reproducibly, and with high resolution, (b) the development of novel polymers, composites, and hybrid materials with appropriate biological, mechanical, chemical, corrosion, and/or tribological properties over the over the anticipated lifetime of the device, and (c) the development of low cost materials and high throughput technologies for 3D printing. This symposium will consider the development of new types of polymers, composites, and hybrid materials for 3D printing of medical devices as well as applications of 3D printed structures for high performance applications for aerospace, automotive, consumer, bioscience, and healthcare applications.

Topics will include:

- Advances in Polymer Materials and Composites for Layered Manufacturing
- Innovations in Digital Light Processing-based 3D Printing of Polymers and Hybrid Materials
- Innovations in Selective Laser Sintering of Polymers
- 3D Printing of Shape Memory Materials and other Smart Materials
- Development of Low Cost and High Throughput 3D Printing Processes
- Aerospace, Automotive, Consumer, Bioscience, and Healthcare Applications of 3D Printed Polymers, Ceramics, and Hybrid Materials

Invited speakers include:

Karen Burg	University of Georgia, USA	**Jayanthi Parthasarthy**	The Ohio State University, USA
Phil Campbell	Carnegie Mellon University, USA	**Wei Sun**	Drexel University, USA
Paola Fabbri	University of Bologna, Italy	**Min Wang**	The University of Hong Kong, Hong Kong
Michael Hickner	The Pennsylvania State University, USA	**Wai Yee Yeong**	Nanyang Technological University, Singapore
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