Symposium CH01: Frontiers of *In Situ* Materials Characterization—From New Instrumentation and Method to Imaging Aided Materials Design

Advancement in synchrotron X-ray techniques, microscopy and spectroscopy has extended the characterization capability to study the structure, phonon, spin, and electromagnetic field of materials with improved temporal and spatial resolution. This symposium will cover recent advances of in situ imaging techniques and highlight progress in materials design, synthesis, and engineering in catalysts and devices aided by insights gained from the state-of-the-art real-time materials characterization. This program will bring together works with an emphasis on developing and applying new methods in X-ray or electron diffraction, scanning probe microscopy, and other techniques to in situ studies of the dynamics in materials, such as the structural and chemical evolution of energy materials and catalysts, and the electronic structure of semiconductor and functional oxides. Additionally, this symposium will focus on works in designing, synthesizing new materials and optimizing materials properties by utilizing the insights on mechanisms of materials processes at different length or time scales revealed by in situ techniques. Emerging big data analysis approaches and method development presenting opportunities to aid materials design are welcomed. Discussion on experimental strategies, data analysis, and conceptual works showcasing how new in situ tools can probe exotic and critical processes in materials, such as charge and heat transfer, bonding, transport of molecule and ions, are encouraged. The symposium will identify new directions of in situ research, facilitate the application of new techniques to in situ liquid and gas phase microscopy and spectroscopy, and bridge mechanistic study with practical synthesis and engineering for materials with a broad range of applications.

Topics will include:

- New instruments for *in situ* imaging
- Full cell design for *in situ* imaging of fuel cell and battery materials
- Big data analysis, artificial intelligence and theoretical modeling of materials dynamics
- *In situ* 4D STEM, ptychography and differential phase contrast imaging
- Ultrafast process of materials science
- Self-assembly
- Ion transport
- Dynamics in soft and biology materials
- Phonons and vibrational properties related to bond characteristics in soft materials
- Probing changes in electronic structures and magnetic states
- Semiconductors and oxide devices
- Materials growth aided by mechanisms revealed from *in situ* microscopy
- Electron beam/x-ray interaction with materials

Joint sessions are being considered with **CH03 - Advances in *In Situ* and *Operando* TEM Methods for the Study of Dynamic Processes in Materials**. Also, a **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Ilke Arslan	Argonne National Laboratory, USA
Veronica Augustyn	North Carolina State University, USA
Nina Balke	Oak Ridge National Laboratory, USA
Jennifer Dionne	Stanford University, USA
Hongyou Fan	Sandia National Laboratories, USA
Nathan Gianneschi	Northwestern University, USA
Martin Holt	Argonne national Laboratory, USA
Deb Kelly	The Pennsylvania State University, USA
James LeBeau	Massachusetts Institute of Technology, USA
Aaron Lindenberg	Stanford University, USA
Xiaoqing Pan	University of California, Irvine, USA
Yuki Sasaki	Japan Fine Ceramics Center, Japan
Tao Sun	University of Virginia, USA
Yugang Sun	Temple University, USA
Renske van der Veen	Helmholtz-Zentrum Berlin für Materialien und Energie, Germany
Marc Willinger	ETH Zürich, Switzerland
Jianbo Wu	Shanghai Jiao Tong University, China
Xianghui Xiao	Brookhaven National Laboratory, USA
Judith Yang	University of Pittsburgh, USA
Xiao-Ying Yu	Pacific Northwest National Laboratory, USA
Yimei Zhu	Brookhaven National Laboratory, USA

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Abstract Submission Closes—Thursday, October 28, 2021 (11:59 PM ET)

Symposium CH02: Ultrafast Probes in Emerging Materials

High temporal resolution and the ability to access non-linear optical responses is enabled by the use of femtosecond lasers. These have allowed spectroscopists to observe and rationalize photophysical processes in a variety of complex materials. Recent advances in laser technologies have also pushed these ultrafast probes into a wider energy range, from X-rays to THz and even ultrafast electron probes have emerged. These lead to groundbreaking and relevant discoveries in a broad variety of materials such as biological matter, energy materials and quantum materials. Keeping in mind the steady metamorphosis of these rather niche spectroscopic tools into standard material probes, this symposium takes stock of recent developments in ultrafast spectroscopic techniques in addressing contemporary issues in emerging materials. This provides an ideal platform for both ultrafast spectroscopists and material scientists to explore ways to converge established and emerging techniques for material characterization and development

Topics will include:

- Photo-excitation dynamics in materials, probed via time-resolved spectroscopies
- Structure-property relationships of ultrafast carrier dynamics via spatial probes
- Multi-dimensional and other non-linear spectroscopies exploring many-body physics in materials.
- Defect physics probed via ultrafast optical/opto-electronic spectroscopies
- Ultrafast opto-electronic probes (Stark effects, current, interface potentials) applied to functional devices
- Hybrid methods that employ optical pump and Xray/electron/THz probes.
- Role of vibrations in the fate of optical excitations probed via ultrafast Raman probes
- Experiments that include magnetic, electrical or pressure perturbations to the standard optical detection
- Materials of interest: Energy materials such as metal halide perovskites, Excitonic materials such as 2D transition-metal dichalcogenides, quantum materials including superconductors, quantum dots and other nanostructures, organic semiconductors.

Invited speakers include:

Martin Aeschlimann	University of Kaiserslautern, Germany
Mathew Beard	National Renewable Energy Laboratory, USA
Eric Bittner	University of Houston, USA
Andrea Cavalleri	Max Planck Institute for the Structure and Dynamics of Matter, Germany
Giulio Cerullo	Politecnico di milano, Italy
Jenny Clark	The University of Sheffield, United Kingdom
David Cooke	McGill University, Canada
Keshav Dani	Okinawa Institute of Science and Technology, Japan
Naomi Ginsberg	University of California, Berkeley, USA
Libai Huang	Purdue University, USA
Elaine Li	The University of Texas at Austin, USA

Kalobaran Maiti	Tata Institute of Fundamental Research, India
Jennifer Oglivie	University of Michigan, USA
Tonu Pullerits	Lund University, Sweden
Akshay Rao	University of Cambridge, United Kingdom
Claus Ropers	University of Goettingen, Germany
D. D. Sarma	Indian Institute of Science, Bangalore, India
Julia Stahler	Humboldt-Universität zu Berlin, Germany
Sergei Tretiak	Los Alamos National Laboratory, USA
Cathy Wong	University of Oregon, USA
Joel Yuen-Zhou	University of California, San Diego, USA
Xiaoyang Zhu	Columbia University, USA

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Symposium CH03: Advances in *In Situ* and *Operando* TEM Methods for the Study of Dynamic Processes in Materials

There has been significant interest in the dynamic processes of smart energy materials and devices, where the properties can be controlled by an external stimulus. The possibility for example to manipulate the electronic band structure, magnetic spin and catalytic properties of such materials opens a plethora of new applications. The nature of these dynamic materials requires operando microscopy techniques to characterize their physical properties while simultaneously measuring their functional performance. Recent technological and computational advances in transmission electron microscopy are transforming what dynamic material science processes and phase changes can be explored. The focus of this symposium is on the application of in situ/operando TEM techniques that include heating, biasing, cooling, magnetic fields and mechanical testing to induce and probe phase transitions in functional materials and devices at the nanoscale that, in synergy with theoretical methods, such as first-principles calculations, phase-field, micromagnetics, finite-element based modelling and simulations, help unravel the structure and properties of materials down to the atomic scale. Furthermore, as data collection, analysis and recording of dynamic information is becoming increasingly demanding, we also welcome contributions in computer-aided image analysis and big data processing, including based on artificial intelligence algorithms, to understand the fundamental physics governing the nano- to atomic-scale phase transitions of functional materials and devices.

Topics will include:

- Phase transitions and dynamic process
- *In situ* TEM capabilities (eg. heating, cooling, ion irradiation, mechanical testing
- Operando TEM capabilities (eg. biasing, magnetic fields, environments)
- Advancements in in-situ holders (eg. cryogenic, vacuum transfer)
- Sample preparation techniques for *in situ/operando* a TEM experimentations
- Combination with advanced TEM techniques (phase related, spectroscopy, 4D-STEM)
- Synergies with theoretical methods and data science
- Computer-aided image analysis (including AI for EM) for quantitative studies
- Controlled electron-beam-induced transitions

Invited speakers include:

Trevor Almeida	Commissariat à l'énergie atomique et aux énergies alternatives, France
Judy Cha	Yale University, USA
Miaofang Chi	Oak Ridge National Laboratory, USA
Michele Conroy	Imperial College London, United Kingdom
Jennifer Cookman	University of Limerick, Ireland
Peter Cozier	Arizona State University, USA
Arnaud Demortiere	Université de Picardie Jules Verne, France
Thierry Epicier	Université de Lyon, France
Christoph Gammer	The Austrian Academy of Sciences, Austria
Sang Ho Oh	Sungkyunkwan University, Republic of Korea
Djamel Kaoumi	North Carolina State University, USA
Lena Kourkoutis	Cornell University, USA
Kristian Mølhave	Technical University of Denmark, Denmark
Dane Morgan	University of Wisconsin–Madison, USA
Colin Ophus	Lawrence Berkeley National Laboratory, USA
Christopher Regan	University of California, Los Angeles, USA
Yukio Sato	Kyushu University, Japan
Kiyou Shibata	The University of Tokyo, Japan
Erdmann Spiecker	Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany
Mitra Taheri	Johns Hopkins University, USA
Vasiliki Tileli	École Polytechnique Fédérale de Lausanne, Switzerland
Yang Yang	The Pennsylvania State University, USA
Qian Yu	Zhejiang University, China

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Symposium DS01: Integrating Machine Learning and Simulations for Materials Modeling, Design and Manufacturing

This symposium aims to promote an integrated vision of material design—informed by data and channeled by physics-based simulations. Although numerical simulations have revolutionized materials design, they face several challenges, including high computing cost, limited accuracy, and limited potential for inverse design. Machine learning models also suffer from some limitations, e.g., need for large, consistent, and accurate datasets, questionable extrapolations, potential violations of physics and chemistry laws, and limited interpretability. In that regard, data-driven machine learning models and knowledge-driven simulations have the potential to inform, advance, and complement each other—and to address each other's deficiencies. This symposium builds on the idea that the lack of meaningful integration between data- and knowledge-driven modeling is a missed opportunity in materials science. This symposium will explore new modeling approaches that seamlessly combine and integrate machine learning and simulations—wherein simulation informs machine learning, machine learning advances simulations, or closed-loop integrations thereof.

Topics will include:

- Multi-fidelity models, data-fusion, and transfer learning approaches
- Machine learning to inform simulations (e.g., machine-learned interatomic forcefields)
- Physics-informed machine learning and symbolic learning
- "Self-driving" simulations, reinforcement learning, and robotic synthesis
- Graph neural networks for materials modeling
- Automatic differentiation, inverse problems, and deep generative models
- Machine learning for "finding needles in haystacks" in simulation output data
- Rare events sampling and automated identification of collective variables
- Machine learning for structural and topology optimization
- Machine-learned surrogate simulators
- Natural language processing for materials modeling
- Use of hardware dedicated to deep learning (e.g.,TPUs) to accelerate simulations

Invited speakers include:

Christine Aikens	Kansas State University, USA
Raymundo Arroyave	Texas A&M University, USA
Alán Aspuru-Guzik	University of Toronto, Canada
Muratahan Aykol	Toyota Research Institute, USA
Amanda Barnard	The Australian National University, Australia
Peter Battaglia	DeepMind, United Kingdom
Miguel Bessa	Delft University of Technology, Netherlands
Souvik Chakraborty	Indian Institute of Technology Delhi, India
Maria Chan	Argonne National Laboratory, USA
Jacqueline Cole	University of Cambridge, United Kingdom
Ekin Dogus Cubuk	Google, USA
Payel Das	IBM T.J. Watson Research Center, USA
Marjolein Dijkstra	Utrecht University, Netherlands
George Em Karniadakis	Brown University, USA
Ian Foster	The University of Chicago, USA

Rodrigo Freitas	Massachusetts Institute of Technology, USA
Rafael Gomez-Bombarelli	Massachusetts Institute of Technology, USA
Bjork Hammer	Arhus University, Denmark
N M Anoop Krishnan	Indian Institute of Technology Delhi, India
Emine Kucukbenli	Harvard University, USA
Artrith Nongnuch	Columbia University, USA
Rampi Ramprasad	Georgia Institute of Technology, USA
Subramanian Sankaranarayanan	University of Illinois at Chicago, USA
Yizhou Sun	University of California, Los Angeles, USA
Rama Vasudevan	Oak Ridge National Laboratory, USA
Wei Wang	University of California, Los Angeles, USA
Xiaonan Wang	National University of Singapore, Singapore
Jie Xu	Argonne National Laboratory, USA
Lusann Yang	Google, USA
Tarek Zohdi	University of California, Berkeley, USA

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Symposium DS02: Advanced Manufactured Materials—Innovative Experiments, Computational Modeling and Applications

Materials layered over many length scales are ubiquitous in materials research. They can be found at the nm-scale, built up out of essentially 2D layers. They exist as polymer-matrix fiber composites, built up of 10s to 100s of many thin plies at the µm-cm scale. Additively manufactured (AM) materials fall into this class, composed of a wide spectrum of metals, ceramics, polymers, cementitious, and biological materials, which are built up layer-by-layer, from the sub-µm to m scale, to form a 3D geometry via deposition and solidification processes. All these layered materials produce new experimental and theoretical challenges as they introduce complex multiphysics that is not yet well comprehended. Hence, the development of experimental techniques and high-fidelity theoretical and computational solutions is needed to capture competing physical phenomena and scalability that lead to novel and consistent material properties. This symposium is devoted to recent advances and developments in new layered/AM materials, including design, material processing, techniques, applications, and characterization. There is a special focus on innovative constitutive and numerical paradigms for revealing the pathways towards achieving and optimizing exceptional material properties, design, and production parameters in layered/AM materials. Of high interest is the implementation of strategic physical measurements, fundamental, continuum and/or atomistic based modeling (e.g., molecular dynamics, discrete-element, finite-element, finite-volume, boundary- element, discrete element methods) of AM novel materials, quasi-2D materials, hybrids/multi-materials, and functional composites made from layered materials over any size scale. This symposium welcomes all research that motivates advances in layered/AM materials via experimentation and/or novel theoretical and computational formulations.

Topics will include:

- Advances in additive manufacturing of multi-scale and multi-material structures and techniques (FFF, SLM, SLA, DIW, Hybrid AM).
- Advances in layered/AM of polymers, metals, ceramics, biomaterials and composites.
- Imaging methods for characterization of layered/AM materials (e.g., length scale modalities and computational analysis).
- Virtual experimentation for layered/AM material characterization, prototypes, and cost-effective development and certification (e.g., topology optimization, process, and testing).
- Hybrid and data-driven, machine learning, and acceleration techniques to compute and optimize layered/AM material properties.
- Multiscale characterization analysis for advanced layered/AM materials using physical experimental studies, atomistic- and/or continuum techniques.
- Effects of complex geometries, anisotropy, heterogeneity, defects, and microstructure on layered/AM material properties: Modeling techniques.
- Multiphysics computational techniques and optimization of layered/AM material properties for ultra-fast and high-resolution materials.
- High-frequency asymptotic methods and electromagnetic scattering analysis of 2D metamaterial (e.g., multilayers, metasurfaces and metascreens).
- Material property control and applications of novel layered/AM materials (e.g., metal-organic/hybrid, porous polymers, and functional composites).
- Effects of solidification processes (time and length-scale local phenomena) and precursor properties on AM construct's material properties.
- Characterization techniques for rheology behavior affecting deposition processes of 1D, 2D, and 3D bioprinted and other soft matter constructs.
- Additive manufacturing in structural (e.g., lightweight, energy-absorbing) and functional (e.g., bio-applications, energy, environment, electronics, robotics) applications.
- New materials, new techniques, curated- and comprehensive material databases, and emerging applications in additive manufacturing.

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

Invited speakers include:

Radha Boya	The University of Manchester, United Kingdom	**Karren More**	Oak Ridge National Laboratory, USA
Balamati Choudhury	CSIR-National Aerospace Laboratories, India	**Brian Simonds**	National Institute of Standards and Technology, USA
Junjun Ding	Alfred University, USA	**Susan Sinnott**	The Pennsylvania State University, USA
Edward Garboczi	National Institute of Standards and Technology, USA	**Hayden Taylor**	University of California, Berkeley, USA
Philippe H. Geubelle	University of Illinois at Urbana-Champaign, USA	**Gregory Whiting**	University of Colorado Boulder, USA
Callie Higgins	National Institute of Standards and Technology, USA	**Boris Wilthan**	National Institute of Standards and Technology, USA
Branden Kappes	KMMD Consulting, USA	**Jinhui Yan**	University of Illinois at Urbana-Champaign, USA
Ying Li	University of Connecticut, USA	**Jing Yu**	Nanyang Technological University, Singapore
Wing Liu	Northwestern University, USA	**Xiang Zhang**	University of Wyoming, USA
Michael McAlpine	University of Minnesota, USA	**Xuanhe Zhao**	Massachusetts Institute of Technology, USA

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Symposium DS03: Phonon Properties of Complex Materials—Challenges in Data Generation, Data Availability and Machine Learning Approaches

This symposium will broadly cover current and emerging data generation techniques and data driven analysis approaches to characterize phonons, the quantized vibrations of condensed matter systems. Phonons play an increasingly important role in information-processing applications, both directly and indirectly through interactions with other quasiparticles and energy carriers. A key focus of the symposium will remain on thermal properties of materials enabling such applications. Additionally, studies exploring co-optimization of properties of multiple carriers (e.g., electron and phonon) in a variety of materials, such as thermoelectrics, wide-bandgap semiconductors, and photovoltaics, will be of particular interest. The first part of the symposium will focus on emerging theoretical and experimental techniques to calculate/measure phononic properties of complex materials. Symposium contributions should address basic science issues or highlight exploration of unusual phenomena (e.g., glass like phonon transport in crystals and/or low-symmetry materials), and address challenges in understanding the corresponding physical mechanisms. Discussion of theoretical, computational or experimental characterization techniques, challenges in data generation and applicability of emerging materials for technologies are also welcomed. The second part will focus on machine learning (ML) approaches for phononic property prediction, that are of mutual interest of the broader materials informatics communities. ML-enabled design and discovery of new materials are increasingly being facilitated by large amounts of data available through databases, however, the availability of phonon properties data is limited. Discussion of development and application of physics-based ML models that can work with sparse data and provide consistent validation approaches are particularly of interest. Contributions discussing availability of data and methods to improve data sharing practices are also of interest.

Topics will include:

- Emerging phonon dynamics in complex materials
- Advances in theoretical, computational and experimental phononic property characterization techniques
- Co-optimization of multiple carrier (e.g., phonon, electron) properties for thermoelectrics and other emerging technologies
- Machine learning studies for prediction of thermal properties of nanostructured materials
- Machine learning studies probing interaction of phonons with electrons and other quasiparticles
- Data driven studies for characterization of vibrational properties of complex materials
- Data mining of thermal imaging data
- Phononic property data generation and sharing practices
- Challenges in developing machine learning algorithms with limited training data
- Novel validation approaches to test machine learning model predictions

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

Invited speakers include:

Maria Chan	Argonne National Laboratory, USA	**Jesús Carrete Montaña**	TU Wien, Austria
Stefano Curtarolo	Duke University, USA	**Kristin Persson**	University of California, Berkeley, USA
Pierre Darancet	Argonne National Laboratory, USA	**Xiulin Ruan**	Purdue University, USA
Geoffroy Hautier	Dartmouth College, USA	**Abhishek Singh**	Indian Institute of Science, Bangalore, India
Run Hu	Huazhong University of Science and Technology, China	**Sebastian Volz**	The University of Tokyo, Japan
Shenghong Ju	Shanghai Jiao Tong University, China	**Chris Wolverton**	Northwestern University, USA
Tengfei Luo	University of Notre Dame, USA	**Yibin Xu**	National Institute for Materials Science, Japan
Apurva Mehta	SLAC National Accelerator Laboratory, USA		

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Symposium DS04: Recent Advances in Data-Driven Discovery of Materials for Energy Conversion and Storage

This symposium will cover new advances in data-driven workflows for the development and discovery of energy conversion and storage materials. The first part of the symposium will focus on experimental work including automated and high-throughput synthesis and characterization. The second part of the symposium will focus on computational work including high-throughput computational screening and active learning workflows.

The experimentally focused portion of the symposium will highlight efforts towards data-driven discovery of materials for energy conversion and storage including photovoltaics, electrocatalysts, and electrochemical energy storage devices. To leverage computational advances and new machine learning approaches, it is vital to generate large, high-quality experimental data sets. To this end, automated and high-throughput laboratory equipment can be used to dramatically accelerate data generation in a well structured format. Symposium contributions should address the use of automated or high-throughput approaches to address basic science questions in materials for energy conversion and storage or address applications of data-driven workflows to quickly discover new materials.

The second part of this symposium will highlight computationally focused efforts towards data-driven discovery of materials for energy conversion and storage. Using data-driven approaches for materials design and discovery presents unique challenges and requires innovation in the application of existing computational tools or the development of completely new tools and workflows. Symposium contributions should address the implementation of machine learning approaches to generate or analyze computational data or address the use of high throughput workflows for energy materials screening using computational techniques such as density functional theory (DFT) calculations and molecular dynamics (MD) simulations.

Topics will include:

- Automated laboratories for energy conversion and storage materials discovery
- High-throughput materials characterization
- Active learning in materials discovery
- High-throughput data processing
- Machine learning to predict performance
- Machine learning assisted molecular simulations
- Natural language processing (NLP) for materials discovery
- Physics-based machine learning
- Visualization and interpretation of materials data
- Workflows that combines experiment and simulation

Invited speakers include:

Alán Aspuru-Guzik	University of Toronto, Canada
William Chueh	Stanford University, USA
Jacqueline Cole	University of Cambridge, United Kingdom
Andy Cooper	University of Liverpool, United Kingdom
Abigail Doyle	Princeton University, USA
Rafael Gomez-Bombarelli	Massachusetts Institute of Technology, USA
John Gregoire	California Institute of Technology, USA
Jennifer Lewis	Harvard University, USA
Elsa Olivetti	Massachusetts Institute of Technology, USA
Kenichi Oyaizu	Waseda University, Japan
Kristin Persson	Lawrence Berkeley National Laboratory, USA
Charles M. Schroeder	University of Illinois at Urbana-Champaign, USA
Taylor Sparks	University of Utah, USA
Dee Strand	Wildcat Discovery Technologies, USA
Zachary W. Ulissi	Carnegie Mellon University, USA
Venkat Viswanathan	Carnegie Mellon University, USA
Hongliang Xin	Virginia Tech, USA

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Symposium EN01: Silicon for Photovoltaics

Silicon continues to dominate the photovoltaic market with increasing efficiencies and lower costs combined with excellent reliability. Further advancement of silicon photovoltaics will be driven by the ability to develop concepts at the cell, module and system level that further increase yield, reduce cost and extend reliability. To maintain this trend, sustained material research in key and emerging areas along the value chain is vital, including: (i) new silicon-enabled absorbers as well as the understanding and mitigation of bulk absorber material defects; (ii) carrier-selective, passivating contact layers and stacks for high voltage devices; (iii) high efficiency device concepts including, but not limited to, photon management, multi-junction solar cells and new metallization schemes; and (iv) silicon PV module and system related material research.
This symposium is focused on these themes, and especially welcomes scientific and technological contributions aimed at (a) increasing the conversion efficiency and lowering the costs, (b) involving cross-cutting developments from other technologies, (c) addressing material requirements for PV system integration, and (d) modeling and characterization aligned with the aforementioned topics.

Topics will include:

- Absorber: We are interested in the development of new silicon-enabled absorbers that could offer higher absorption and/or lower Auger recombination. This also extends to alternative absorber fabrication methods such as layer separation/transfer, epitaxial wafer processes, and solid-/liquid-induced crystallization aimed at kerfless silicon or ultra-thin silicon absorbers. Research related to bulk Si defects analysis, gettering, bulk hydrogenation, and lifetime degradation / mitigation are also en
- Carrier-selective passivating contacts: We welcome contributions discussing fundamental, underlying principles of carrier-selective contacts (i.e. surface passivation, band alignment/bending, Fermi-level pinning at interfaces), innovative deposition techniques and doping methods, contact hydrogenation, new materials (including transparent electrodes and doping-free approaches) and new functionalities (temperature stability, transparency, patterned depositions).
- High efficiency device concepts: We seek contributions aimed at improved solar cell performance, including the development of novel photon management strategies (e.g. advanced surface textures, up- and down conversion), multi-junction architectures (e.g. III-V/Si or Perovskite/Si tandems), new metallization technologies (especially to passivated contacts), and back-contacted architectures.
- Module: We invite contributions dealing with module-related material aspects ranging from the interconnection and encapsulation of silicon solar cells to optical design of silicon modules (e.g. new anti-reflective coatings, albedo for bifacial modules).
- System: We also invite contributions focusing on the integration of Si modules into systems (e.g. PV-battery interface, building & vehicle integration).
- Silicon and silicon-enabled photovoltaic devices, such as all-silicon tandem solar cells, X-on-silicon solar cells, new device architectures, bifacial cells, silicon nanowires/nanocrystals solar cells, and thin-film silicon solar cells. Absorber, doping, contact, passivation, transparent conductor, and metallization materials for silicon (or tandem) photovoltaic devices.
- Silicon film materials such as amorphous silicon, nanocrystalline silicon, silicon carbides and oxides, epitaxial silicon and epitaxial layers on silicon, silicon-germanium, barium-disilicide, silicon clathrates and silicon-(carbon-)tin alloys. Methods of making and/or doping silicon including (PE)CVD, kerfless wafering, laser- and metal-induced crystallization, and implantation.
- Characterization and modeling of the structural, mechanical, electrical, and optical properties of silicon-related materials and devices. Material focused techno-economic and life-cycle analysis of emerging concepts as well as recycling aspects of PV materials.

Invited speakers include:

Andrew Blakers	Australian National University, Australia
Yifeng Chen	Trina Solar, USA
Chris Deline	National Renewable Energy Laboratory, USA
Stefan Glunz	Fraunhofer ISE, Germany
Erwin Kessels	Technische Universiteit Eindhoven, Netherlands
Radovan Kopecek	ISC Konstanz, Germany
Sarah Kurtz	University of California, Merced, USA

Agata Lachowicz	Swiss Center for Electronics and Microtechnology, Switzerland
John Murphy	University of Warwick, United Kingdom
Bonna Newman	Netherlands Organisation for Applied Scientific Research, Netherlands
Uwe Rau	Forschungszentrum Jülich GmbH, Germany
Cassidy Sainsbury	Sinton Instruments, USA
Adele Tamboli	National Renewable Energy Laboratory, USA
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Symposium EN02: III-V Semiconductors for Energy Conversion Technologies

III-V semiconductors (with cation as Al/Ga/In, and anion as N/P/As/Sb) while traditionally explored for electronic and photonic devices, have not seen much development for energy conversion technologies apart from multijunction photovoltaic stacks. Due to their superior light absorption, charge transfer, bandgap energy tunability, epitaxial crystal relationships, and single crystal nanoscale growth properties, this materials system offers promise within integration in a variety of energy conversion technologies. This includes photovoltaics, solar-to-fuels systems, thermophotovoltaics, and betavoltaics. Therefore, an emerging nexus of materials growth, device development, and systems engineering around III-V semiconductors for these energy conversion applications has the potential to shape these technologies in the present and future, and form a research core of utilizing these materials in novel ways to support development for a variety of energy conversion systems. This symposium will bring together researchers in III-V materials growth, materials characterization, device design, systems applications, and broader overviews in renewable energy and resource utilization with these materials.

Topics will include:

- Molecular beam epitaxy (MBE) and metalorganic chemical vapor deposition (MOCVD) of III-V semiconductors for energy conversion
- Alternative crystal growth methods, such as electrochemical crystal growth, colloidal nanocrystal synthesis, liquid phase epitaxy, halide chemical vapor deposition, and vapor-liquid-solid (VLS) nanowire growth
- Characterization methods in determining structure and properties, including in-situ methods
- Modeling methods, including molecular dynamics (MD) for crystal growth and device/band engineering modeling for junctions
- III-V semiconductors in photovoltaics; with variants for thermophotovoltaics and betavoltaics
- Interface engineering of III-V materials with electrocatalysts and electrolytes for solar-to-fuels technologies
- Modeling and experiments of coupling III-V semiconductors to non-conventional primary power sources (e.g. IR radiation and beta particle emitters)
- Integration with non-conventional/non-epitaxial substrates in device implementation
- Processing technologies around III-V crystals for energy applications integration
- Systems-level coupling to energy storage systems
- Technoeconomic analysis of using III-V materials for energy conversion (resource cost, efficiency and other metrics), synthesis and manufacturing methods to reduce cost
- Investigations of micro/nanoscale morphologies on performance
- Earth-abundant alternatives to III-V semiconductors

Invited speakers include:

Rebecca Anthony	Michigan State University, USA
Harry Atwater	California Institute of Technology, USA
Ned Ekins-Daukes	University of New South Wales, Australia
Anna Fontcuberta i Morral	École Polytechnique Fédérale de Lausanne, Switzerland
Sophia Haussener	École Polytechnique Fédérale de Lausanne, Switzerland
Hannah Joyce	Cambridge University, United Kingdom
Rehan Kapadia	University of Southern California, USA
Minjoo Lawrence Lee	University of Illinois at Urbana-Champaign, USA
Marina Leite	University of California, Davis, USA
Stephen Maldonado	University of Michigan–Ann Arbor, USA
Zetian Mi	University of Michigan–Ann Arbor, USA
Sudha Mokkapati	Monash University, Australia
Aaron Ptak	National Renewable Energy Laboratory, USA
Michael Spencer	Morgan State University, USA
Myles Steiner	National Renewable Energy Laboratory, USA
Mahendra Sunkara	University of Louisville, USA
Kimberly Dick Thelander	Lund University, Sweden
Xiaowang Zhou	Sandia National Laboratories, USA

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Symposium EN03: Emerging Inorganic Semiconductors for Solar Energy and Fuels

This symposium is jointly organized by MRS and MRS-Singapore (MRSS). Photovoltaic (PV) and photoelectrochemical (PEC) solar cells are energy technologies that convert sunlight into electricity or fuels. The main component common to both PV and PEC technologies is the semiconductor absorber material, where the sunlight is absorbed and photoactivated charge carriers are transported. Established absorber technologies have matured to the point where PV is now cost competitive against all other energy sources for electricity production, but work remains to achieve even higher efficiencies and lower costs. On the other hand, the technology of generating fuels from photocatalytic processes is far less mature than energy generated by PV, due to stringent selection criteria for suitable photoelectrodes. In addition to solar spectrum-matched band gaps and favorable charge transport required for PV technologies, PEC absorbers must also have band edges that can drive chemistry with photogenerated carriers, sufficient stability to survive in aqueous environments, and catalytic selectivity toward the desired reaction. Thus, additional research and development of emerging inorganic semiconductor absorber materials is needed to diversify the portfolio of existing PV—and especially PEC—solar cell technologies.

This symposium will cover all aspects of emerging inorganic photoabsorber materials, with particular emphasis on materials for photovoltaic and photoelectrochemical solar cells. A wide range of emerging materials will be discussed including SnS, ZnTe, Cu_2O, Sb_2Se_3, Bi_2S_3, $MoSe_2$, $ZnSnN_2$, $FeWO_4$, $CuBi_2O_4$, $CuSbS_2$, $BiVO_4$, $AgBiS_2$, $CsPbCl_3$, Cu_2ZnSnS_4, Cu_2BaSnS_4, as well as other novel oxides, chalcogenides, nitrides, and phosphides. Contributions on emerging contacts, buffers, transparent conductors, and other supporting materials for semiconductors such as, Si, CdTe, CIGS, and III-V PV absorbers are of interest, but not these well-established absorbers themselves. This year, we will also consider contributions focusing on emerging photocatalysts, absorber/catalyst interactions, catalyst surface decoration, PEC cell designs, device encapsulants, and other materials supporting photocatalytic processes, in addition to the photoelectrochemical cell absorbers. Contributions on emerging materials for other optoelectronic energy conversion technologies, such as solid-state lighting and photodetectors are also welcome.

Topics will include:

- Materials chemistry & physics, interface science, photoelectrochemistry
- Theory, computation, synthesis, characterization, modelling, and device integration
- Photon, electron, and chemical processes in PEC materials and cells
- Absorber materials, photocatalysts, contact layers, transparent conductors
- Aqueous stability, grain boundaries, defects & dopants, surface passivation
- Data-driven, high-throughput computational and experimental methods

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

Invited speakers include:

Shiyou Chen	Fudan University, China
Nicolas Gaillard	University of Hawai'I, USA
John Gregoire	California Institute of Technology, USA
Maarja Grossberg	Tallinn University of Technology, Estonia
Xiaojing Hao	University of New South Wales, Australia
Sophia Haussener	École Polytechnique Fédérale de Lausanne, Switzerland
Robert Hoye	Imperial College London, United Kingdom
Paul Maggard	North Carolina State University, USA
Jon Major	University of Liverpool, United Kingdom
Roland Marschall	University of Bayreuth, USA
Hiroaki Misawa	Hokkaido University, Japan
David Mitzi	Duke University, USA
Frank Osterloh	University of California, Davis, USA
Annabella Selloni	Princeton University, USA
Byungha Shin	Korea Advanced Institute of Science and Technology, Republic of Korea
Issei Suzuki	Tohoku University, Japan
Adele Tamboli	National Renewable Energy Laboratory, USA
Jiang Tang	Huazhong University of Science and Technology, China
Roel van de Krol	Helmholtz-Zentrum Berlin für Materialien und Energie, Germany
Julia Wiktor	Chalmers University of Technology, Sweden
Rong Xu	Nanyang Technological University, Singapore

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Symposium EN04: Next-Generation Organic Photovoltaics—Fundamentals and Applications for Flexible, Stretchable and Wearable Devices

Next-generation thin-film photovoltaic devices are drawing significant attention as off-grid power sources for next-generation wearable electronics, such as biosensors, electronic skins, and displays. Among them, organic photovoltaics (OPVs)-based flexible photovoltaic platforms can be seamlessly integrated to any devices while supplying efficient light harvesting owing to their unique features of high power-per-weight output and their excellent mechanical robustness. Indeed, in the last few decades, significant advancements have been achieved in OPVs, which exhibit power conversion efficiencies (PCEs) of up to 18% for single-junction cells via optimization of photovoltaic donor/acceptor (D/A) materials (especially developing non-fullerene (NF) acceptors), device architectures, and D/A blend morphologies. As a result, we are witnessing advances in flexible and even stretchable organic solar cells as energy sources for state-of-the-art devices.

Despite the surprising progress in OPVs, achieving such high efficiency and reasonable mechanical robustness simultaneously for wearable devices is still considered a grand challenge. Challenges to overcome include material designs, fabrication processes, novel device structures, and performance characterization under diverse harsh circumstances.

This symposium welcomes a collection of abstracts that highlight these major challenges in the state-of-the-art novel organic material designs, device structures for enhancing mechanical stability, and fabrication processes on plastic substrates. The symposium will be open to various researchers focusing on materials and devices for flexible and wearable electronics and their applications, including biosensors, e-skins, and system-level integrations.

Topics will include:

- Synthesis of new organic (and polymeric) photovoltaic materials
- Device fabrication and photovoltaic characteristics
- Fundamentals for charge generation, transport, recombination and extraction
- Photovoltaic applications for flexible, stretchable and wearable devices
- Mechanical properties and device stability
- Film morphology control and characterization
- Device dynamics by transient absorption and time-resolved spectroscopy
- Theoretical modeling and calculation of photovoltaic materials and characteristics

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

Invited speakers include:

Natalie Banerji	University of Bern, Switzerland
Melanie Bertrand	Armor, France
Jean Luc Bredas	The University of Arizona, USA
Dong Hoon Choi	Korea University, Republic of Korea
Xugang Guo	Southern University of Science and Technology, China
Bumjoon Kim	Korea Advanced Institute of Science and Technology, Republic of Korea
Mario Leclerc	Université Laval, Canada
Kwanghee Lee	Gwangju Institute of Science and Technology, Republic of Korea
Pooi See Lee	Nanyang Technological University, Singapore

Dongling Ma	Institut National de la Recherche Scientifique, Canada
Thuc-Quyen Nguyen	University of California, Santa Barbara, USA
Brendan O`Connor	North Carolina State University, USA
Jean-Rémi Pouliot	Brilliant Matters, Canada
Erin Ratcliff	University of Arizona, USA
Safa Shoaee	University of Potsdam, Germany
Keisuke Tajima	RIKEN, Japan
Wei You	University of North Carolina at Chapel Hill, USA
Yingping Zou	Central South University, China

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Symposium EN05: Emerging Materials for Electrochemical Energy Storage Devices—Degradation and Failure Characterization—From Composition, Structure and Interfaces to Deployed Systems

Industry challenges with fielding safe and reliable rechargeable energy storage technologies are increasing as new higher specific energy devices are introduced into the growing global marketplace. Structural and interfacial degradations, as well as other failure mechanisms in electrochemical energy storage technologies, dictate a path for developing novel materials resilient to stressful operating conditions while improving overall performance, environmental impact, and safety. Fast charge and extended use are examples of operating conditions that drive materials towards early performance degradation which may lead to reduced safety margins. A fundamental understanding of processes at the materials level, both structural and interfacial, that leads to specific degradation and failure modes is required to develop innovative materials capable of performing in diverse operating environments. Mitigation strategies from a materials perspective are also critical to reduce the risk associated with degradation and failure in large energy storage systems. Therefore, the focus of this symposium is an increased understanding of the interfaces, intercalation, degradation, and failure associated with advanced electrochemical energy storage technologies. The symposium's main discussion topic is emerging materials for improved performance, safety, sustainability, and reliability of all types of rechargeable batteries and supercapacitor devices. A secondary focus is degradation and failure mechanisms under stressful operating conditions in various industrial applications. Emphasis will be given to materials characterization, diagnostic, and prognostics from *in-situ*, *in-operando*, and *post-mortem* techniques. The symposium will bring together a diverse group of interdisciplinary industry and academic material scientists and engineers to fast-track the development of inherently safe materials for electrochemical energy storage devices.

Topics will include:

- Emerging materials for improved performance, safety, sustainability and reliability
- Electrode-electrolyte interfaces
- Intercalation materials
- Electrolyte degradation and gas production
- Degradation of electrode materials
- Failure and degradation modes of fast-charged batteries
- High cycle-life performance
- Diagnostics and prognostics
- State of health monitoring, trending, analysis, and modeling
- Lithium plating
- Failure initiation and propagation
- Hazards analysis and safety testing

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

Invited speakers include:

Doron Aurbach	Bar-Ilan University, Israel	**Maria Lukatskaya**	ETH Zürich, Switzerland
Neil Dasgupta	University of Michigan, USA	**Jodie Lutkenhaus**	Texas A&M University, USA
Bruce Dunn	University of California, Los Angeles, USA	**Y. Shirley Meng**	University of California, San Diego, USA
Xuning Feng	Tsinghua University, China	**Linda Nazar**	University of Waterloo, Canada
David Howey	University of Oxford, United Kingdom	**Dan Steingart**	Columbia University, USA
Judy Jeevarajan	Underwriters Laboratories Inc., USA	**Rachid Yazami**	KVI PTE LTD, Singapore

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Symposium EN06: Solid-State Batteries—From Electro-Chemo Mechanics to Devices

Solid-state battery (SSB) research has experienced an explosion worldwide, driven by increased demand for advanced electric vehicle batteries. However, there are many practical and fundamental challenges in the SSB development, which requires a balance of performance metrics,safety, and compatibility with existing manufacturing techniques. Fundamentally, SSBs present different challenges than liquid electrolyte systems, owing to additional mechanical constraints imposed by the solid electrolyte and the distinctive properties of multiple interfaces and interphases. Commercial adoption of SSBs has thus been hindered at least by limited understanding of the complex interplay between electrochemical stability, interfacial phenomena, morphological evolution, and mechanical degradation.

In this symposium, we aim to bring researchers from academia and industry together to share a vision of how practical challenges can be overcome through materials and device design that is informed by critical insights obtained from experiments, simulations, and theories. The symposium thus will bring together researchers working on these aspects, with an emphasis on critical design principles of advanced SSBs. A key focus of the symposium is to develop an integrated and interdisciplinary understanding of coupled electro-chemo-mechanical phenomena in SSBs. All forms of solid electrolytes will be considered, including ceramics, glasses, polymers and composites.

Topics will include:

- New electrolyte, cathode and interfacial coating materials for SSBs
- Interfacial stability and conductivity design of solid electrolytes against metal anodes and high-voltage cathodes
- Process-structure-property relationships in the synthesis and scale-up of solid electrolytes and composite electrodes
- Li and Na metal anodes (including initially anode-free configurations) in SSBs
- Advanced characterization using imaging, spectroscopy, diffraction, and *In situ/operando* techniques
- Materials genome approaches, machine learning, multiscale modeling of materials and devices
- Mechanical stress, deformation and fracture evolution at solid electrode-electrolyte interfaces

Invited speakers include:

Timothy Arthur	Toyota Research Institute, USA
Nitash Balsara	University of California, Berkeley, USA
Peter Bruce	University of Oxford, United Kingdom
Joshua Buettner-Garrett	Solid Power, USA
Gerbrand Ceder	University of California, Berkeley, USA
Long-Qing Chen	Pennsylvania State University, USA
Stephen Harris	Lawrence Berkeley National Laboratory, USA
Kelsey Hatzell	Vanderbilt University, USA
Akitoshi Hayashi	Osaka Prefecture University, Japan
Liangbing Hu	University of Maryland, USA
Yanyan Hu	Florida State University, USA
Yoon Seok Jung	Yonsei University, USA
Toshikazu Kotaka	Nissan Motor Company, Japan
Hyun-Wook Lee	Ulsan National Institute of Science and Technology, Republic of Korea
Hong Li	Institute of Physics, Chinese Academy of Sciences, China

Y. Shirley Meng	University of California, San Diego, USA
Munekazu Motoyama	Nagoya University, Japan
Partha Mukherjee	Purdue University, USA
Cewen Nan	Tsinghua University, China
Jagjit Nanda	Oak Ridge National Laboratory, USA
Shyue-Ping Ong	University of California, San Diego, USA
Mauro Pasta	University of Oxford, United Kingdom
Yue Qi	Brown University, USA
Jennifer Rupp	Massachusetts Institute of Technology, USA
Jeff Sakamoto	University of Michigan–Ann Arbor, USA
Asma Sharafi	Ford Motor Company, USA
Xueliang Sun	University of Western Ontario, Canada
Stanley Whittingham	Binghamton University, USA
Yan Yao	University of Houston, USA
Wolfgang Zeier	University of Münster, Germany

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Symposium EN07: Sustainable Polymeric Materials by Green Chemistry—Degradability and Resilience

To combat the pressing environmental challenges associated with the consumption of polymeric materials by the growing world population, material scientists have identified three key strategies: Reducing chemical-related impact of polymer preparation through Green chemistry approaches. Resilience, to prolong the polymer material's functional lifetime and facilitate repurposing, thereby reducing the need for raw materials while degradability allows for adapting the material's lifetime to its functional lifecycle and eliminate the side-effects of discarded materials. The symposium contributions should focus on the three aforementioned strategies and related aspects for enhancing the sustainability of polymer materials. The first part of the symposium will present innovative synthetic pathways that utilize bio-based and non-toxic starting materials, reduce energy consumption, and produce fewer by-products. It will also include biotechnologically produced polymers and address the corresponding challenges of scaling-up required to make a meaningful impact. The second part of the symposium will focus on pathways to prolong the lifetime of polymers, and discuss for instance self-healing materials, non-toxic stabilizing additives and other strategies to avoid or deal with material damages. The third part of the symposium will focus on polymer materials that can degrade via hydrolysis or specific external stimuli. Here, approaches for lifetime prediction and analysis of environmental impact, both experimental and theoretical, are of high relevance. Also, challenges associated with processing of degradable and recycled materials into functional devices will be discussed.

Topics will include:

- Novel green polymer synthesis routes, e.g. NIPUs, polycarbonates
- Polymer synthesis for capturing CO(2)
- Polymers from biological sources for large-scale production and advanced applications
- Green processing of polymers
- Design of green and degradable polymers for additive manufacturing
- New hydrolytically degradable polymers and their applications
- Polymers degrading in response to specific environmental stimuli
- Polymer degradation by enzymes
- Self-repairing and self-replenishing materials
- Green polymer stabilizers and their impact on polymer lifetimes
- Strategies to avoid or mitigate material damage
- Recycling and upcycling of degradable polymers
- Mechanistic studies of polymer degradation and lifetime prediction
- Material life-cycle and carbon footprint analysis

Joint sessions are being considered with **SF04 - Progress in Materials Genomics, Synthesis and Characterization of Functional Polymers and Polymer Nanocomposites**.

Invited speakers include:

Zhibin Guan	University of California, Irvine, USA	**Kei Saito**	Kyoto University, Japan
Christine Jerome	University of Liège, Belgium	**Takamasa Sakai**	The University of Tokyo, Japan
Julia Kalow	Northwestern University, USA	**Kotaro Satoh**	Tokyo Institute of Technology, Japan
LaShanda T.J. Korley	University of Delaware, USA	**Brent Sumerlin**	University of Florida, USA
Bronwyn Laycock	University of Queensland, Australia	**John Torkelson**	Northwestern University, USA
Karin Odelius	KTH Royal Institute of Technology, Sweden	**Takashi Uneyama**	Nagoya University, Japan
Daniela Pappalardo	University of Sannio, Italy	**Marek Urban**	Clemson University, USA
H. Jerry Qi	Georgia Institute of Technology, USA		

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Symposium EQ01: Ultra-Wide Bandgap Materials and Devices

Research in ultra-wide-bandgap (UWBG) semiconductor materials and devices continues to progress rapidly. Materials beyond silicon carbide and gallium nitride, such as gallium oxide, diamond, cubic boron nitride, aluminum nitride, and others, are at the frontier of semiconductor materials research and device physics. While such materials hold great promise for applications such as ultraviolet optoelectronic emitters and detectors, more compact and efficient energy converters, higher power high-frequency amplifiers, and quantum information science, many materials and processing challenges must still be addressed before UWBG semiconductors mature and can have significant impact. For example, many of the fundamental properties of these emerging materials are still poorly understood, including the physics of high-energy carrier scattering and transport responsible for electrical breakdown. Practical challenges such as efficient and controllable *n*- and *p*-type doping, synthesis of large area, low-defect-density substrates, the formation of reliable, low resistance electrical contacts, and the integration of dielectric films with high quality interfaces are also areas that need to be further advanced before delivery of mature, viable, and cost competitive UWBG technologies can occur. This symposium will address a comprehensive set of topics related to the materials science, device physics, and processing of ultra-wide-bandgap materials, with a view towards the applications that are driving research in the field. Topics of current interest in the more traditional wide-bandgap materials will also be considered.

Topics will include:

- Bulk crystals, substrates, and epitaxial growth
- Theory and first-principles calculations
- Defect science, including doping
- Novel polarization effects and utilization in devices
- UWBG heterostructures and low-dimensional structures
- Device performance and reliability
- Carrier recombination dynamics
- Gate and passivation dielectrics
- Thermal properties and thermal engineering
- Advanced materials characterization techniques
- Color centers for quantum technologies
- Ultraviolet emitters and detectors

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

Invited speakers include:

Jocelyn Achard	Centre National de la Recherche Scientifique, France
Andrew Allerman	Sandia National Laboratories, USA
Sukwon Choi	The Pennsylvania State University, USA
David Eon	Centre National de la Recherche Scientifique, France
Timothy Grotjohn	Michigan State University, USA
Masataka Higashiwaki	National Institute of Information and Communications Technology, Japan
Hiroshi Kawarada	Waseda University, Japan
Anke Krüger	Universität Würzburg, Germany
Maki Kushimoto	Nagoya University, Japan
Farid Medjdoub	University of Lille, France
Zetian Mi	University of Michigan–Ann Arbor, USA
Hideto Miyake	Mie University, Japan
Nobuko Naka	Kyoto University, Japan
Robert Nemanich	Arizona State University, USA
Nicolas Rouger	Centre National de le Recherche Scientifique, France
Kohei Sasaki	Japan Cybertech, Japan
Arunima Singh	Arizona State University, USA
Marko Tadjer	U.S. Naval Research Laboratory, USA
Norio Tokuda	Kanazawa University, Japan
Takahide Yamaguchi	National Institute for Materials Science, Japan
Hongping Zhao	The Ohio State University, USA
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Symposium EQ02: Harnessing Functional Defects in Energy and Electronic Materials

Defects are ubiquitous in materials, and can alter its functionality – mechanical, chemical, electrical, optical, thermal etc. and their coupling with each other, in a profound manner. Not only are the ground-state properties modified, but also excited state properties as well as the material responses to external fields are significantly altered. Many compelling cases exist in energy and electronic materials where such profound role of defects manifest in a controlled manner. However, harnessing functional defects in energy and electronic materials present outstanding scientific and technical challenges to researchers since effective and efficient theoretical and experimental tools permitting us to rationalize, predict, observe, visualize and control defect formation, migration and interactions are largely limited.

To address the pressing opportunities and difficulties, we envision this symposium to highlight most recent trends, applications and forefront challenges in developing and harnessing functional defects in a wide range of energy and electronic materials via bridging expertise on theoretical modeling/simulation, materials synthesis, functional measurement/control, and advanced characterization. Particular attention will be paid to predictive design of functional defects for energy and electronic applications via a combination of theory, high-throughput computations and machine-learning/artificial intelligence; synthesis of defect structures in functional nanostructures and epitaxial heterostructures; control of functional defects formation/migration/ordering; the interplay between defect responses in ionic lattices and their manipulation by external fields; and use of transformative imaging capabilities to probe defect-driven phenomena in-situ along with their dynamics, etc. The goal of this symposium is to provide an interactive forum for scientists from various fields who wish to develop and harness functional defects in energy and electronic materials towards emerging applications. We hope this symposium would help the materials scientists from various backgrounds to understand and take advantage of predictive design, smart synthesis/control and advanced characterization approaches to solve the pressing problems.

Topics will include:

- Synthesis of functional defects in nanostructures, two-dimensional layered structures, heterostructures, polycrystalline and substrate-support systems
- Progress of defect-enabled/enhanced electrochemical, photocatalysis, light-harvesting, ionotronic/neuromorphic computing, and smart sensing applications
- Methodological advances in theory, high-throughput computations and machine-learning/artificial intelligence for predictive modeling and design of functional defects
- Multi-scale methods to study the role of extended defects on the functionality of energy and electronic materials
- Visualizing creation and manipulation of defects dynamically in bulk, surface, interface and grain boundary of energy (e.g. batteries/fuel-cells/solar-cells/ultracapacitors) and electronic materials (e.g. ionotronic/neuromorphic materials, smart sensors)
- Structural diagnosis and quantitative analysis on the defects from atomic to meso and micro scale and their correlation to energy and electronic functionalities
- *In-situ*/*operando* characterizations of defects and defect transports
- Relevance of defects in the operation of photovoltaics, ranging from purely inorganic to hybrid-materials, such as hybrid-perovskites, etc.

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

Invited speakers include:

Rajeev Ahuja	Uppsala University, Sweden	**Suhas Kumar**	Hewlett Packard Enterprise, USA
David Cahen	Weizmann Institute of Science, Israel	**Chen Ling**	Toyota Research Institute, USA
Maria Chan	Argonne National Laboratory, USA	**Cecilia Mattevi**	Imperial College London, United Kingdom
Carsten Deibel	Technische Universität Chemnitz, Germany	**Orgiani Pasquale**	Consiglio Nazionale delle Ricerche, Italy
Regina Dittmann	Forschungszentrum Jülich GmbH, Germany	**Nicola Perry**	University of Illinois at Urbana-Champaign, USA
David Ginger	University of Washington, USA	**Nini Pryds**	Technical University of Denmark, Denmark
Laura Herz	University of Oxford, United Kingdom	**Elisa Riedo**	New York University, USA
Jinsong Huang	University of North Carolina at Chapel Hill, USA	**Junwoo Son**	Pohang University of Science and Technology, Republic of Korea
Alex Jen	City University of Hong Kong, Hong Kong	**Jordi Sort**	Universitat Autònoma de Barcelona, Spain
Hiroshi Kageyama	Kyoto University, Japan	**María Verónica Ganduglia-Pirovano**	Spanish Council for Scientific Research, Spain

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Symposium EQ03: Next-Generation Organic Semiconductors—Materials, Fundamentals and Applications

Organic semiconductors continue to draw great attention from different disciplines because of the plethora of unique and attractive properties they can exhibit. Recent advances in fundamental understanding, coupled with the introduction of new materials and synthetic routes, have enabled the development of a wide range of devices with new functionalities and performance on par with established inorganic technologies. Such demonstrations are paving the way for many innovative applications in emerging sectors of science and technology. This symposium focuses on recent advances on the synthesis, characterization and application of organic materials and devices. Of particular interest are the molecular design, solid-state structure, physics and applications of emerging classes of molecules, including macromolecular semiconductors, molecular dopants, self-assembling surface-modifying molecules, open-shell organic semiconductors, light-emitting molecules with enhanced reverse intersystem crossing, solid-state laser materials, organic thermoelectrics and mixed ion-electron (hole) conductors. The ultimate aim of the symposium is to provide a venue for researchers to discuss recent developments, challenges and emerging opportunities in this field.

Topics will include:

- Design and synthesis of new organic semiconductors
- Development of new dopant molecules
- Engineering the solid-state structure of organic single crystals and thin films
- Device design for improved charge injection and charge transport
- Stretchable and flexible electronics, optoelectronics, sensors, OFETs, OLEDs and OSCs
- Heterointerfaces at electron/hole transport semiconductors, donor-acceptor interfaces, metal- or insulator-semiconductor interfaces
- Novel organic optical sources
- Fundamentals of charge injection and transport in organic semiconductors
- Exciton formation, dissociation and charge recombination
- Fundamental characterization by XPS, SPM, XRD, NEXAFS etc.

Invited speakers include:

Kouki Akaike	National Institute of Advanced Industrial Science and Technology, Japan
John Anthony	University of Kentucky, USA
Thomas Anthopoulos	King Abdullah University of Science and Technology, Saudi Arabia
Ana Claudia Arias	University of California, Berkeley, USA
Ilaria Bargigia	Wake Forest University, USA
Michael Chabinyc	University of California, Santa Barbara, USA
Konstantinos Daskalakis	University of Turku, Finland
Antonio Facchetti	Northwestern University, USA
Hirohiko Fukagawa	Japan Broadcasting Corporation, Japan
Keiki Fukumoto	High Energy Accelerator Research Organization, KEK Research Organization, Japan
Nicola Gasparini	Imperial College London, United Kingdom
Martin Heeney	Imperial College London, United Kingdom
Peter Ho	National University of Singpore, Singapore
Jong-Won Jung	Samsung Advanced Institute of Technology, Republic of Korea
Antoine Kahn	Princeton University, USA
John Labram	Oregon State University, USA
Karl Leo	Technische Universität Dresden, Germany
Christine Luscombe	University of Washington, USA
Iain McCulloch	University of Oxford, United Kingdom
Martyn McLachlan	Imperial College London, United Kingdom
Thuc-Quyen Nguyen	University of California, Santa Barbara, USA
Yong-Young Noh	Pohang University of Science and Technology, Republic of Korea
Alexandra F. Paterson	University of Kentucky, USA
Pichaya Pattansattayavong	Vistec, Thailand
Alberto Salleo	Stanford University, USA
Ingo Salzmann	Concordia University, Canada
Peter Skabara	University of Glasgow, United Kingdom
Yana Vaynzof	Technische Universität Dresden, Germany
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Abstract Submission Opens—Thursday, September 23, 2021

Abstract Submission Closes—Thursday, October 28, 2021 (11:59 PM ET)

Symposium EQ04: Advanced Soft Materials and Processing Concepts for Flexible Printed Optoelectronic Devices and Sensors

Printable functional materials whose optical, electronic and mechanical properties can be tailored by chemical approaches provide unparalleled opportunities to advance emerging technologies in sensing, energy harvesting and storage, robotics, wearables, personalized healthcare and the Internet-of-Things. Furthermore, the large palette of digital and conventional printing techniques (e.g. inkjet, aerosoljet, screen or gravure printing) present cost- and material efficient fabrication tools capable of manufacturing large-area optoelectronic devices as well as integrated and personalized systems onto flexible, stretchable and soft substrates. Representative examples of printed optoelectronic and sensing elements currently attracting increased attention extend from transistors, photodetectors, triboelectric, thermoelectric, light-emitting and photovoltaic devices, all the way to supercapacitors, actuators, tactile (including pressure, strain, temperature, humidity) or magnetic sensors. Printing processing of such devices requires precise control of the film quality and micromorphology to yield not only a printed pattern but an assembly of materials with an specific functionality. Simultaneously, the selected materials and printing techniques should produce high-quality interfaces that promote efficient optical/electronic processes. Addressing these multifaceted challenges requires a multidisciplinary approach at the crossroads between chemistry, physics, material science and engineering.

This symposium aims to bring together scientists and engineers across different disciplines to discuss the common challenges and the recent advances in the field of advanced soft materials and printing processing of (opto-)electronic and sensing devices. The symposium will address the design of printable advanced soft materials (including conductors, semiconductors, dielectrics, substrates, and barrier layers), their processing and the correlation to device performance and functionality. Furthermore, it will discuss the recent developments on the multidevice integration of flexible, foldable, and soft electronic systems with higher complexity (e.g. integrated circuits, displays, interactive sensors, energy harvesting, etc). The symposium will contribute to a better understanding of materials and device properties as well as highlight emerging applications in the field of next-generation thin film (opto)electronic devices.

Topics will include:

- Synthesis and characterization of novel printable functional optoelectronic and sensing materials
- Newly developed materials for deformable electronics.
- Fabrication and characterization of printed stretchable and/or flexible optoelectronic devices and sensors.
- Characterization of materials, films, and rational design of functional inks and substrates.
- 3D printed electronics and vertical or lateral integration of devices and sensors.
- Novel manufacturing technology for large area fabrication and precise patterning of multilayer/multimaterial/multidevice systems.
- Applications of printed elements in sensing, energy harvesting, e-skin, soft robotics, wearables and bioelectronics technology.
- Interactive soft sensors (gas, chemical, pressure, biomedical, etc.)
- New device architectures for deformable displays, sensing circuits and novel user-interfaces/experience.

Joint sessions are being considered with **MF03 - Materials and Methods for Fabricating Flexible and Large-Area Electronics**.

Invited speakers include:

Ana Claudia Arias	University of California, Berkeley, USA
Paul Blom	Max Planck Institute for Polymer Research, Germany
Mario Caironi	Instituto Italiano di Tecnologia, Italy
P.K.L. Chan	The University of Hong Kong, Hong Kong
Corie Cobb	University of Washington, USA
Ying Diao	University of Illinois at Urbana-Champaign, USA
Antonio Facchetti	Northwestern University, USA
Tawfique Hasan	University of Cambridge, United Kingdom
Jukka Hast	VTT Technical Research Centre of Finland, Finland
Mark Hersam	Northwestern University, USA
Unyong Jeong	Pohang University of Science and Technology, Republic of Korea
Sungjune Jung	Pohang University of Science and Technology, Republic of Korea
Oana Jurchescu	Wake Forest University, USA
Pooi See Lee	Nanyang Technological University, Singapore
Uli Lemmer	Karlsruhe Institute of Technology, Germany
Jung Ah Lim	Korea Institute of Science and Technology, Republic of Korea
Henning Sirringhaus	University of Cambridge, USA
Barbara Stadlober	JOANNEUM RESEARCH Forschungsgesellschaft mbh, Austria
Vivek Subramanian	École Polytechnique Fédérale de Lausanne, Switzerland
Benjamin Tee	National University of Singapore, Singapore
Shizuo Tokito	Yamagata University, Japan
Tomoyuki Yokota	The University of Tokyo, Japan
Jana Zaumseil	Universität Heidelberg, Germany
Yingying Zhang	Tsinghua University, China

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Abstract Submission Opens—Thursday, September 23, 2021
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Symposium EQ05: Semiconductor Physics of Halide Perovskites—From Fundamentals to Devices

Organic-inorganic halide perovskites (3D, 2D and 0D) have emerged as a novel semiconductor platform for understanding and discovering the rich structure and property relationship arising from the interaction of organic-inorganic interfaces and assemblies. They are formed with organic and inorganic two-dimensional layers, which self-assemble in solution to form highly ordered periodic stacks. Their properties appear to imbibe the best attributes from classical semiconductors, multi quantum wells (MQWs), 2D materials beyond graphene such as transition metal dichalcogenides and organic semiconductors, which has enabled a large compositional and structural phase space and resulted in the discovery of novel and emergent physical properties. In addition to applications for fabricating efficient and stable solar cells and light emitting diodes, and detectors, new properties and behaviors such as water-stability, light-induced structural dynamics, ferroelectricity, Rashba effect, polarized emission from chiral 2DPKs, single photon emitters, and optical modulators. However, despite these advances, there are serious scientific and engineering challenges, which if resolved may pave the path for optoelectronic and energy conversion technologies with state-of-the-art performance and technologically relevant durability.

This symposium is dedicated to bringing together researchers across the globe from a wide range of disciplines including material science, chemistry, condensed matter physics, surface science, device engineering and reliability physics, light matter interactions and photonics to communicate important recent developments, which address key questions pertaining to the fundamental structure-property relationships and applications using novel experimental and theoretical approaches with special focus on: 1. Understanding and tailoring materials chemistry to obtain high purity thin-films 2. Design principles for the selection of spacer cations – charge, shape, size and heteroatom 3. Advanced structural, and imaging of perovskites 4. Excitonics and photo-phononics 5. Spintronics and spin-orbitronics 6. Electron transport and device physics 7. Device engineering, interfaces, reliability science.

Topics will include:

- Controlled synthesis of halide perovskite from single crystals to thin-films
- Advanced chemical engineering of halide perovskites with tailored physical properties
- Photo-phononics and its correlation with structure and chemistry
- Exciton generation, recombination and transport
- Many-body effects, biexcitons, hot carriers, electron-phonon coupling, exciton-polaritons.
- Tailoring defects, dopants, film morphology for efficient light emission
- Proximity induced interactions in halide perovskites and their heterostructures
- Halide perovskite-based photonics, optics and lasers
- Spintronics and spin-orbitronics
- Device physics and electron transport
- Scalability, sustainability and reliability science of perovskite based devices and technologies

Invited speakers include:

Osman Bakr	King Abdullah University of Science and Technology, Saudi Arabia
Jean Christophe Blancon	Rice University, USA
Letian Dou	Purdue University, USA
Jacky Even	University of Rennes, France
Guilia Grancini	University of Pavia, Italy
Laura Herz	University of Oxford, United Kingdom
Jinsong Huang	University of North Carolina at Chapel Hill, USA
Deep Jariwala	University of Pennysylvania, USA
Antoine Kahn	Princeton University, USA
Mercouri Kanatzidis	Northwestern University, USA
Hemamala Karunadasa	Stanford University, USA
Jong Hyun Kim	Ajou University, Republic of Korea
Tae-Woo Lee	Seoul National University, Republic of Korea
Kiang Ping Loh	National University of Singapore, Singapore
Maria Antonietta Loi	University of Groningen, Netherlands
Biwu Ma	Florida State University, USA
Barry Rand	Princeton University, USA
Bayrammurad Saparov	University of Oklahoma, USA
Ted Sargent	University of Toronto, Canada
Ruth Shinar	Iowa State University, USA
Franky So	North Carolina State University, USA
Yana Vaynzof	Technische Universität Dresden, Germany
Michael Wong	Rice University, USA
Omer Yaffe	Weizmann Institute of Science, Israel
William W. Yu	Louisiana State University, USA
Kai Zhu	National Renewable Energy Laboratory, USA

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Symposium EQ06: Surfaces and Interfaces in Electronics and Photonics

Surfaces and interfaces have become increasingly important factors for the integration of emerging materials and the implementation of latest fabrication processes into new generation of electronic and photonic devices. When interfaces are formed at the junction between materials surfaces with dissimilar properties, surprising new properties not present in either parent phase emerge at the intersection. These intriguing interfacial properties play key roles in organizing the multilayered device structures and modulating the charge-transfer dynamics across connecting layers. As system dimensions are scaled downward for future electronic device applications and heterogeneous integration of inorganic and organic surfaces are getting prevalent in wearable devices, the nature and complexity of materials interfaces bring tremendous challenges to scientists and engineers resulting in slowing down the progress towards emerging applications. Advanced characterization techniques to study these complex interfaces accurately are also rare. Methods of film and surface preparation and interface formation are often coupled, and they significantly affect the operation of devices. Thus, this symposium is aimed at bringing together experts in the different aspects of materials surfaces and interfaces ranging from advanced characterization, to unconventional film-growth, patterning and device level integration. Both experimental and theoretical papers are welcome. Special emphasis will be given to papers in areas of in-situ characterization techniques as well as modelling and multiscale simulations.

Topics will include:

- Interfaces in area-selective ALD enabled nanopatterns
- Self-assembled monolayers (SAM) growth and in-situ characterization
- Next generation interconnects-interfacial challenges
- Surface activation, deactivation, patterning, and spectroscopic studies
- Mechanistic understanding of interface defect formation and mitigation
- Surface characterization techniques and metrology innovation
- Hybrid (inorganic/organic) interfaces in flexible electronics and additive manufacturing
- Interfacial challenges in printed hybrid electronics
- Emerging deposition equipments
- Control of surfaces, interfaces and grain-boundaries to tailor properties and functionalities
- Surfaces of emerging electronic and photonic materials
- Interface engineering in emerging photovoltaics including perovskites

Invited speakers include:

Ana Claudia Arias	University of California, Berkeley, USA
Julien Bachmann	Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany
Katherine Develos Bagarinao	National Institute of Advanced Industrial Science and Technology, Japan
Derya Baran	King Abdullah University of Science and Technology, Saudi Arabia
Stacey Bent	Stanford University, USA
Charles Black	Brookhaven National Laboratory, USA
Jane P. Chang	University of California, Los Angeles, USA
John Conley	Oregon State Universtiy, USA
Catherine Dubourdieu	Helmholtz-Zentrum Berlin für Materialien und Energie, Germany
Lara A. Estroff	Cornell University, USA
Steven George	University of Colorado Boulder, USA
Angel Yanguas Gil	Argonne National Laboratory, USA
Oki Gunawan	IBM T.J. Watson Research Center, USA
Dipti Gupta	Indian Institute of Technology Bombay, India
Melissa Hines	Cornell University, USA
Erwin Kessels	Technische Universiteit Eindhoven, Netherlands
Rebecca Kramer-Bottiglio	Yale University, USA
Andrew C. Kummel	University of California, San Diego, USA
Stéphanie P. Lacour	École Polytechnique Fédérale de Lausanne, Switzerland
Adrie Mackus	Eindhoven University of Technology, Netherlands
George Malliaras	University of Cambridge, United Kingdom
Tse Nga Ng	University of California, San Diego, USA
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Riikka Puurunen	Aalto University, Finland
Danna Rosenberg	Massachusetts Institute of Technology, USA

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Symposium EQ07: Emerging Opto-Magnetic Materials—Advances, Trends and Challenges at the Interface Between Optics and Magnetism

Breakthroughs in materials research are needed to address the ever-growing market for higher-density data storage within faster and more efficient photonic devices. This includes new ways to create and implement innovative energy-efficient multifunctional materials for different sectors, such as Information & Communication Technology by leveraging the convergence of several complementary and synergetic corner-stones: magnetism and optics/photonics as well as electronics. For instance, single molecule magnets (SMMs) are anticipated to revolutionize spintronic applications as their magnetic properties are intrinsic to the molecule, allowing hundreds of times more storage than the best existing hard drives, while using significantly less energy. Discovery and application of optical materials that use light to trigger, harness and enhance physical properties led to the development of the optoelectronic devices that our modern and technology-driven society heavily relies on. Yet, the need for more efficient, energy-saving approaches remains a challenge. Consequently, cutting-edge research is conducted around the world focussing on novel magnetic and optical probes, including (but not limited to) lanthanide-based SMMs, lanthanide-doped inorganic nanostructures, metal-organic frameworks (MOFs), and their hybrids. Particularly the concept of multimodality is receiving growing attention given that the interplay of multiple functionalities – e.g., magnetism and optics – is the way to produce a total effect that is greater than the sum of the individual entities. An emerging example in that regard is the combination of SMMs with optical temperature sensing capabilities.

The goal of this symposium is to present and discuss the most recent advancement, trends, and challenges regarding modern optics and magnetism. It is the particular aim to bring together experts from the various communities (optics, magnetism, nano, molecular) to learn from each other, exchange ideas, and jointly contribute to this emerging field. This symposium will not only offer a common ground for established experts in the fields, but also be an accommodating and inclusive platform for young and upcoming researchers: we strive to bring together an inclusive mix of established and young researchers, women and underrepresented minorities to showcase their work in a unique and inspiring environment to jointly create tomorrow's opto-magnetic probes and devices.

Topics will include:

- Materials at the interface between magnetism and optics – lanthanides and beyond
- Materials discoveries with potential for opto-magnetic junctions, high-density magnetic storage, quantum and related applications
- Photoluminescence in molecular materials, metal-organic-frameworks, and nanostructures
- Novel synthesis and characterization methods for magnetic, optical, and opto-magnetic nanomaterials and molecules
- Molecular magnetism and nano-magnets: towards next-generation magnetic devices
- Recent advances in dual functional probes: emerging luminescent single-molecule magnets and opto-magnetic nanostructures
- Enhanced probe properties through multifunctionality (e.g., optical thermal sensing with molecular magnets)
- Self-assembly and emergence of complexity in organic/inorganic hybrids
- In-silico and ab-initio methods for next-generation opto-magnetic molecules and materials

Joint sessions are being considered with **QT06 - Recent Developments on the Properties of Emergent Layered 2D Quantum Magnetic Materials and Heterostructures**.

Invited speakers include:

Riccardo Bertacco	Politecnico di Milano, Italy
Hélène Brault	Université de Nantes, Institut des Matériaux Jean Rouxel, France
Loic Charbonniere	Université de Strasbourg, France
Maria Rute de Amorim e Sá Ferreira André	Universidade de Aveiro, Portugal
Andrea de Camargo Stucchi	São Carlos Institute of Physics, Brazil
Selvan Demir	Michigan State University, USA
Jérôme Long	Université de Montpellier, France
Venkataramanan Mahalingam	Indian Institute of Science Education and Research Kolkata, India
Jani O. Moilanen	University of Jyväskylä, Finland
Muralee Murugesu	University of Ottawa, Canada
Miguel Alexandre Novak	Universidade Federal do Rio de Janeiro, Brazil
Ute Resch-Genger	Bundesanstalt für Materialforschung und -prüfung, Germany
Sidney Ribeiro	São Paulo State University, Brazil
Wieslaw Strek	Polish Academy of Sciences, Poland
Markus Suta	Heinrich-Heine-Universität Düsseldorf, Germany
Simon Trudel	University of Calgary, Canada
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Symposium EQ08: Quantum Dot Optoelectronics and Low-Dimensional Semiconductor Electronics

This symposium is jointly organized by MRS and MRS-Korea (MRS-K). Since its foundation in 1991, MRS-K has been serving as a great platform where a number of researchers in materials science from both academia and industry interact, promoting the growth of the technology and scholarship of the materials science and engineering. One of the main interests of the society is functional materials for (opto)electronic and energy applications. As such, the joint symposium is dedicated to the topic of quantum dot optoelectronics and low-dimensional semiconductor materials for electronics and (photo)electrochemical applications. The low-dimensional structures of interest include quantum dots, colloidal nanocrystals, nanowires, nanorods, as well as 2D layered crystals. Relevant materials include (but are not limited to) metal-chalcogenide, binary, tertiary, and quaternary compound semiconductors. The target applications are solar cells, light emitting diodes, and thin film transistors based on low-dimensional semiconductors, but the invitation is extended to other devices such as laser, photo- and radiation-detectors based on active layers in the form of nanostructures. Given the wide use of low-dimensional structures in photoelectrochemical energy conversion, the application of nanostructured semiconductors for photoelectrodes/(photo)electrocatalysts will be also discussed. The symposium will cover advances in the synthesis, characterization, computational modeling and applications of these low-dimensional optoelectronic materials. Given the interdisciplinary nature of the topic, participation of experts with a broad range of backgrounds is anticipated.

Topics will include:

- Novel synthesis methods of low-dimensional semiconductors, including layered crystals
- Advances in the controlled assembly of nanocrystals
- Large scale synthesis of low-dimensional semiconductors
- Strategies for defect passivation of nanostructures
- In-situ characterization of formation/degradation of nanostructures
- Atomic-scale and *in-situ* characterization of semiconductor nanocrystals
- Advances in high efficiency quantum dot solar cells
- Bulk thin films and single crystals of materials with low structural dimensionality
- Non-toxic III-V semiconductor quantum dots for electroluminescence device applications
- Thin film transistors based on a layered semiconductor channel
- Novel nanostructured semiconductors for photoelectrodes/(photo)electrocatalysts in (photo)electrochemical energy conversion devices

Joint sessions are being considered with **EQ09 - Emerging Light Emitters for Photonics and Optoelectronics—Hybrid Perovskites and Other Low-Dimensional Emitters**.
Also, a **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Manish Chhowalla	University of Cambridge, United Kingdom
Jianbo Gao	Clemson University, USA
Shujuan Huang	Macquarie University, Australia
Kwang Seob Jeong	Korea University, Republic of Korea
Sohee Jeong	Sungkyunkwan University, Republic of Korea
Cherie Kagan	University of Pennsylvania, USA
Hemamala Karunadasa	Stanford University, USA
Joonhyung Kim	Samsung Advanced Institute of Technology, Republic of Korea
Tae-Gon Kim	Samsung Advanced Institute of Technology, Republic of Korea
Yong-Hyun Kim	Korea Advanced Institute of Science and Technology, Republic of Korea
Zheng Liu	Nanyang Technological University, Singapore
Joseph Luther	National Renewable Energy Laboratory, USA
Cecilia Mattevi	Imperial College London, United Kingdom
David Muñoz-Rojas	Université Grenoble Alpes, France
Kevin Musselman	University of Waterloo, Canada
Lea Nienhaus	Florida State University, USA
Jiwoong Park	The University of Chicago, USA
Shuyan Shao	Tianjin University, China
Dmitri Talapin	The University of Chicago, USA
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Symposium EQ09: Emerging Light Emitters for Photonics and Optoelectronics—Hybrid Perovskites and Other Low-Dimensional Emitters

Light-emitting materials are key materials for displays, lighting, and other optoelectronic applications. Major research goals of self-emissive materials have revolved around high luminescence efficiency and long device lifetime. New classes of emitters such as organic-inorganic hybrid perovskite emitters, inorganic semiconductor nanocrystals and quantum dots, carbon/graphene quantum dots, and other low-dimensional structures are increasingly proposed for displays, lightings, lasers and other optoelectronic applications, as well as quantum light sources. In recent years particularly, metal halide perovskite emitters emerged as promising candidates for the next generation of narrow-band, high color-purity, low-cost emitters.

Discussions in the proposed symposium will encompass the synthesis, characterization, photophysics and devices comprising emerging light-emitting materials. Therefore, the proposed symposium will cover the complete range from the synthesis and characterization of emerging emitting materials to their fundamental chemistry and physics, and related practical device applications.

Topics will include:

- Emerging organic-inorganic hybrid and halide perovskite emitters
- Quantum dots, 1D/2D materials and other nanoscale emitters
- Emerging inorganic or carbon-based nanoscale emitters
- Photophysics of emitters
- New device architecture for light-emitting diodes
- Charge transport layers and interfacial effects in light-emitting diodes
- Degradation mechanism of emitters and their devices.
- Down-conversion emitters, films, and display/lighting devices
- Lasing from micro- and nanoscale materials

Joint sessions are being considered with **EQ08 - Quantum Dot Optoelectronics and Low-Dimensional Semiconductor Electronics**.

Invited speakers include:

Osman Bakr	King Abdullah University of Science and Technology, Saudi Arabia
Matt Beard	National Renewable Energy Laboratory, USA
Maryna Bodnarchuk	ETH Zürich, Switzerland
Letian Dou	Purdue University, USA
Alexander Efros	U.S. Naval Research Laboratory, USA
Feng Gao	Linköping University, Sweden
Bin Hu	University of Tennessee, Knoxville, USA
Sohee Jeong	Sungkyunkwan University, Republic of Korea
Song Jin	University of Wisconsin–Madison, USA
Cherie Kagan	University of Pennsylvania, USA
Victor Klimov	Los Alamos National Laboratory, USA
Maria Antonietta Loi	University of Groningen, Netherlands
Biwu Ma	Florida State University, USA
Aditya D. Mohite	Rice University, USA
Angshuman Nag	Indian Institute of Science Education and Research Pune, India

Cheolmin Park	Yonsei University, Republic of Korea
Barry Rand	Princeton University, USA
Ted Sargent	University of Toronto, Canada
Myoung Hoon Song	Ulsan National Institute of Science and Technology, Republic of Korea
Samuel Stranks	University of Cambridge, United Kingdom
Tze-Chien Sum	Nanyang Technological University, Singapore
Dmitri Talapin	The University of Chicago, USA
Zhi Kuang Tan	National University of Singapore, Singapore
William A. Tisdale	Massachusetts Institute of Technology, USA
Zhengguo Xiao	University of Science and Technology of China, China
Qihua Xiong	Tsinghua University, China
Yanfa Yan	The University of Toledo, USA
Jingbi You	Institute of Semiconductors, Chinese Academy of Sciences, China
Haizheng Zhong	Beijing Institute of Technology, China
Xiaoyang Zhu	Columbia University, USA

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Symposium EQ10: Advances in Metasurfaces, Metamaterials and Plasmonics—Materials Design, Manufacturing, Applications and Industrial Aspects

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. Moreover, currently we are witnessing the advances in nanoscale optics, photonics and materials with metasurfaces-driven flat optics, which is going from science to technology transition.This symposium aims at bringing together researchers with diverse backgrounds from physics, materials science, engineering, and manufacturing, to cover the fundamental principles and technological applications of metasurfaces and plasmonics spanning from imaging/display system, bio/chemical sensing, photovoltaics, and energy harvesting devices, to quantum information processing, medical devices, communication system, and data storage.

Topics will include:

- Metasurfaces, metamaterials and plasmonics
- Photonics with two-dimensional materials
- Materials with epsilon-near-zero and hyperbolic dispersion properties
- Active and multifunctional plasmonics, nanophotonics, metamaterials, metasurfaces
- Time-varying and quantum metasurfaces and its applications
- Topological photonic and parity-time symmetric materials and metasurfaces
- Ultrafast and nonlinear effects in metamaterials and plasmonics
- Terahertz, photovoltaic, and thermal devices and applications
- Advanced nanophotonic design strategies including machine learning, topological optimizations, and inverse design
- Novel imaging technologies with metasurfaces and plasmonics
- Optical computing and analog processing enabled by functional metasurfaces

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

Invited speakers include:

Andrea Alù	The City University of New York, USA
Harry Atwater	California Institute of Technology, USA
Alexandra Boltasseva	Purdue University, USA
Mark Brongersma	Stanford University, USA
Wenshan Cai	Georgia Institute of Technology, USA
Federico Capasso	Harvard University, USA
Debashis Chanda	University of Central Florida, USA
Artur Davoyan	University of California, Los Angeles, USA
Jennifer Dionne	Stanford University, USA
Nader Engheta	University of Pennsylvania, USA
Andrei Faraon	California Institute of Technology, USA
Patrice Genevet	Centre National de la Recherche Scientifique, France
Shangjr Gwo	Academia Sinica, Taiwan
Yao-Wei Huang	National Chiao Tung University, Taiwan
Min Seok Jang	Korea Advanced Institute of Science and Technology, Republic of Korea
Yuri Kivshar	Australian National University, Australia
Seungwoo Lee	Korea University, Republic of Korea
Yu-Jung Yuri Lu	Academia Sinica, Taiwan
Stefen Maier	Ludwig-Maximilians-Universität München, Germany
Arka Majumdar	University of Washington, USA
Jeremy Munday	University of California, Davis, USA
Ki Tae Nam	Seoul National University, Republic of Korea
Teri Odom	Northwestern University, USA
Junghyun Park	Samsung Advanced Institute of Technology, Republic of Korea
Younggeun Roh	Samsung Advanced Institute of Technology, Republic of Korea
Vladimir M. Shalaev	Purdue University, USA
Giulia Tagliabue	École Polytechnique Fédérale de Lausanne, Switzerland
Din-Ping Tsai	The Hong Kong Polytechnic University, Hong Kong
Joel Yang	Singapore University of Technology and Design, Singapore
Shuang Zhang	The University of Hong Kong, Hong Kong

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Symposium EQ11: Neuromorphic Computing and Biohybrid Systems—Materials and Devices for Brain-Inspired Computing, Adaptive Biointerfacing and Smart Sensing

The human nervous system is a massively distributed, parallel, and interconnected system, with superior functionality and performance in data processing and adaptive learning compared to digital computers. Neuromorphic computing aims to replicate some of the functionality and architecture of the human brain within artificial machines. Accurate and faithful emulation of neuromorphic functionality requires unconventional materials and devices beyond the standard von Neumann digital architecture. Moreover, the computational primitives of biological neural networks on device and circuit level can be considered a 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. This approach requires materials, devices and systems that would be able to interface biology in a smart and dynamic way.

The purpose of this symposium is to bring together an interdisciplinary and diverse group of researchers on neuromorphic computing as well as smart sensing, actuation and bio-interfacing, enhancing transdisciplinary interactions and bridging gaps between materials science, computing and neuroscience. The symposium focuses on elements with simultaneous memory and processing capabilities towards "in-memory" computing and local adaptive bio-interfaces and computing paradigms, and highlights fundamental materials properties, discovery of novel inorganic and organic materials, novel devices harnessing physical emergent phenomena, new computing paradigms enabled by unconventional materials, and theory and simulation on materials, devices, and architectures.

Topics will include:

- Bioelectronics, smart sensors, and bio-inspired information processing
- Inorganic and organic materials for neuromorphic devices
- Nonvolatile memory with hybrid memory and computation capabilities
- Devices and circuits for neuromorphic computing
- Adaptive bio-interfacing and neural interface devices
- Memristive materials and devices at the interface with biology
- Neuromorphic and memristive sensors and actuators
- Stochastic memory devices and neural networks
- Theory and simulation of materials and devices in memory-based computing

Invited speakers include:

Fabien Alibart	University of Lille, France
Stefano Ambrogio	IBM T.J. Watson Research Center, USA
Fabio Biscarini	University of Modena, Italy
Monica Burriel	Université Grenoble Alpes, France
Regina Dittman	Forschungszentrum Jülich GmbH, Germany
Simone Fabiano	Linköping University, Sweden
Paschalis Gkoupidenis	Max Planck Institute for Polymer Research, Germany
Catherine Graves	Hewlett Packard Enterprises, USA
Julie Grollier	Centre National de la Recherche Scientifique, France
Daniele Ielmini	Polytechnic University of Milan, Italy
Seyoung Kim	Pohang University of Science and Technology, Republic of Korea
Hans Kleemann	Technical University of Dresden, Germany
Duygu Kuzum	University of California, San Diego, USA
Wei D Lu	University of Michigan, USA
Matthew Marinella	Sandia National Laboratories, USA
Mariela Menghini	IMDEA Materials Institute, Spain
Priyadarshini Panda	Yale University, USA
Themis Prodromakis	Imperial College London, United Kingdom
Jonathan Rivnay	Northwestern University, USA
Jennifer Rupp	Massachusetts Institute of Technology, USA
Alberto Salleo	Stanford University, USA
Sean Shaheen	University of Colorado Boulder, USA
Dmitri Strukov	University of California, Santa Barbara, USA
A Alec Talin	Sandia National Laboratories, USA
Benjamin Tee	National University of Singapore, Singapore
Kazuya Terabe	National Institute for Materials Science, Japan
Huaqiang Wu	Tsinghua University, China
Joshua Yang	University of Southern California, USA
Yuchao Yang	Peking University, China
Bilge Yildiz	Massachusetts Institute of Technology, USA

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Symposium MF01: Cutting-Edge Plasma Processes Contributing to Sustainable Development Goals

The Sustainable Development Goals (SDGs) are the blueprint to achieve a better and more sustainable future for all. Recent plasma technologies have been expanded in a wide range of applications from materials processing to environmental issues, medicine and agriculture, and continue to broaden their applicability. Plasma technologies will undoubtedly contribute to our evolving sustainable society. Plasma technology continues to be essential to developing large-capacity, high-speed and highly reliable devices required in the Information Age. Especially, plasma-driven atomic layer deposition and etching are key technologies to realize next-generation three-dimensional nanoelectronics devices. MEMS level large-dimension processing is increasing its importance to realize power devices, sensors and optical communication devices. Plasma-induced reactions have been applied for environmental problems such as soil, gas and water remediation and treatment. Plasma-assisted catalytic process, multiphase plasmas, and plasma-catalyst interaction are a hot topic for fuel and gas-reforming such as fuel reforming, syngas conversion, hydrogen generation, and nitrogen fixation. Plasma processing is a feasible way to realize high-efficiency and low-cost solar cells fabrication. Plasma-plant interaction is applied as plasma agriculture, which ensures a stable food supply. Plasma-bio interactions are paving the way for novel medical treatment such as hemostasis, wound treatment, cancer therapy and virus inactivation.

This symposium focuses on the plasma science and technologies that contribute to SDGs, to share the cutting-edge information and accelerate their developments. All of the above-mentioned plasma technologies are based on the advanced plasma-material (solid, liquid, living body, soft-matter, etc,) interactions. Therefore, the fundamental study on plasma sources and plasma-material interaction is also within the scope of the symposium.

Topics will include:

- Plasma processes for manufacturing functional device; etching and deposition technologies including atomic layer processes, surface reaction and damage
- Plasma processes for biocompatible materials and biomaterials synthesis
- Plasma processes for clean and renewable energies; fuel conversion and nitrogen fixation, solar cell fabrication
- Plasma for environmental issues (e.g. water and gas treatment, recycling)
- Plasma agriculture; seed germination, plant growth promotion, sterilization, food preservation
- Plasma processes for biological and medical application, plasma interaction with living systems
- Fundamentals of plasma source and plasma-material (solid, liquid, multiphase, living body, soft-matter, etc.) interactions
- Other topics of plasma application contributing to SDGs

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

Invited speakers include:

Peter Bruggeman	University of Minnesota, USA	**Tsuyoshi Moriya**	Tokyo Electron Ltd., Japan
Masaru Hori	Nagoya University, Japan	**Tomohiro Nozaki**	Tokyo Institute of Technology, Japan
Erwin Kessels	Technische Universiteit Eindhoven, Netherlands	**Gyungsoon Park**	Kwangwoon University, Republic of Korea
Mark J. Kushner	University of Michigan, USA	**Kanta Sangwijit**	University of Phayao, Thailand
Catherine Labelle	Intel Corporation, USA	**Endre Szili**	University of South Australia, Australia
Dae-Hoon Lee	Korea Institute of Machinery & Materials, Republic of Korea	**Satoshi Uchida**	Tokyo Metropolitan University, Japan
Nathan Marchack	IBM T.J. Watson Research Center, USA	**Takayuki Watanabe**	Kyushu University, Japan
Selma Mededovic	Clarkson University, USA		

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Symposium MF02: 3D Printing of Passive and Active Medical Devices

3D printing, also known as additive manufacturing and solid freeform fabrication, is an approach involving additive layer-by-layer fabrication of a three-dimensional structure through selective joining of material; processing of the structure is directed by a computer-aided design (CAD) model. Unlike conventional methods, 3D printing techniques may enable the development of structures with well-defined, high resolution, small-scale features and multiple functions. In recent years, 3D printing techniques, including fused deposition modeling, lithography-based apparatus, selective laser sintering, and laser induced forward transfer, have been used to prepare both passive and active medical devices. For example, 3D printing of shape memory materials may enable fabrication of smart medical devices that combine detection and actuation functions. Current challenges associated with the use of 3D printing for medical device fabrication include (a) the development of novel materials that can be processed rapidly, reproducibly, and with high resolution, (b) the development of novel materials with appropriate biocompatibility over the anticipated lifetime of the medical device, (c) the development of novel materials with appropriate mechanical and chemical properties over the over the anticipated lifetime of the medical device. This symposium will focus on the development of new types of materials for 3D printing of passive and active medical devices as well as applications of 3D printed medical devices.

Topics will include:

- Novel methods for 3D printing of medical devices
- Development of new materials for 3D printing of medical devices
- 3D printing of shape memory materials and other smart materials for medical applications
- 3D printing of patient-specific medical devices
- 3D printing of biomicrofluidic devices
- 3D printing of “organ-on-chip” devices
- Validation of novel 3D printing processes for medical applications
- Use of modeling approaches to understand 3D printing processes for medical applications
- Translation of 3D printed medical devices into clinical use

Invited speakers include:

Amit Bandyopadhyay	Washington State University, USA	**Jayanthi Parthasarthy**	Nationwide Children's Hospital, USA
Jason Burdick	University of Pennsylvania, USA	**Wei Sun**	Drexel University, USA
David Dean	The Ohio State University Medical Center, USA	**Stephanie Willerth**	University of Victoria, USA
Lucy Di Silvio	King's College London, United Kingdom	**Mia Woodruff**	Queensland University of Technology, Australia
Reginald Hamilton	The Pennsylvania State University, USA	**Wai Yee Yeong**	Nanayng Technological University, USA
Shim Jin-Hyung	Korea Polytechnic University, Republic of Korea	**James Yoo**	Wake Forest Baptist Health, USA
Cambre Kelly	Restor3D, USA	**Boyang Zhang**	McMaster University, Canada

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Symposium MF03: Materials and Methods for Fabricating Flexible and Large-Area Electronics

The next generation of electronics is dependent on new materials and methods that can reach beyond the capabilities of rigid, silicon-based technologies. Many new and promising applications are emerging that necessitate electronic materials of novel form factors and processing. Specifically, flexible and large-area electronic systems have the potential to impact many industries. For example, foldable displays could benefit from flexible transistor backplanes, thin-film photovoltaics could benefit from large-area fabrication schemes, and multifunctional wearable sensors could benefit from expanded functionality and resilient stretching behavior. There has been extensive research into new materials and fabrication methods that enable the efficient production of these novel form-factor electronics. To facilitate important discussion and dissemination of new results, this symposium will include three broad themes correlated with the advancement of flexible and large-area electronic systems. The primary themes include: (1) the synthesis of materials or material systems that enable inherent resilience to strain, solution processability, or biocompatibility; (2) methods of depositing materials (including printing) to enable flexible or large-area devices; and (3) novel flexible/large-area devices and systems with applications in sensing, energy generation, or communication. Additionally, work that exists as a combination of all the relevant topics is specifically encouraged.

Topics will include:

- Development of electronic inks
- Techniques for printing electronic materials
- Stretchable electronics
- Electronic skin
- Wearable devices and sensors
- Nanomaterial-based thin films
- Printed thin-film transistors
- Devices enabled by printed electronics
- Flexible electronic devices and sensors
- Large-area electronic devices and sensors
- Advanced manufacturing techniques for large-area electronics
- Solution-phase processing of electronic materials
- Interfaces and transport properties in thin-film electronic devices/sensors

Joint sessions are being considered with **EQ04 - Advanced Soft Materials and Processing Concepts for Flexible Printed Optoelectronic Devices and Sensors**.

Invited speakers include:

Jong-Hyun Ahn	Yonsei University, Republic of Korea	**Chang Kyu Jeong**	Jeonbuk National University, Republic of Korea
Deji Akinwande	The University of Texas at Austin, USA	**Oana Jurchescu**	Wake Forest University, USA
Trisha Andrew	University of Massachusetts at Amherst, USA	**John Kymissis**	Columbia University, USA
Stephen Forrest	University of Michigan, USA	**Vincenzo Pecunia**	Soochow University, China
Daniel Frisbie	University of Minnesota, USA	**Becky Peterson**	University of Michigan, USA
Mark Hersam	Northwestern University, USA	**Luisa Torsi**	Università degli Studi di Bari Aldo Moro, Italy
Hideo Hosono	Tokyo Institute of Technology, Japan	**Jana Zaumseil**	Universität Heidelberg, Germany
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Symposium NM01: Beyond Graphene 2D Materials—Synthesis, Properties and Device Applications

The vast interest in "beyond graphene" 2D and layered materials have been driven by the compelling properties of individual atomic layers compared to their bulk counterparts. Such properties include the emergence of a direct bandgap with large exciton binding energies, valley polarization, magnetism, piezoelectricity, ferroelectricity and etc., all of which depend on the composition, crystal structure, phase, twist angle and number of individual layers in stacked heterostructures. 2D materials are extreme surfaces that are susceptible to physical, electrical and/or chemical modifications, with unique properties that can cover all of the components necessary to address voltage, interconnect, energy and dimensional scaling issues in a variety of devices. These materials are also remarkable platforms to study new phenomena in chemistry, materials science, biology and condense matter physics. This interdisciplinary symposium brings together a diverse set 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, halides, oxides, MPX3, nitrides, carbides and etc.) and 2D layered (transition-metal di-/tri-chalcogenides, group-III/-IV chalcogenides and etc.) materials, alloys and their van der Waals heterostructures. Furthermore, it will focus on recent progress of novel devices enabled by 2D materials, particularly with recent developments in viable approaches for large scale synthesis, doping and integration of monolayers, lateral and vertical heterostructures, twisted layers and the emergence of 2D polymers, 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, Polymers, 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.
- Mechanical Properties and Defects in 2D Materials Beyond Graphene.

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

Invited speakers include:

Deji Akinwande	The University of Texas at Austin, USA
James Analytis	University of California, Berkeley, USA
Cinzia Casiraghi	The University of Manchester, United Kingdom
Feng Ding	Ulsan National Institute of Science and Technology, Republic of Korea
Xiangfeng Duan	University of California, Los Angeles, USA
Xinliang Feng	Technische Universität Dresden, Germany
Andrea Ferrari	University of Cambridge, United Kingdom
Susan Fullerton	University of Pittsburgh, USA
Sarah Haigh	University of Manchester, United Kingdom
Philip Kim	Harvard University, USA
Young Hee Lee	Sungkyunkwan University, Republic of Korea
Lain-Jong Li	The University of Hong Kong, Hong Kong
Jun Lou	Rice University, USA
Xavier Marie	Institut National des Sciences Appliquées, France
David Muller	Cornell University, USA
Sungwoo Nam	University of Illinois at Urbana-Champaign, USA
Taisuke Ohta	Sandia National Laboratories, USA
Jiwoong Park	The University of Chicago, USA
Amalia Patane	The University of Nottingham, United Kingdom
Diana Qiu	Yale University, USA
Iuliana Radu	imec, Belgium
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Symposium NM02: Reconfiguring the Properties of 2D Materials by Post-Synthesis Design

As materials dominated by their surface, atomically thin two-dimensional (2D) materials cannot be thought of as isolated membranes, but instead as a product of both their intrinsic properties and their local environment. This introduces many post-synthesis knobs to modify the electronic, magnetic, optical, mechanical, superconducting, and topological properties of 2D materials by design. For instance, the ability to stack freestanding films without traditional epitaxial considerations adds new degrees of freedom, which cannot be explored in bulk or as-synthesized materials, like tailoring proximity effects due to neighboring films, tuning correlations through the creation of long-range moire potentials, or creating three-dimensional deformations in 2D sheets. This session will focus on the various methods that have been explored to reconfigure, switch and tune the properties of the 2D materials after synthesis. Examples include: proximity effects (dielectric, superconducting and magnetic); relative twist and dynamical slip between layers including engineering the Moire potential; strain engineering; defect engineering; chemical functionalization; and the creation of transient excited-state phases and phenomena on ultrafast timescales using photons, x-rays and electrons. Additional focus will include exploring applications to generate reconfigurable properties, new quantum materials and systems, multifunctional surfaces, straintronics, twistronics, and stretchable electronics.

Topics will include:

- Experiment and theory of post-synthesis manipulation/tuning of properties of 2D materials
- Proximity effects, including proximity-induced 2D magnetism, 2D/1D superconductivity
- Twistronics, dynamic slip and twist
- Defect engineering
- Straintronics and deformation engineering
- Dielectric and substrate engineering
- Chemical functionalization, multifunctional surfaces
- Ultrafast and transient excited-state phenomena in 2D materials

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

Invited speakers include:

Jong-Hyun Ahn	Yonsei University, Republic of Korea
Judy Cha	Yale University, USA
Chitraleema Chakraborty	Harvard University, USA
Yang-Hao Chan	Academia Sinica, Taiwan
Alexey Chernikov	Dresden University of Technology, Germany
Keshav Dani	Okinawa Institute of Science and Technology, Japan
Milan Delor	Columbia University, USA
Goki Eda	National University of Singapore, Singapore
Chang-beom Eom	University of Wisconsin–Madison, USA
Libai Huang	Purdue University, USA
Pinshane Huang	University of Illinois at Urbana-Champaign, USA
Harold Hwang	Stanford University, USA
Felipe Jornada	Stanford University, USA
Frank Koppens	Institut de Ciències Fotòniques, Spain
Elad Koren	Technion–Israel Institute of Technology, Israel
Gwan-Hyoung Lee	Seoul National University, Republic of Korea
Kin Fai Mak	Cornell University, USA
Abhay Pasupathy	Columbia University, USA
Yuan Ping	University of California, Santa Cruz, USA
Rebecca Ribeiro-Palau	Centre for Nanosciences and Nanotechnology, France
Saverio Russo	University of Exeter, United Kingdom
Jie Shan	Cornell University, USA
Jangyup Son	Korea Institute of Science and Technology, Republic of Korea
Ajit Srivastava	Emory University, USA
William A. Tisdale	Massachusetts Institute of Technology, USA
Sefaattin Tongay	University of Arizona, USA
Bernhard Urbaszek	Institut National des Sciences Appliquées, France
Alexander Weber-Bargioni	Lawrence Berkeley National Laboratory, USA
Tim Wehling	University of Bremen, Germany

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Symposium NM03: 2D MXenes—Synthesis, Properties and Applications

Two-dimensional (2D) transitional metal carbide, nitrides and carbonitrides, known as MXenes, have become one of the largest families of materials. MXenes have remarkable physical, chemical, electrochemical, and mechanical properties. These 2D carbides and nitrides have shown great promise in energy storage (batteries and supercapacitors), catalysis, electromagnetic interference shielding, wireless communications, flexible and transparent electronics, sensors, environmental and biomedical applications.

This symposium aims at being an international forum for the discussion of synthesis, properties, and applications of MXenes. All aspects of fundamental experimental and theoretical research related to MXenes including materials discovery and synthesis, characterizations of their electrical, electrochemical, optical, thermal, mechanical properties of MXenes, and their assembly and integration into functional devices will be covered in this symposium.

Topics will include:

- Synthesis of novel MXenes: experimental and theoretical
- Atomic structure and surface chemistry of MXenes
- Optical and electronic properties of MXenes
- Electrochemical properties and applications of MXene
- Catalytic properties and applications of MXenes
- Thermal and thermoelectric properties of MXenes
- Mechanical and tribological properties of MXenes
- Biomedical applications of MXenes
- MXene-based sensors, actuators, and other devices
- MXenes thin films, composites, hybrids, and 3D structures and their applications

Invited speakers include:

Hussam Alshareef	King Abdullah University of Science and Technology, Saudi Arabia
Michel Barsoum	Drexel University, USA
Majid Beidaghi	Auburn University, USA
Yohan Dall'Agnese	University College London, United Kingdom
Yury Gogotsi	Drexel University, USA
Tae Hee Han	Hanyang University, Republic of Korea
Qing Huang	Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences, China
Hee Tae Jung	Korea Advanced Institute of Science and Technology, Republic of Korea
Paul Kent	Oak Ridge National Laboratory, USA
Sang Ouk Kim	Korea Advanced Institute of Science and Technology, Republic of Korea
Seon Joon Kim	Korea Institute of Science and Technology, Republic of Korea
Maria Lukatskaya	ETH Zürich, Switzerland
Khaled Mahmoud	Hamad Bin Khalifa University, Qatar
Vadym Mochalin	Missouri University of Science and Technology, USA
Michael Naguib	Tulane University, USA
Cheolmin Park	Yonsei University, Republic of Korea
Hanna Pazniak	Universität Duisburg-Essen, Germany
Miladin Radovic	Texas A&M University, USA
Johanna Rosen	Linköping University, Sweden
Raymond Unocic	Oak Ridge National Laboratory, USA
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Symposium NM04: Nanotubes and Related Low-Dimensional Nanostructures

Nanotubes and related low-dimensional nanostructures, such as carbon nanotubes, and other non-carbon nanotubes and nanosheets (materials in the B-C-N system, including boron nitride, and boron), have attracted tremendous attentions for their unique structures and intriguing properties. These nanomaterials have been widely investigated spanning synthesis, structure and property characterization to applications and industrialization in electronic devices, energy generation and storage, biological and chemical sensors etc.. This symposium will emphasize fundamental aspects of these materials as well as emerging technologies which utilize their exceptional properties, such as artificial intelligence and additive manufacturing. We will bring together researchers from different disciplines to discuss the fundamental and industrial aspects of theory, synthesis, assembly, characterization, and application.

Topics will include:

- Synthesis, doping, and characterization
- Theoretical study on the growth, doping, and the fundamental properties
- Machine learning and artificial intelligence
- Approaches for purification, modification and sorting
- Synthesis and characterization of B-C-N thin films and novel heterostructures
- Energy harvesting, conversion, and storage
- Multifunctional devices for wearable electronics, etc.
- Advanced functional materials, composites, etc.
- Nanomaterial/biomolecule interactions: biochemical applications and toxicity studies
- Hierarchical organization
- Optical spectroscopy

Invited speakers include:

Seunghyun Baik	Sungkyunkwan University, Republic of Korea	**Allan MacDonald**	The University of Texas at Austin, USA
Ray Baughman	The University of Texas at Dallas, USA	**Benji Maruyama**	Materials & Manufacturing Directorate at Air Force Research Laboratory, USA
Huiming Cheng	Institute of Metal Research, Chinese Academy of Sciences, China	**Shigeo Maruyama**	The University of Tokyo, Japan
Yury Gogotsi	Drexel University, USA	**Yutaka Ohno**	Nagoya University, Japan
Tawfique Hasan	Cambridge University, United Kingdom	**Deseree Plata**	Massachusetts Institute of Technology, USA
Esko Kauppinen	Aalto University, Finland	**Irene Suarez-Martinez**	Curtain University, Australia
Jing Kong	Massachusetts Institute of Technology, USA	**Fei Wei**	Tsinghua University, China
Young-Hee Lee	Sungkyunkwan University, Republic of Korea	**Yoke Khin Yap**	Michigan Technological University, USA
Qingwen Li	Suzhou Institute of Nanotechnology and Nano-Bionics, Chinese Academy of Sciences, China	**Qinghong Yuan**	East China Normal University, China
Yan Li	Peking University, China		

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Symposium NM05: Advances in Nanodiamonds for Sensing, Biomedical and Other Novel Applications

Nanodiamond is a unique class of carbon materials with size ranging from 3 nm to several hundreds nm. It has favorable properties for biomedical applications including non-toxic, biocompatible, and flexible surfaces for wide range of functionalization. In addition, the color centers, atomic size point defects in nanodiamond, is rapidly driving the development of nanoscale sensing capabilities owing to the materials unique photonic and spin properties. These unique properties are driving fast growing applications in nanotherapies, diagnostics, drug delivery, medical imaging, nanosensors for magnetic, electric fields, temperature, strain and single molecules. Moreover, nanodiamond based composite have also sparked new development of multi-modal theranostics, as well as emerging applications in catalysis and waste water treatment.

This symposium provides a platform for discussing recent advances of nanodiamond in quantum sensing, diagnostic, biomedical and other novel applications, as well as advances in the fabrication, functionalization, and characterization that enables enhanced performances of nanodiamonds. With recent advances to nanodiamond mass production and clinical applications, this symposium also provides an attractive forum for industry to discover and highlight the growing commercial potential of nanodiamonds

Topics will include:

- Nanodiamond-based nanosensors for imaging, temperature, field sensing
- Nanodiamond for imaging contrast enhancement
- Advances in fluorescent nanodiamond fabrication
- Advances in nanodiamond fabrication for better control in size, shape, defects, doping and spin
- Advances in single digit well-dispersed nanodiamonds
- Advances in characterization and modeling of nanodiamond structures and properties
- Advances of *in situ and in operando characterization of nanodiamonds*
- Advances in surface chemistry modifications of nanodiamonds
- Nanodiamonds for drug delivery: mechanisms and clinical translation
- Nanodiamond toxicity, biodistribution and pharmacokinetics
- Nanodiamond-based composites
- Other novel applications unique to nanodiamonds

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

Invited speakers include:

Igor Aharonovich	University of Technology Sydney, Australia
Amanda Barnard	The Australian National University, Australia
Huan-Cheng Chang	Academia Sinica, Taiwan
Joseph Heremans	The University of Chicago, USA
Fedor Jelezko	Universität Ulm, Germany
Anke Krueger	Universität Würzburg, Germany
Melissa Mather	The University of Nottingham, United Kingdom
Rachael McKendry	University College London, United Kingdom
Carlos Meriles	The City University of New York, USA
Elke Neu	Universität des Saarlandes, Germany
Masahiro Nishikawa	Daicel Corporation, Japan
Eiji Osawa	Nanocarbon Research Institute, Japan
Rodney Ruoff	Ulsan National Institute of Science and Technology, Republic of Korea
David Simpson	University of Melbourne, Australia
Sabine Szunerits	University of Lille, France
Igor Vlasov	General Physics Institute RAS, Russian Federation
Alexander Vul	Ioffe Institute, Russian Federation
Trevor Willey	Lawrence Livermore National Laboratory, USA
Abaraham Wolcott	San José State University, USA

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Symposium NM06: Nanoscale Mass Transport Through 2D and 1D Nanomaterials

2D and 1D nanomaterials offer fundamentally new opportunities to control nanoscale mass transport and present potential for breakthrough advances in gas separation, nanofiltration, desalination, ionic/molecular separation, proton transport, isotope separation, DNA translocation, dialysis and protein desalting, among others. The outstanding properties of 2D and 1D nanomaterials provides unique opportunities to overcome the historical trade-off in permeance vs selectivity endemic to nanoscale mass transport. However, challenges in scalable synthesis, controlled assembly and integration into functional devices using scalable manufacturing processes have limited progress towards practical applications. Recent research progress has helped to overcome many of the challenges, allowing progress towards practical applications. This interdisciplinary symposium aims to bring together the community of researchers working on nanoscale mass transport through 2D and 1D nanomaterials including fundamental physics, theory, material synthesis and characterization, device integration and scalable manufacturing, to disseminate the latest advances. The symposium will help promote the field of nanoscale mass transport through 2D and 1D nanomaterials and help to form connections between researchers to accelerate innovation and move these materials towards practical applications.

Topics will include:

- Water and ion transport through 2D membranes and 1D channels
- Gas transport through 2D materials
- Synthesis and Characterization of 2D and 1D materials for membrane applications
- Membrane fabrication processes with 2D and 1D materials
- Theory of nanoscale transport phenomena

Invited speakers include:

Narayana Aluru	University of Illinois at Urbana-Champaign, USA	**Ulrich Keyser**	University of Cambridge, United Kingdom
Daria Andreeva-Baeumler	National University of Singapore, Singapore	**Varoon Kumar Agarwal**	École Polytechnique Fédérale de Lausanne, Switzerland
Radha Boya	The University of Manchester, United Kingdom	**Marcelo Lozada-Hidalgo**	University of Manchester, United Kingdom
Saheed Bukola	National Renewable Energy Laboratory, USA	**Rahul Nair**	University of Manchester, USA
William Dichtel	Northwestern University, USA	**Konstantin Novoselov**	National University of Singapore, Singapore
Marija Drndic	University of Pennsylvania, USA	**Aleksandr Noy**	Lawrence Livermore National Laboratory, USA
Francesco Fornasiero	Lawrence Livermore National Laboratory, USA	**Hyun Gyu Park**	Pohang University of Science and Technology, Republic of Korea
Slaven Garaj	National University of Singapore, Singapore	**Huanting Wang**	Monash University, Australia
Armin Gölzhäuser	Universitat Bielefeld, Germany	**Luda Wang**	Peking University, USA
Jeffrey Grossman	Massachusetts Institute of Technology, USA	**Jamie Warner**	The University of Texas at Austin, USA
Nicolas Hadjiconstantinou	Massachusetts Institute of Technology, USA	**Wayne Yang**	Delft University of Technology, Netherlands
Rohit Karnik	Massachusetts Institute of Technology, USA	**Zhe Yuan**	Massachusetts Institute of Technology, USA

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Symposium QT01: Applications and Characterization of Nonequilibrium Electron, Phonon and Polaron Dynamics

The interactions between charge carriers (electrons and holes) and a material's vibrational modes (phonons) in far from equilibrium conditions has given rise to new condensed matter physics that can be exploited for a variety of applications. The development of new materials and devices is on-going to take advantage of these non-equilibrium dynamics to achieve improved efficiencies. This symposium will cover materials exhibiting novel non-equilibrium electron and phonon dynamics, and their applications to solar energy conversion in photovoltaics and photocatalysis. The interdisciplinary nature of the topics will bring together physicists, material scientists, engineers, chemists, and theorists working towards "Applications of Nonequilibrium Electron, Phonon, and Polaron Dynamics". Papers will cover novel hot carrier (electron or hole), phononic, and polaronic materials and their applications, along with computer modelling and simulation, and characterization techniques. Submissions ranging from material characterization to device demonstrations, modelling, and characterization technique development will be welcome.

It is anticipated that submissions will fall into three categories - Applications of non-equilibrium dynamics in photovoltaics, photocatalysis, and optoelectronics; Characterization and theory of non-equilibrium electron/hole and phonon dynamics; and Materials exhibiting novel hot carrier, phononic, and polaronic dynamics/interactions covering plasmonics, bulk and quantum confined semiconductors, and perovskites and other soft materials.

Topics will include:

- Simulation/theory of non-equilibrium electron, phonon, and photon interactions
- Characterization of carrier/phonon dynamics in materials and devices
- Polaron and phonon dynamics of perovskites and other soft materials
- Non-equilibrium dynamics in structured materials including quantum confined and nanostructures
- Applications of hot carriers in photovoltaics, photocatalysis, and optoelectronics

Invited speakers include:

Harry Atwater	California Institute of Technology, USA
Marco Bernardi	California Institute of Technology, USA
Jonathan Bird	University at Buffalo, The State University of New York, USA
Alexandra Boltasseva	Purdue University, USA
Pedro Camargo	University of Helsinki, Finland
Felix Deschler	Technical University of Munich, Germany
Nicholas Ekins-Daukes	University of New South Wales, Australia
Ralph Ernstorfer	Technical University of Berlin, Germany
David Ferry	Arizona State University, USA
Stephen Goodnick	Arizona State University, USA
Laura Herz	University of Oxford, United Kingdom
Tom Hopper	Stanford University, USA
Jacob Khurgin	Johns Hopkins University, USA
Aaron Lindenberg	Stanford University, USA
Suljo Linic	University of Michigan, USA

Heiner Linke	Lund University, Sweden
Stefan Maier	Ludwig-Maximilians-Universität München, Germany
Prineha Narang	Harvard University, USA
Rupert Oulton	Imperial College London, United Kingdom
Daniele Sanvitto	Consiglio Nazionale delle Ricerche, Italy
Rebecca Scheidt	National Renewable Energy Laboratory, USA
Renee Sher	Wesleyan University, USA
Ajay Ram Srimath Kandada	Wake Forest University, USA
Daniel Suchet	École Polytechnique Fédérale de Lausanne, France
Tze-Chien Sum	Nanyang Technological University, Singapore
Ravishankar Sundararaman	Rensselaer Polytechnic Institute, USA
Giulia Tagliabue	École Polytechnique Fédérale de Lausanne, Switzerland
Caterina Vozzi	Consiglio Nazionale delle Ricerche, Italy
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Symposium QT02: Quantum and Topological Phenomena in Two-Dimensional Systems

This symposium will cover the physics, synthesis, characterization, and application of current and emerging quantum and topological two-dimensional systems. New materials in these categories are expected to exhibit novel states of matter and enable new electronic devices and computing architectures, such as topological electronics and quantum computing.

The first day of the symposium will focus on the theory and synthesis of 2D behavior in thin films. The first sessions will create a shared theoretical foundation by focusing on the physical framework and mathematical tools needed to understand topological phenomena in thin films and heterostructures. A key focus in this session will be on novel calculation schemes for predicting topological materials and quantum phenomena in 2D. Following the theoretical sessions will be a session on the synthesis, characterization, and application of topological thin films and heterostructures composed of materials that show quantum and topological phenomena in the bulk. Discussion of film growth techniques and fabrication methods; enhancing the properties that are important for practical applications; and discussions that advance understanding of the fundamental phenomena are encouraged. The second day of the symposium will begin with sessions focused on theoretical aspects of non-trivial topology in Van der Waals systems. The theory session will be followed by sessions focusing on experimental aspects of Van der Waals materials, with focus on novel systems such as twisted bilayer graphene and Kagome lattice materials. Finally, this symposium will conclude with a session on two-dimensional topological superconductivity. In this session, we focus on the origins and stabilization of topological superconductivity, creating quantum computing systems that are robust against decoherence, and interface engineering of hybrid topological superconductors with non-abelian anyons. Symposium contributions should shed light on the fundamental scientific problems, reveal novel phenomena, or address obstacles confronting the development of practical applications.

Topics will include:

- Theoretical description of quantum phenomena in 2D systems
- Topological phenomena in thin films and heterostructures
- Topological superconductivity
- Van der Waals materials (Graphene, TBG, Kagome lattice, TMDs)

Joint sessions are being considered with **QT05 - 2D Topological Materials—Growth, Theoretical Models and Applications**, and **QT10 - Emerging Phenomena in Moiré Materials**.
Also, a **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Charles Ahn	Yale University, USA
Leon Balents	University of California, Santa Barbara, USA
Andrei Bernevig	Princeton University, USA
Jennifer Cano	Stony Brook University, The State University of New York, USA
Xi Dai	The Hong Kong University of Science and Technology, Hong Kong
Claudia Felser	Max Planck Institute for Chemical Physics of Solids, Germany
Liang Fu	Massachusetts Institute of Technology, USA
Philip Kim	Harvard University, USA
Stephanie Law	University of Delaware, USA
Michael Manfra	Purdue University, USA
Stuart Parkin	Max Planck Institute of Microstructure Physics, Germany
Leslie Schoop	Princeton University, USA
Javad Shabani	New York University, USA
Kyle Shen	Cornell University, USA
Susanne Stemmer	University of California, Santa Barbara, USA
Stephen Wilson	University of California, Santa Barbara, USA
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Abstract Submission Opens—Thursday, September 23, 2021
Abstract Submission Closes—Thursday, October 28, 2021 (11:59 PM ET)

Symposium QT03: Higher-Order Topological Structures—From Charge to Spin

Topologically non-trivial real space structures in ferroelectrics, such as polar skyrmions, domain walls and dislocations, are rich sources for emergent functional phenomena, enabling local control of electronic and ionic transport properties, light-matter interactions, propagation of phonons and more. There is a strong cross-disciplinary dimension connecting the research to the magnetism community and it is now clear that higher-order topological charge and spin textures open up a plethora of possible future dynamic nanoelectronic, spintronic and quantum devices. The beauty and connections of the unifying scientific concepts in materials with electric and / or magnetic order are mutually beneficial and have become a strong motivation for interdisciplinary activities, propelled by the recent developments in theory, synthesis and characterisation. This symposium aims to bring together scientific experts and young scientists with an interest in topologically non-trivial charge and spin textures that arise in real space, fostering interactions and advancing knowledge of higher-order topological structures in ferroelectrics, multiferroics and magnetic materials.

Topics will include:

- Skyrmions and chiral textures, higher-order topological structures
- Domains and domain walls, dislocations and disclinations
- Vortex, anti-vortex, and vertex structures
- Nanoelectronics using topological defects
- Interactions with extrinsic and intrinsic defects
- Emergent functional properties
- Materials (bulk crystals, thin films, superlattices, 2D systems)
- Controlled formation and movement of topological structures
- Atomic-scale charge, spin and phonon characterization
- Three-dimensional characterisation and reconstruction of topologies
- In-situ/operando characterization of dynamic processes via electron and local probe microscopy
- Time-resolved and ultrafast measurements
- Theoretical simulation and modeling of mechanically, electrically and magnetically driven processes

Invited speakers include:

Salia Cherifi-Hertel	National Center for Scientific Research and Strasbourg University, France
Miaofang Chi	Oak Ridge National Laboratory, USA
Claire Donnelly	University of Cambridge, United Kingdom
Jirka Hlinka	The Czech Academy of Sciences, Czech Republic
Jorge Íñiguez	Luxembourg Institute of Science & Technology, Luxembourg
Demie Kepaptsoglou	SuperSTEM, United Kingdom

Yousra Nahas	University of Arkansas, USA
Christian Pfleiderer	Technical University of Munich, Germany
Peggy Schoenherr	University of New South Wales, Australia
Shinichiro Seki	The University of Tokyo, Japan
Haidan Wen	Argonne National Laboratory, USA
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CALL FOR PAPERS

Abstract Submission Opens—Thursday, September 23, 2021

Abstract Submission Closes—Thursday, October 28, 2021 (11:59 PM ET)

Symposium QT04: Topology and Exotic Quantum Phases in 3D Materials

Fast, high-density, energy-efficient nano-devices are required to push quantum information processing beyond Moore's era. The current challenges lie in designing new transistor concepts and miniaturized energy-saving components that are small enough to fit in a transistor. This necessitates research on the development of new quantum materials, which has led to recent advances in high-Tc superconductors, magnetic and non-magnetic topological materials, chiral magnetic materials among others. A promising avenue is provided by layered magnetic topological insulators as ideal platforms for manipulating topologically protected edge states to build novel electronics, valleytronics, and spintronics architectures. Similarly, the recently discovered superconducting phase of transition metal dichalcogenides holds promise for applications in quantum information science. With parallel theoretical and experimental advances, new quantum materials and their heterostructures are thus the key for ushering in the era of quantum technologies. Interest in quantum materials spans over multiple research disciplines and industries.

This symposium will encompass theoretical studies and experimental discovery as well as applications research. It will enable active dialog between the experts from materials science, physics, chemistry, quantum information science, and device communities.

Abstracts are solicited in relevant experimental (growth, spectroscopy, (magneto) transport, local-probe techniques, devices and related issues) and theoretical (high-throughput design, first-principles- predictions, theory of experiment, device models) areas involving wide classes of quantum materials. Contributions that feature multidisciplinary research are of special interest.

Topics will include:

- Magnetic and non-magnetic (strong, weak, crystalline) 3D topological insulators.
- Weyl, Dirac, nodal line, and other 3D topological semimetals.
- Higher order topological insulators.
- Discovery and design of correlated-electron materials and 3D superconductors.
- Theory and simulation of novel 3D topological materials and exotic quantum phases.
- Characterizations and device applications of 3D topological materials and exotic quantum phases.

Invited speakers include:

Nurit Avraham	Weizmann Institute of Science, Israel
Tamalika Banerjee	University of Groningen, Netherlands
Arun Bansil	Northeastern University, USA
Silke Bühler-Paschen	TU Wien, Austria
Mei-Yin Chou	Academia Sinica, Taiwan
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Symposium QT05: 2D Topological Materials—Growth, Theoretical Models and Applications

2D Topological materials are a new class of materials that can, thanks to their extraordinary properties, project us in the Beyond CMOS world. The symposium will cover the growth, the theoretical models on physics and the applications for 2D topological materials. The first part will focus on the growth of 2D materials. The growth of the new generation of 2D topological materials such as Stanene, Plumbene, Bismuthene or Tellurene will be presented and will have an important place. We will highlight the issues concerning the capacity to obtain layers that do not react with ambient environment using opportune protection without changing the layer properties and on their functionalization for band gap engineering. The second part of the symposium will deal with the theoretical models explaining the topological behavior. A part will be devoted to the way and the conditions for the Quantum Spin Hall effect (QSH) to take place in 2D Topological insulators. Theoretical models that will link the QSH with other properties, such as ZT (figure of merit) for Thermoelectrics (TE) materials will be highlighted. The way to decouple phonon and charge in these materials exploiting functionalization or adding defects will be pointed out in this session. In the third part of the symposium, first applications of these materials will be presented. 2D topological materials can be a game changer in different fields such as TE with large ZT (i.e. avionics, space, energy consumption reduction in new intelligent buildings), new forms of quantum computing/memories at subatomic level and beyond CMOS electronics exploiting spin transport with very low energy consumption. Abstract for applications in these fields will be strongly solicited.

Topics will include:

- Growth of 2D topological materials
- Ambient stability of 2D topological materials
- Surface funcionalisation
- Theoretical modelling of 2D topological materials
- Quantum transport
- Thermoelectric properties and devices
- Sub-atomic quantum computing based on 2D materials
- Beyond CMOS electronics based on 2D materials
- Phase transitions in 2D topological materials
- Quantum based metrology

Joint sessions are being considered with **QT02 - Quantum and Topological Phenomena in Two-Dimensional 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 January.

Invited speakers include:

Monica Allen	University of California, San Diego, USA
Dimitri Basov	Columbia University, USA
Kwabena Bediako	University of California, Berkeley, USA
Bogdan Bernevig	Princeton University, USA
Elisabeth Bianco	Cornell University, USA
Jennifer Cano	Stony Brook University, The State University of New York, USA
Ralph Claessen	Julius-Maximilians-Universität Würzburg, Germany
Bruno Dlubak	Centre National de la Recherche Scientifique, France
Claudia Felser	Max Planck Institute for Chemical Physics of Solids, Germany
Benedetta Flebus	Boston College, USA
M. Zahid Hasan	Princeton University, USA
Thomas Heine	Technische Universität Dresden, Germany
Anna Isaeva	Technische Universität Dresden, Germany
Jinfeng Jia	Shanghai Jiao Tong University, China
Nadya Mason	University of Illinois at Urbana-Champaign, USA
Cecilia Mattevi	Imperial College London, United Kingdom
Ingrid Mertig	Martin Luther University Halle-Wittenberg, Germany
Laurens W. Molenkamp	Université de Groningen, Netherlands
Alessandro Molle	Consiglio Nazionale delle Ricerche, Italy
Amalia Patane	The University of Nottingham, United Kingdom
Leslie Schoop	Princeton University, USA
Pierre Seneor	Centre National de la Recherche Scientifique, France
Qi-kun Xue	Tsinghua University, China
Junji Yuhara	Nagoya University, Japan

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Symposium QT06: Recent Developments on the Properties of Emergent Layered 2D Quantum Magnetic Materials and Heterostructures

The discovery of magnetic 2D materials in 2016 (antiferromagnet) and 2017 (ferromagnets) has created widespread research excitement in the recent past. Exceptional properties led to the unprecedented experimental and theoretical explorations of 2D magnetism. These materials have emerged as ideal solid-state platforms, in which the structural and magnetic order strongly couple. 2D magnets also present unique routes for controlling magnetic order through electrical gating, stacking, and heterostructure composition. Furthermore, it offers an exciting new opportunity for the seamless integration of 2D magnets with dissimilar electronic and photonic 2D crystals. Therefore, it is anticipated that 2D magnets will open extraordinary opportunities for a plethora of designer quantum heterostructures with previously inaccessible magneto-optical and magnetoelectric properties.

Of particular importance, this symposium focuses on the recent advances in the design and fabrication of new 2D magnets and their heterostructures; their magneto-optical and magnetoelectric properties; novel techniques in characterization of 2D magnets; and theoretical developments. 2D magnets include atomically thin chromium trihalides, chalcogen-based van der Waals magnets, twisted bilayer graphene, magnetic topological insulators, and Weyl semimetals. This symposium's primary goal is to bring together both experimentalists and theoreticians investigating the physics, chemistry, materials science, and engineering aspects of magnetic quantum materials. With a mix of young scientists and established leaders in the field as invited and joint keynote speakers, the symposium will capture the new and most recent developments in the field of quantum magnetism and simultaneously enable researchers to receive a more in-depth perception of this emerging field and its grand challenges and opportunities.

Topics will include:

- Synthesis and exploration of new air-stable 2D quantum magnets
- Novel strategies to tune 2D magnetic order and proximity effects
- Magneto-optical properties of magnetic 2D materials
- Multiferroic properties and magnonic transport properties of magnetic 2D materials
- State-of-the-art experimental probes to directly characterize 2D magnetism
- Theoretical developments and computational methodologies of 2D magnetic heterostructures
- Novel magnetism in twisted bilayer graphene, magnetic topological insulators, and Weyl semimetals
- Integration of 2D magnets into heterostructures for spin- and valleytronic applications

Joint sessions are being considered with **QT02 - Quantum and Topological Phenomena in Two-Dimensional Systems**, **QT05 - 2D Topological Materials—Growth, Theoretical Models and Applications**, **QT03 - Higher-Order Topological Structures—From Charge to Spin**, **QT04 - Topology and Exotic Quantum Phases in 3D Materials**, and **QT09 - Light-Matter Strong Coupling in the Infrared and THz—Materials, Methods and New Phenomena**. Also, a **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Ken Burch	Boston College, USA
Ching-Ray Chang	National Taiwan University, Taiwan
Rebecca Dally	National Institute of Standards and Technology, USA
Eda Goki	National University of Singapore, Singapore
Venkatraman Gopalan	The Pennsylvania State University, USA
M. Zahid Hassan	Princeton University, USA
Mark Hersam	Northwestern University, USA
Jaehoon Kim	Yonsei University, Republic of Korea
Hyun-Woo Lee	Pohang University of Science and Technology, Republic of Korea
Robert McQueeney	Iowa State University, USA
Janice Musfeldt	University of Tennessee, Knoxville, USA
Masaki Nakano	The University of Tokyo, Japan
Qian Niu	The University of Texas at Austin, USA

Abhay Pasupathy	Columbia University, USA
Silvia Picozzi	Consiglio Nazionale delle Ricerche, Italy
Tatiana Gabriela Rappoport	Universidade Federal do Rio de Janeiro, Brazil
Trevor David Rhone	Rensselaer Polytechnic Institute, USA
Elton Santos	The University of Edinburgh, United Kingdom
Siddharth Saxena	University of Cambridge, United Kingdom
Andrew Wee T S	National University of Singapore, Singapore
Andrew Wildes	Institut Laue-Langevin, France
Seonghoon Woo	IBM T.J. Watson Research Center, USA
Weida Wu	Rutgers, The State University of New Jersey, USA
Xiao Xiao	The University of Florida, USA
Liuyan Zhao	University of Michigan–Ann Arbor, USA
Brian Zhou	Boston College, USA

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Symposium QT07: Atomic and Molecular Quantum Systems and Defect Engineering for Quantum Technologies

Single atom impurities and point defects in solid and molecular semiconductors and insulators have been observed to be excellent quantum systems that behave as qubits or single photon emitters. They can have long lived spin degrees of freedom suitable for quantum information processing, optical transitions that allow for coupling to photons, and promise to push quantum technologies beyond cryogenic environments. These properties spurred intense global interest in further developing such quantum defects as qubits, quantum memories, quantum registers, and single photon sources. However, the intrinsic fragility of quantum states poses a major materials science challenge and building a device that utilizes quantum states requires attention to decoherence-causing defects. For example, qubits based on shallow donors in silicon require close proximity to dielectric interfaces and metal gates to enable control, but can lead to loss of quantum information, rendering defect minimization important. Optical applications of quantum defects require integration into nanophotonic devices, introducing microfabricated surfaces that can host defects that lead to magnetic and electric field noise. In superconducting qubits, defects can act as two-level systems that cause dielectric loss and decoherence. These problems can be circumvented by learning to diagnose and control surfaces and interfaces, and by designing qubits that are insensitive to such issues. Enhanced understanding of defect measurements, manipulation, and modeling is essential but still lacking: Being able to control defects and impurities at the single emitter level and, or even knowing what the defect is, creates challenges that need to be addressed before significant progress can be made, motivating this symposium.

Challenges related to the controlled synthesis of impurities with desired defect spacing and defect type, occur e.g. for diamond or silicon carbide hosts, and low-dimensional materials, such as single-layer boron nitride. In particular, quantum sensing and quantum optics require specific defects in high-quality hosts. Nitrogen-vacancy centers in diamond, for example, can be synthesized using ultrashort laser pulses, but the role of electronic excitations and non-adiabatic mechanisms versus lattice annealing remains an open question. Similarly, techniques for positioning arrays of rare-earth ions in oxides need further development. Challenges for characterization include charge and spin states of defects, to assess suitability as single photon quantum emitters or qubits with long-term stability of their spin excitations. Modeling coupling between quantum defects poses challenges in its own right: Accurately understanding real-time dynamics, electronic and spin excited-state lifetimes, and non-adiabatic electron-ion effects complicates the description, hampering a connection to experiment.

Topics will include:

- Materials synthesis and characterization
- Semiconductors, insulators, wide-band-gap materials
- Low-dimensional materials
- Computational and theoretical modeling
- Defect manipulation
- Hybrid quantum devices
- Identification and control of sources of decoherence
- Characterization and modeling of qubits and single-photon emitters

Invited speakers include:

Igor Aharonovich	University of Technology Sydney, Australia
David Awschalom	The University of Chicago, USA
Nathalie de Leon	Princeton University, USA
Jennifer Dionne	Stanford University, USA
Sudipta Dubey	Indian Institute of Technology Kanpur, India
Danna Freedman	Northwestern University, USA
Kai-Mei Fu	University of Washington, USA
Adam Gali	Wigner Research Centre for Physics, Hungary
Giulia Galli	The University of Chicago, USA
Weibo Gao	Nanyang Technological University, Singapore
Andreas Heinrich	Center for Quantum Nanoscience, Republic of Korea
Stephen Jesse	Oak Ridge National Laboratory, USA
Ute Kaiser	Universität Ulm, Germany
Prineha Narang	Harvard University, USA
Kasturi Saha	Indian Institute of Technology Bombay, India
Michelle Simmons	University of New South Wales, Australia
Nick Vamivakas	University of Rochester, USA
Chris G. Van de Walle	University of California, Santa Barbara, USA

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Symposium QT08: Group IV Quantum Engineering

Uncovering and harnessing quantum phenomena in materials that can leverage industrial semiconductor manufacturing is a long-sought-after strategy to create novel or superior quantum technologies for computing, communication, and sensing. With this perspective, this symposium will bring together a diverse set of scientific communities to present and discuss the progress, current challenges, and future opportunities in group IV quantum engineered materials for integrated quantum technologies. The symposium will cover the broad spectrum from fundamental materials and quantum science to engineering and industrial applications. The first part of the symposium will be dedicated to quantum systems based on group IV materials that are readily integrated on a Si wafer (Si, SiC, Ge, Sn, and their alloys) and their use as platforms to tailor and tune key quantum processes and particles (fermions, Majorana fermions, bosons, anyons, etc.). This includes two-dimensional electron and hole gases, quantum dots, quantum wires, metal-oxide-semiconductor structures, atomic-level doped semiconductors, topological insulators, hybrid superconductor-semiconductor systems, isotopically programmed semiconductors, defect-enabled optical emitters, and ultrasensitive micro- and nano-electromechanical systems (MEMS/NEMS). The key focus will be on the significant progress in materials to solve outstanding challenges in generating, controlling, and manipulating quantum states and quasi-particles. The second part of the symposium will target group IV-enabled quantum components such as qubits, single-photon emitters, single-photon detectors, quantum repeaters, quantum transducers, quantum LIDAR, gravitometers, nanoscale magnetic sensors, etc. Special sessions will be dedicated to focused topics on ultrasensitive metrology, theoretical modeling, quantum device packaging, and challenges in industry-compatible quantum manufacturing.

Abstracts will be solicited in the following areas: Scalable and CMOS-compatible quantum materials and devices; Group IV elements and alloys; Silicon-integrated quantum technologies; Qubits; Single-photon emitters; Single-photon detectors; Ultrasensitive MEMS and NEMS; Spin-photon interfaces; Quantum photonics; Quantum communication; Quantum computing; Quantum sensing.

Topics will include:

- Two-dimensional hole and electron gases.
- Quantum dots and Quantum wires.
- Single atom doping.
- Isotopically enriched semiconductors.
- Topological insulators.
- Single-photon emitters.
- Single-photon detectors.
- Spin injection and spin devices.
- Photon-to-spin conversion.
- Ultrasensitive micro- and nano-electromechanical systems.
- Scalable quantum photonics and topological quantum photonics.
- Quantum communication and quantum computation.
- Quantum sensing and metrology.
- Topological quantum computation.
- Modeling and packaging.

Joint sessions are being considered with **QT07 - Atomic and Molecular Quantum Systems and Defect Engineering for Quantum Technologies**.

Invited speakers include:

Marco Abbarchi	University Aix-Marseille 3, France
Gerald Buller	Heriot-Watt University, United Kingdom
Stefano Chesi	Beijing Computational Science Research Center, China
Anais Dreau	Université de Montpellier, France
Eva Dupont-Ferrier	Université de Sherbrooke, Canada
Mark A. Eriksson	University of Wisconsin–Madison, USA
Elham Fadaly	Eindhoven University of Technology, Netherlands
Yvonne Gao	National University of Singapore, Singapore
Andrea Hofmann	Institute of Science and Technology Austria, Austria
Angela Kou	University of Illinois at Urbana-Champaign, USA
Holly Stemp	University of New South Wales, Australia
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Symposium QT09: Light-Matter Strong Coupling in the Infrared and THz—Materials, Methods and New Phenomena

This symposium addresses the reinvigorated topic of strong coupling between light and matter in the infrared and THz spectral ranges (frequency range 1-300 THz), including the emergence of novel quantum interactions. In the strong coupling regime, two or more modes coherently interact and exchange energy at a rate much faster than the energy decay in either material. Under these conditions, the modes take on a hybrid character with properties and information shared between the constituent components. Thus, strong coupling can enable one system to adopt the beneficial properties of another. As such, strong coupling promises advances in quantum optics, control of chemical and biological reaction pathways, and, tailoring of emission properties of infrared emitters.

Strong coupling has been demonstrated in a wide range of materials (including two-dimensional materials, metamaterials, and biological and molecular systems). At its heart, strong coupling relies heavily upon the material properties that can couple to light, and thus investigations of strong coupling require the development of a concerted materials-centric understanding of light-matter interactions. Currently, however, strong coupling phenomena are viewed as interesting phenomenon observed within a variety of research fields, limiting cross-pollination of ideas and concepts between different research communities. It is the intent of this symposium to bring together leaders in strong coupling research across research disciplines. We hope a unified approach will allow us to advance our fundamental understanding of the transition from weak to ultra-strong coupling and from classical to quantum behavior, among other topics.

Topics will include:

- Spectroscopic techniques for observation of strong coupling in the infrared
- Vibrational strong coupling
- Polariton-phonon strong coupling
- Exciton polaritons
- Nonlinear spectroscopy of strongly coupled systems
- Strong coupling for biological, biochemical and molecular systems
- Ultrafast spectroscopy of strong coupling aspects in chemistry
- Novel material systems for strong coupling

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

Invited speakers include:

Claudia Climent	Universsidad Autonoma de Madrid, Spain	**Sang-Hyun Oh**	University of Minnesota, USA
Simone De Liberato	University of Southampton, United Kingdom	**Meera Parish**	Monash University, Australia
Hui Deng	University of Michigan, USA	**Stephanie Reich**	Freie Universitat Berlin, Germany
Felipe Herrera	Universidad de Santiago de Chile, Chile	**Blake Simpkins**	U.S. Naval Research Laboratory, USA
Vinod Menon	The City University of New York, USA	**Joel Yuen-Zhou**	University of California, San Diego, USA

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Symposium QT10: Emerging Phenomena in Moiré Materials

Moiré materials have recently emerged as widely tunable platforms hosting exotic strongly correlated and topological phenomena, including superconductivity, correlated insulator states, orbital magnetism and ferroelectricity. They can also be used to perform quantum simulation of important models in condensed matter systems. The number of materials that have been combined into moiré structures is continuously growing, currently including graphene, hexagonal boron nitride and transition metal dichalcogenides, with future prospects for expanding to 2D magnets, superconductors, and more. From an initial focus on bilayer structures, the field is now expanding to include the exploration of various types of multilayer moiré materials.

The plethora of phenomena that have been discovered in moiré systems is motivating intense research efforts ranging from understanding the origin of the unconventional superconductivity observed in magic-angle twisted bilayer graphene to investigating the interplay of correlations, magnetism, and topology in a tunable flat-band platform. The increasing number of moiré materials being studied and the richness of emerging new phenomena make this one of the most rapidly evolving fields in condensed matter physics.

This symposium will focus on both experimental and theoretical efforts to understand and characterize phenomena arising in moiré materials, covering the different directions the field is taking, including transport and scanning tunnelling microscopy studies, optical characterization, investigation of magnetic phenomena, efforts to improve fabrication strategies to solve the issue of twist-angle disorder, and the use of moiré materials as quantum simulators.

Topics will include:

- Superconductivity in moiré materials
- Magnetism in moiré materials
- Ferroelectricity in moiré materials
- Topological properties of moiré flat bands
- Optical properties of moiré materials
- Moiré materials as quantum simulators
- Scanning probe imaging and characterization of moiré materials
- Development of new experimental control knobs (including *in situ* twist angle control, strain, and pressure)

Joint sessions are being considered with **QT02 - Quantum and Topological Phenomena in Two-Dimensional Systems**.

Invited speakers include:

Andrei Bernevig	Princeton University, USA	**Jie Shan**	Cornell University, USA
Cory Dean	Columbia University, USA	**Ashvin Vishwanath**	Harvard University, USA
Francisco Guinea	IMDEA Materials Institute, Spain	**Feng Wang**	University of California, Berkeley, USA
Shalal Ilani	Weizmann Institute of Science, Israel	**Xiaodong Xu**	University of Washington, USA
Pablo Jarillo-Herrero	Massachusetts Institute of Technology, USA	**Ali Yazdani**	Princeton University, USA
Philip Kim	Harvard University, USA	**Andrea Young**	University of California, Santa Barbara, USA
ChunNing Jeanie Lau	The Ohio State University, USA	**Mike Zaletel**	University of California, Berkeley, USA
Allan MacDonald	The University of Texas at Austin, USA	**Eli Zeldov**	Weizmann Institute of Science, Israel

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Symposium QT11: Superconducting Materials and Applications

The symposium will broadly cover superconducting materials and applications. An emphasis is placed on facilitating the transition from basic science discoveries to technology deployment of superconducting materials. Contributions to the development of novel and customized superconducting materials are encouraged, which include superconducting electronics for quantum computation and large-scale superconducting devices for high field magnets and power applications.

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

Topics will include:

- Superconducting qubits: materials issues, gates and error corrections
- Josephson junctions technology and interface
- Topological superconductors and unconventional superconductivity
- REBCO wires and Coated Conductors: processing and applications
- Fe-based superconductors and potential applications
- Bi-based, Nb-based, MgB(2) tapes and round wires: processing and applications
- Flux pinning and critical currents: intrinsic pinning behavior, anisotropy, irradiation effect
- Energy applications and devices based on superconducting materials

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

Invited speakers include:

Giuseppe Celentano	Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy
Chang-beom Eom	University of Wisconsin–Madison, USA
Arno Godeke	Varian Medical Systems, Inc., Germany
Francesco Grilli	Karlsruhe Institute of Technology, Germany
Gaia Grimaldi	Consiglio Nazionale delle Ricerche, Italy
Ramesh Gupta	Brookhaven National Laboratory, USA
Alex Gurevich	Old Dominion University, USA
Jens Haenisch	Karlsruhe Institute of Technology, Germany
Tomoya Horide	Kyushu Institute of Technology, Japan
Harold Y. Hwang	Stanford University, USA
Irene Lucas del Pozo	University of Zaragoza, Spain

Andrea Malagoli	Consiglio Nazionale delle Ricerche, Italy
Masashi Miura	Seikei University, Japan
Toshinori Ozaki	Kwansei Gakuin University, Japan
Anna Palau	Institut de Ciència de Materials de Barcelona, Spain
Jeong Ming (Jane) Park	Massachusetts Institute of Technology, USA
Marty Rupich	American Superconductors, USA
Takao Sasakawa	Tokyo Institute of Technology, Japan
Susannah Speller	University of Oxford, United Kingdom
Tsuyoshi Tamegai	The University of Tokyo, Japan
Akiyasu Yamamoto	Tokyo University of Agriculture and Technology, Japan

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Symposium SB01: Organic Electronics—Multimodal Characterization and Computation-Driven Material Design and Performance

The potential of next-generation flexible, printable, and biocompatible electronic devices made from organic materials continues to draw significant interest in the research community. This symposium focuses on how the community can realize this potential through advanced nanostructure characterization and device physics combined with state-of-the-art computational methods to enable breakthroughs in design of molecular materials. Recent results show exciting new high-performance devices within innovative application spaces. Of particular interest are novel in-situ or operando experimental studies that reveal the dynamics of film formation into a final organic or hybrid nanostructure in connection to resulting properties and performance. In addition, studies are called for which involve new computational techniques and algorithms that can predict the statistically relevant structure and properties as well as intelligently fuse such results with multimodal quantitative measurements. Finally, the emphasis is given to combining such experimental and computational insights to drive the design of the next generation materials and devices.

Topics will include:

- *In situ/operando* characterization of organic and hybrid materials
- Frontiers in multimodal nanostructure measurements involving electrons, X-rays, neutrons, and scanning probes
- Merging experiment with theory and simulation towards designed materials, structures, and properties
- Novel algorithms, machine learning, and other approaches towards predictive methods of structure and properties
- Engineering interfacial and bulk structures to influence excited state dynamics and performance
- Understanding of the structure and dynamics of conjugated polymers for stable device operation
- Holistic design of molecules to address device processing, structure, properties, and lifetime
- Emerging device applications that harness the advantages of organic materials

Invited speakers include:

Derya Baran	King Abdullah University of Science and Technology, Saudi Arabia
Mariano Campoy-Quiles	Nanostructured Materials for Optoelectronics and Energy Harvesting, Spain
Michael Chabinyc	University of California, Santa Barbara, USA
Carsten Deibel	Technische Universität Chemnitz, Germany
Chong-an Di	Institute of Chemistry, Chinese Academy of Sciences, China
Ying Diao	University of Illinois at Urbana-Champaign, USA
Lei Fang	Texas A&M University, USA
Alessio Gagliardi	Technische Univeristät München, Germany
David Ginger	University of Washington, USA
Wenping Hu	Tianjin University, China
Lynn Loo	Princeton University, USA
Christine Luscombe	Okinawa Institute of Science and Technology, Japan
Iain McCulloch	Oxford University, United Kingdom
Jianguo Mei	Purdue University, USA
Marcus Noack	Lawrence Berkeley National Laboratory, USA
Harald Oberhofer	Technical University of Munich, Germany
Jian Pei	Peking University, China
Lillo Pozzo	University of Washington, USA
Erin Ratcliff	University of Arizona, USA
Jonathan Rivnay	Northwestern University, USA
Simon Rondeau-Gagné	University of Windsor, Canada
Bret Savoie	Purdue University, USA
Natalie Stingelin	Georgia Institute of Technology, USA
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Symposium SB02: Materials, Power Sources, Sensors, Actuators and Mechanics for Untethered Soft Robots

In recent years, considerable efforts have been devoted to developing novel soft robots, yielding advances in biomimetic robot mechanisms, soft actuators, soft artificial organs, and biocompatible and conformable prostheses. To realize these applications, high-performance power sources, sensors, actuators, and processors made of soft materials are essential.

The final step to achieve wearable and autonomous soft robots is to remove their tether to electrical power and introduce untethered systems. The integration of new, flexible energy harvesting/storage devices with soft actuators and sensors makes it possible to achieve this ultimate form of soft robots. For further development and future practical applications, multidisciplinary research linking materials, devices, actuation, mechanics, and information processing is critical. Based on this motivation, the main purpose of this symposium, by gathering researchers from different disciplines worldwide, is to discuss the challenges and possibilities for the next generation of soft robots. This symposium will cover newly developed materials, thin and light-weight energy harvesting/storage devices, flexible/stretchable sensors, flexible photonics for sensing and stimulation, new mechanics, and artificial intelligence.

Thanks to their tissue-like mechanical compliance (including both flexibility and stretchability), devices built with soft materials can serve as the interface between the electronic world and the biological one, conforming to internal organs or skin and other soft, curved surfaces. Furthermore, the stretchability of these devices allows them to maintain operation even under large deformation. Already, soft robots and soft machines that integrate energy harvesting, sensing, actuation, and information processing have appeared, heralding remarkable potential applications in wearable consumer electronics, mobile health monitoring, artificial prostheses, artificial organs, and disaster relief.

Topics will include:

- Thin and light-weight energy harvesting/storage devices
- Stretchable conductors
- Soft actuators for untethered robots and wearables
- Soft robotics and artificial intelligence with a focus on untethered systems
- Design & materials for Flexible and stretchable electronic devices
- Organic and hybrid electronics for flexible/stretchable devices
- Soft optical devices for imaging, sensing and stimulation
- Integrated systems for soft-robot applications

Joint sessions are being considered with **SB08 - Soft Embodiments of Electronics and Devices for Healthcare Applications**.

Invited speakers include:

Ichiro Amimori	Xenoma Inc., Japan
Yi Cui	Stanford University, USA
Marco Fontana	Sant'Anna School of Advanced Studies, Italy
Chuafei Guo	Southern University of Science and Technology, China
Christoph Keplinger	Max Planck Institute for Intelligent Systems, Germany
Dae-Hyeong Kim	Seoul National University, Republic of Korea
Cecilia Laschi	National University of Singapore, Singapore
Pooi See Lee	Nanyang Technological University, Singapore
Yigit Menguc	Facebook Reality Labs, USA
Kohei Nakajima	The University of Tokyo, Japan
John Rogers	Northwestern University, USA
Herbert Shea	École Polytechnique Fédérale de Lausanne, Switzerland
Takao Someya	The University of Tokyo, Japan
Kenji Suzuki	University of Tsukuba, Japan
Koichi Suzumori	Tokyo Institute of Technology, Japan
Kuniharu Takei	Osaka Prefecture University, Japan
Zhong Lin Wang	Georgia Institute of Technology, USA

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Symposium SB03: Robotic Materials for Advanced Machine Intelligence

The natural world motivates a new paradigm for robot design: advancing machine intelligence by way of new materials for robot bodies, whose mechanical and physicochemical properties yield advanced capabilities and autonomous behaviors akin to those of living organisms. Soft robotics has exemplified how a materials-driven approach to robotics has expanded robots' abilities, opened new avenues for wearable and biomedical machines, and transformed our ideas of what a robot is and can be. However, continued advances are needed to address fundamental limitations in fabrication, power, and control. To address these interdisciplinary challenges, this symposium will bring together researchers from soft and microscale robotics, stretchable electronics, active matter, mechanics, and chemistry to share research that advances robotics by way of new materials.

This symposium is structured around three research themes. The first theme - *robotic components from soft and architected materials* - will feature new materials for actuation, perception, power, and control capabilities in soft robots and devices across all scales. Innovations of special interest include electrically-driven soft actuators, self-powered components, chemical power strategies, and iontronic devices. The second theme - *integrated design and fabrication strategies for robotic materials* - will showcase progress in manufacturing. Methods of particular interest will facilitate distributed actuation and sensing capabilities, multi-material fabrication, multiscale assembly, and/or paths towards the end-to-end design, fabrication, and evaluation of robotic materials. The third theme - *advances in the modeling and control of materials for physical machine intelligence* - will highlight theoretical contributions that will improve robotic material design and fabrication. The symposium will broadly explore new applications for robotic materials, including autonomous/untethered systems, wearable and biomedical devices, smart textiles, and beyond.

Topics will include:

- Actuators for soft robots and devices - liquid crystal elastomers, dielectric elastomer actuators, and shape-memory/shape-morphing materials
- Elastomers, hydrogels, polymers, and composites for robot bodies
- Materials and strategies for power and energy management in soft devices
- Additive and digital fabrication schemes for soft robots and robotic materials
- Architected and biomimetic materials for robots
- Materials for self-healing, growing, learning, and other adaptive robotic functions
- Bioinspired and biohybrid design in robotic materials
- Modeling, simulation, and control of robotic materials
- Robotic materials for innovations at the human-robot interface
- Autonomous soft/microscale robots and active matter

Joint sessions are being considered with **SF13 - From Actuators and Energy Harvesting Storage Systems to Living Machines**.

Invited speakers include:

Bilge Baytekin	Bilkent University, Turkey
Ravinder Dahiya	University of Glasgow, United Kingdom
Chiara Daraio	California Institute of Technology, USA
Kristen Dorsey	Smith College, USA
Ryan Hayward	University of Colorado Boulder, USA
Yan Ji	Tsinghua University, China
Mirko Kovac	Imperial College London, United Kingdom
Rebecca Kramer-Bottiglio	Yale University, USA
Andreas Lendlein	University of Potsdam, Germany
Hani Naguib	University of Toronto, Canada
Jordan Raney	University of Pennsylvania, USA
Herbert Shea	École Polytechnique Fédérale de Lausanne, Switzerland
Robert Shepherd	Cornell University, USA
Metin Sitti	Max Planck Institute for Intelligent Systems, Germany
Thomas Speck	Albert-Ludwigs-Universität Freiburg, Germany
Zeynep Temel	Carnegie Mellon University, USA
Li Zhang	The Chinese University of Hong Kong, China

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Symposium SB04: Advanced Soft Materials for Bioelectronic Interfaces

Bioelectronic interfaces, which facilitate the transduction of biological signals and the stimulation of biological organs/tissues, open new opportunities for various applications such as healthcare, robotics, sports, and e-games. These devices often require the conformal attachment of devices on the curvilinear human skin or organ surface and the long-term operational reliability even under severe mechanical deformation.For these purposes, many researchers have been searching for specialized constituent materials, particularly, targeting stretchable/flexible/soft conductors, semiconductors, and dielectrics, in conjunction with processing/integration methods toward robust high-performance devices.

This symposium covers the recent progress in advanced soft materials, processing, and device architectures for bio-electronic interfaces in the fields of healthcare, robotics, sports, and Internet of Things (IoTs), etc.

Topics will include:

- Flexible and/or stretchable active/passive materials for bioelectronics
- Conductive hydrogel materials
- Self-healing, biocompatible, and biodegradable soft electronic materials
- Soft conductive materials for 3D printing
- Soft organic, inorganic, or hybrid materials with capacitive, piezoelectric, piezoresistive, triboelectric, and/or ferroelectric properties
- Stimuli (e.g., stress, light, heat, pH, chemical, etc.)-responsive soft materials
- Soft electronic materials for biochemical sensing
- Soft electronic materials for electrocardiogram (ECG or EKG), electroencephalogram (EEG), electromyogram (EMG), and electrooculogram (EOG)
- Novel electronic materials for brain-machine interfaces
- Novel stretchable and/or flexible device architectures for practical applications in the fields of healthcare, robotics, sports, IoTs, etc.
- Soft energy harvesting materials for bioelectronics

Joint sessions are being considered with **SB05 - Tissue-Like Bioelectronics and Living Bioelectronic Interfaces**, and **SB06 - Bioelectronic Materials and Devices for *In Vitro* Systems**.

Invited speakers include:

Polina Anikeeva	Massachusetts Institute of Technology, USA
Chris Bettinger	Carnegie Mellon University, USA
Mary Donahue	Linköping University, Sweden
Kenjiro Fukuda	RIKEN, Japan
Wei Gao	California Institute of Technology, USA
Anna Herland	KTH Royal Institute of Technology, Sweden
Suk-Won Hwang	Korea University, Republic of Korea
Ali Javey	University of California, Berkeley, USA
Unyong Jeong	Pohang University of Science and Technology, Republic of Korea
Pawan Jolly	Harvard University, USA
Martin Kaltenbrunner	Johannes Kepler Universität Linz, Austria
Shana Kelley	University of Toronto, Canada
Dae-Hyeong Kim	Seoul National University, Republic of Korea
Sang-Woo Kim	Sungkyunkwan University, Republic of Korea
Stéphanie P. Lacour	École Polytechnique Fédérale de Lausanne, Switzerland
Hyunjoo Lee	Korea Advanced Institute of Science and Technology, Republic of Korea
Wei Lin Leong	Nanyang Technological University, Singapore
Christian Müller	Chalmers University of Technology, Sweden
Clara Santato	Polytechnique Montréal, Canada
Thomas Stieglitz	Universität Freiburg, Germany
Jeong-Yun Sun	Seoul National University, Republic of Korea
Benjamin Tee	National University of Singapore, Singapore
Jadranka Travas-Sejdic	University of Auckland, New Zealand
Sheng Xu	University of California, San Diego, USA

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Symposium SB05: Tissue-Like Bioelectronics and Living Bioelectronic Interfaces

Bioelectronics are a broad class of devices that convert biological information into electronic currents or vice versa. Such systems give rise to bidirectional flows of information between humans and machines and serve as instrumental therapeutics and diagnostics. Examples include implantable medical devices (e.g. pacemakers, cochlear implants, neural probes), surgical tools, and scientific apparatus. To expand efficacy, utility, and new applications, innovation is needed in the structural and functional properties of bioelectronic devices and the materials that compose these devices. Challenges include improving biological-device interfaces for resolution and specificity and prolonging device operation in biological environments. This symposium will cover the latest innovative materials and fabrication strategies that blur distinctions between tissue and device.

Material advances borrowed from other fields, such as tissue engineering, tissues-on-chip, and neural engineering, are fueling innovation in bioelectronic devices. Advanced manufacturing methods, such as 3D printing and bioprinting, that expand the versatility of materials in device composition and give rise to novel device structures and function will be highlighted. Emerging approaches that integrate biomaterials (e.g. hydrogels, proteins), thin films and devices laden with cells that are incorporated either during or after fabrication will be explored. Basic studies of biological-electrical interfaces, which elucidate important materials and device design principles are also key areas to be covered. The symposium will bring together investigators from a range of disciplines and whose research spans the spectrum of these topics.

Topics will include:

- Conducting hydrogels & proteins
- Bioelectronic devices built from soft & hydrated materials
- Cell-laden, biohybrid, or tissue-embedded bioelectronic devices
- Printed bioelectronics for integration of multiple materials and/or cells
- The use of electronics for engineered tissues, for recording or stimulation, such as tissues-on-chips
- Material strategies for improving cellular & tissue interfaces with electronics
- Biocompatibility studies & chronic evaluations of bioelectronic materials & devices
- Chronic evaluations of implanted devices
- New materials and material modifications to prolong device functionality/operation in biological environments
- Biomimetic bioelectronics
- Biofunctional nanomaterials
- Materials considerations for bioelectronic data and power transfer

Joint sessions are being considered with **SB06 - Bioelectronic Materials and Devices for *In Vitro* Systems**, and **SB08 - Soft Embodiments of Electronics and Devices for Healthcare Applications**.

Invited speakers include:

Tzahi Cohen-Karni	Carnegie Mellon University, USA
Tal Dvir	Tel Aviv University, Israel
Ying Fang	National Center for Nanoscience and Technology, China
Diego Ghezzi	École Polytechnique Fédérale de Lausanne, Switzerland
Sahika Inal	King Abdullah University of Science and Technology, Saudi Arabia
Abigail Koppes	Northeastern University, USA
Kristen Kozielski	Karlsruhe Institute of Technology, Germany
Duygu Kuzum	University of California, San Diego, USA
Antonio Lauto	Western Sydney University, Australia
Adam Micolich	University of New South Wales, Australia
Ivan Minev	The University of Sheffield, United Kingdom
Hidenori Okuzaki	University of Yamanashi, Japan
Roisin Owens	University of Cambridge, United Kingdom
Jonathan Rivnay	Northwestern University, USA
Francesca Santoro	Istituto Italiano di Tecnologia, Italy
Molly Stevens	Imperial College London, United Kingdom
Flavia Vitale	University of Pennsylvania, USA

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Symposium SB06: Bioelectronic Materials and Devices for *In Vitro* Systems

In vitro bioelectronics combines the realms of electronics and *in vitro* biological systems with the aim of developing improved bioassays for drug screening or for fundamental studies. As in the broader field of bioelectronics, progress in this area has been mainly driven by advances in materials science and device engineering as well as by the development of more predictive biological models. Materials that promote communication with cells can result in novel device configurations that can transduce and even amplify biological signals, bridging the gap between biology and measurements towards predictive models that can be reliably used for high-throughput high-content studies.The merging of synthetic biology and bioengineering with electronics allows for precise control over the biological model offering unprecedented opportunities to probe biology at multiple length scales, as well as to use biotechnology approaches to exploit biomolecules for applications such as energy harvesting and environmental/healthcare diagnostics. This symposium will encompass advances in multifunctional electronic materials, for interfacing biology, as well as for satisfying the technological demands of electronics industry such as compatibility with large area processes and miniaturisation. The scope of this symposium will go beyond traditional *in vitro* cell-based models and include cell-free biological models made via synthetic and bioinspired routes including cell membranes, vesicles and subcellular components.

Topics will include:

- Engineering the cell-material interface
- Bioinspired electronic materials and structures
- Cell based nanobioelectronics (nanomaterials, nanopatterning etc)
- 2D electronic materials and devices or bio-interfacing
- 3D bioelectronic models/ devices (including electroactive scaffolds, organoids, spheroids)
- On-chip integration of electronics with biological components (organ/tissues on chip, plasma membranes on chip etc)
- Interfacing subcellular components (i.e., organelles, vesicles etc) with bioelectronics
- Membrane biophysics (ion channel function, nanopore sensing, electrophysiology etc)
- Electronic sensors of cellular metabolic activity

Joint sessions are being considered with **SB05 - Tissue-Like Bioelectronics and Living Bioelectronic Interfaces**, and **SB04 - Advanced Soft Materials for Bioelectronic Interfaces**.

Invited speakers include:

Craig Aspinwall	University of Arizona, Austria
Fabio Biscarini	University of Modena, Italy
Annalisa Bonfiglio	Università degli Studi di Cagliari, Italy
Tzahi Cohen-Carni	Carnegie Mellon University, USA
Sahika Inal	King Abdullah University of Science and Technology, Saudi Arabia
Sven Ingerbrandt	RWTH Aachen University, Germany
Sungjune Jung	Pohang University of Science and Technology, Republic of Korea
Wolfgang Knoll	Austrian Institute of Technology, Austria
George Malliaras	University of Cambridge, United Kingdom
Damia Mawad	University of New South Wales, Australia
Aleksandr Noy	Lawrence Livermore National Laboratory, USA
Charalampos Pitsalidis	University of Cambridge, United Kingdom
Agneta Richter-Dahlfors	KTH Royal Institute of Technology, Sweden
Marco Rolandi	University of California, Santa Cruz, USA
Kaori Sugihara	University of Geneva, Switzerland
Bozhi Tian	The University of Chicago, USA
Feng Yan	The Hong Kong Polytechnic University, Hong Kong
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Symposium SB07: Bioresponsive Nanotheranostics

This symposium will cover the vibrant research field of the design and development of novel nanomaterials that can integrate therapeutic (e.g. drug/gene delivery, radiation, thermal/dynamic therapy, etc.) and diagnostic (e.g. non-invasive imaging, in vivo/ex vivo sensing, etc.) capabilities, in response to various cues in the biological/physiological environment (e.g. pH, redox potential, enzyme, glucose, oxygen level, biomimicry, etc.) and/or certain physical stimuli (e.g. temperature, magnetic field, radiation, light, self-assembly/disassembly, etc.).

Despite significant advances in medical approaches, many critical questions still remain: How to realize accurate prognosis to guide personalized/precision treatment? How to achieve desirable therapeutic efficacy while minimizing adverse systematic toxicity? How to spatiotemporally monitor drug fate and drug response for precision medicine? By harnessing the modular structure and bioresponsive properties of functional nanomaterials, nanotheranostics hold tremendous potential to provide accurate diagnostic and therapeutic capabilities, which has been a flourishing field of the last decade.

This symposium will gather the brightest minds with academic, industry and clinical backgrounds from many international institutions to share cutting-edge research and inspirational opinions, which will foster/catalyze exciting opportunities for (international) interdisciplinary and multidisciplinary collaborations. With an elite list of internationally renowned invited speakers from several continents, we welcome abstract submissions from all around the world to this exciting forum of scientific exchange.

Topics will include:

- Nanotheranostics in response to biological stimuli
- Nanotheranostics in response to physical stimuli
- Biomimetic nanotheranostics
- Clinical translation of nanotheranostics
- Nanomaterials for biomedical imaging
- Nanomaterials for new type of treatments
- Nanomaterials as drug delivery systems

Invited speakers include:

Frank Caruso	University of Melbourne, Australia
Liang Cheng	Soochow University, China
Tomáš Etrych	The Czech Academy of Sciences, Czech Republic
Zhen Gu	Zhejiang University, China
Taeghwan Hyeon	Seoul National University, Republic of Korea
Shana Kelley	University of Toronto, Canada
Ester Kwon	University of California, San Diego, USA
Teri Odom	Northwestern University, USA
Kanyi Pu	Nanyang Technological University, Singapore
Molly Stevens	Imperial College London, United Kingdom
Wei Tao	Harvard Medical School, USA
Nguyen Thanh	University College London, United Kingdom
Kristopher Thurecht	University of Queensland, Australia
Matthew Tirrell	The University of Chicago, USA
Zhi Ping Xu	University of Queensland, Australia
Liangfang Zhang	University of California, San Diego, USA
Jie Zheng	The University of Texas at Dallas, USA

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Symposium SB08: Soft Embodiments of Electronics and Devices for Healthcare Applications

Advancement in the field of flexible/stretchable electronics, and the materials needed to provide soft embodiments of electronics, is essential to the improvement of devices for healthcare applications. Providing a seamless interface between electronics and the human body is crucial for applications such as rehabilitation, brain machine interfaces, diagnostics, and disease management. Critical factors that drive the widespread introduction of systems aiming to establish a highly functional biological interface include the performance, cost, stability, power management, and lifetime of the materials. This symposium focuses on the development of soft, elastic, and flexible materials, devices and technologies aimed at advancement in healthcare. This includes the fundamental understanding of the material systems and use of these in applications which benefit from the compliant nature of the materials.

Progress within this field relies on multidisciplinary expertise, including electronics, material science, biology, and biophysics. Bringing together scientists and engineers actively engaged in research and development in these fields will facilitate possibilities to overcome limitations of current materials and devices. This will in turn enable further advancement of next-generation materials and devices, resulting in new opportunities in the areas of medicine, healthcare, and brain-machine interactions. The invited speakers possess expertise over a range of material systems as well as the targeted applications. A strong focus of this symposium is to facilitate collaboration between academic institutions and industry.

Topics will include:

- Soft embodiments of electronics and prosthetics
- Flexible/stretchable electronic materials
- Organic multifunctional materials
- Organic/inorganic and hybrid materials and systems
- Conducting hydrogels
- Substrates and encapsulation materials / methods with superior mechanical / thermal properties
- Novel signal transduction approaches
- Self-healing materials and sensors
- Wireless communication integrated with bioelectronic sensors and devices
- Biocompatible / bioresorbable layers
- Understanding the interface between organic electronics and biological materials
- Theory & modelling
- Molecular electronics & photonics
- Combining multiple sensing or stimulation modalities

Joint sessions are being considered with **SB02 - Materials, Power Sources, Sensors, Actuators and Mechanics for Untethered Soft Robots**, and **SB05 - Tissue-Like Bioelectronics and Living Bioelectronic Interfaces**.
Also, a **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Polina Anikeeva	Massachusetts Institute of Technology, USA	**John Rogers**	Northwestern University, USA
Michael Dickey	North Carolina State University, USA	**Tsuyoshi Sekitani**	Osaka University, Japan
Eric Glowacki	Linköping University, Sweden	**Robert Shepherd**	Cornell University, USA
Christoph Keplinger	University of Colorado Boulder, USA	**Takao Someya**	The University of Tokyo, Japan
Stéphanie P. Lacour	École Polytechnique Fédérale de Lausanne, Switzerland	**Kuniharu Takei**	Osaka Prefecture University, Japan
Nanshu Lu	The University of Texas at Austin, USA	**Benjamin Tee**	National University of Singapore, Singapore
George Malliaras	University of Cambridge, United Kingdom	**Bozhi Tian**	The University of Chicago, USA
Nicholas Melosh	Stanford University, USA		

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Symposium SB09: Genetically-Encoded and Bioinspired Materials Science

Living cells exhibit exquisite control over their molecular networks to detect environmental changes and to execute sophisticated commands. Bio-inspired or bio-integrated engineering of these cellular processes have enabled new avenues to manipulate the form and function of cells and tissue both ex vivo and in vivo. In this symposium, we will actively discuss how the convergence of materials science, synthetic biology, and bioengineering has facilitated the evolution of biomaterials from passive scaffolds to dynamic systems. We will focus on the materials design of bio-inspired, genetically-encoded and biomolecular materials and their application in mimicking and/or understanding living systems as well as in the development of new treatment concepts and therapeutics.

This symposium will be devoted to both fundamental research and applications of bio-inspired and genetically-encoded materials grouped into the following themes: tissue engineering, nanomedicine and bioelectronics. In the first theme on tissue engineering, we will cover topics on bioactive hydrogels, cellular bioprinting, and other materials approaches that incorporate biological matter and/or genetic engineering to assemble complex microenvironments for tissue modeling and regeneration. In the second theme on nanomedicine, we will focus on the molecular assembly of biomolecular (e.g. nucleic acids and proteins), nanoscale (e.g. viruses and exosomes), cellular or synthetic material to enable new therapeutic approaches. Finally, the bioelectronics theme will explore topics that include redox and conductive biomolecules as well as genetically-encoded reporters and actuators of cellular activity. This symposium will highlight multidisciplinary efforts to advance biomaterials research towards new approaches and solutions for precision medicine.

Topics will include:

- Tissue engineering
- In situ tissue chemistry
- Organoids, spheroids and multicellular assembly
- Biomolecular self-assembly
- Nanomaterial-cellular interface
- Biorthogonal chemistry
- Supramolecular chemistry
- Bioelectronics
- Nanomedicine
- Synthetic Biology

Invited speakers include:

Kristi Anseth	University of Colorado Boulder, USA	**Timothy Lu**	Massachusetts Institute of Technology, USA
David Baker	University of Washington, USA	**Nikhil Malvankar**	Yale University, USA
Weibo Cai	University of Wisconsin, USA	**Michael Mayer**	University of Fribourg, Switzerland
Hongjie Dai	Stanford University, USA	**Adrianne Rosales**	The University of Texas at Austin, USA
Cole DeForest	University of Washington, USA	**Samuel Stupp**	Northwestern University, USA
Nicholas Kotov	University of Michigan–Ann Arbor, USA	**Jerry Yang**	University of California, San Diego, USA
Steven Little	University of Pittsburgh, USA	**Shu Yang**	University of Pennsylvania, USA
Jia Liu	Harvard University, USA	**Liangfang Zhang**	University of California, San Diego, USA

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Symposium SB10: Complex States in the Observation, Control and Utilization of Biomimetic Functionalities—From Fundamentals to Applications

Complex-states are interconnected processes that often occur as broader phenomena in emerging fields such as biomimetics and biophotonics. As the mechanisms behind these processes are revealed, or applications of the phenomena are being considered, it becomes necessary to decouple and isolate the individual processes. In materials synthesis using biomineralization, for example, the individual role of the stiffened component inside a cell should be clarified. In disease detection, a single diagnostic biomarker can provide higher disease detection sensitivity than symptomatic diagnosis. For optogenetics, where precise control of neural networks is desired, the off target activation of neurons due to excess heat and biologically active wavelengths of light must be minimized for use in human tissue.

This symposium will cover a variety of topics related to mixed or coupled systems that are common in biomimetic functionalities such as biogenic nanocomposite fabrication, electronic and optical devices for biosensing, and optogenetics. The use of novel or state-of-the-art characterization methods to elucidate the underlying mechanisms behind these functionalities will be an important aspect of the symposium. This symposium aims to bring together a diverse community of researchers in physics, chemistry, biology and engineering who are advancing the field of biomimetic functionality through material synthesis, nanofabrication, and device application. The goal of the symposium is to provide opportunities to discuss complex-states in interdisciplinary phenomena, as well as current challenges that exist and possible approaches for overcoming them.

Topics will include:

- Biogenic materials, nanoparticles, and nanostructures
- Understanding of mechanisms for biomimetic material synthesis
- Electron microscopy and spectroscopy, optical spectroscopy, and in-situ characterization methods, as well as methods to probe biomimetic functionalities
- Nanomaterials and composites for bioelectronics
- Implantable bioelectoronic devices
- Flexible bio-chips for biomedical science
- Light operation technology for optogenetics
- Bioimaging technology for observation of life activities
- Biosensing devices and techniques for healthcare

Invited speakers include:

Elizabetta Collini	University of Padova, Italy
Urs Frey	MaxWell Biosystems, Switzerland
Dion Khodagholy	Columbia University, USA
David Kisailus	University of California, Irvine, USA
Keon Jae Lee	Korea Advanced Institute of Science and Technology, Republic of Korea
Yi-Kuen Lee	The Hong Kong University of Science and Technology, Hong Kong
Julie Lin	Panasonic Singapore, Singapore
Kazuki Nagashima	The University of Tokyo, Japan

Jun Ohta	Nara Institute of Science and Technology, Japar
Yoshiko Okamura	Hiroshima University, Japan
Kazuaki Sawada	Toyohashi University of Technology, Japan
Micho Suzuki	The University of Tokyo, Japan
Yasuo Terasawa	Nidek Co., Ltd., Japan
Lan Yin	Tsinghua University, China
Euisik Yoon	University of Michigan, USA

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Symposium SF01: Materials Research Needs to Advance Nuclear Fuels, Structural Materials and Wasteforms

Rising global energy demand and the adverse environmental impact of fossil energy sources have led to renewed interest in increasing the share of energy coming from power nuclear reactors. Some of the key materials challenges facing nuclear technology include understanding and predicting material performance in often synergistic, extreme conditions. Novel ceramic materials and approaches help to advance the utilization of nuclear energy in a manner consistent with the goals of proliferation resistance, and energy sustainability, while ensuring waste reduction and thus improving public perception. This symposium will bring together experimentalists, theoreticians, and modelers to discuss the innovations needed to develop the next generation of materials and fuels for nuclear applications and to understand the performance of existing ceramic materials under extreme operating conditions.

Topics will include:

- Nuclear fuels of current and future reactors
- Advanced reactor cladding and structural materials
- Advances in nuclear materials characterization
- Multiscale modeling of materials for extreme environments
- Radiation damage in nuclear ceramics
- Radiation effects and performance of nanomaterials
- Lifetime extension of reactor materials
- Development of glass, glass-ceramics and ceramic wasteforms
- Development of geopolymers for nuclear applications
- Material challenges for Small Modular Reactors

Joint sessions are being considered with **SF02 - Actinide Materials—From Basic Science to Applications**.

Invited speakers include:

Benjamin Beeler	North Carolina State University, USA
Colin Boxall	Lancaster University, United Kingdom
Marco Cologna	European Commission Joint Research Centre, Germany
Chaitanya Deo	Georgia Institute of Technology, USA
Lionel Desgranges	Commissariat à l'énergie atomique et aux énergies alternatives, France
Sarah Finkeldei	University of California, Irvine, USA
Christine Gueneau	Commissariat à l'énergie atomique et aux énergies alternatives, France
Lingfeng He	Idaho National Laboratory, USA
Peter Hosemann	University of California, Berkeley, USA
Maik Lang	University of Tennessee, Knoxville, USA
Simon Middleburgh	Bangor University, United Kingdom
Nathalie Moncoffre	Institut de Physique des 2 Infinis de Lyon, France
Gabriel Murphy	Forschungszentrum Jülich GmbH, Germany
Claire Onofri	Commissariat à l'énergie atomique et aux énergies alternatives, France
Sylvain Peuget	Commissariat à l'énergie atomique et aux énergies alternatives, France
Damien Prieur	Helmholtz-Zentrum Dresden-Rossendorf, Germany
Farida Selim	Bowling Green State University, USA
Takeshi Sonoda	Central Research Institute of Electric Power Industry, Japan
Kostya Trachenko	Queen Mary University of London, United Kingdom
Blas P. Uberuaga	Los Alamos National Laboratory, USA
Sven van den Berghe	SCK CEN, Belgium
William J. Weber	University of Tennessee, Knoxville, USA
Karl Whittle	University of Liverpool, United Kingdom
Kazuhiro Yasuda	Kyushu University, Japan
Di Yun	Xi'an Jiaotong University, China
Zhaoming Zhang	Australian Nuclear Science and Technology Organisation, Australia

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Symposium SF02: Actinide Materials—From Basic Science to Applications

Actinide materials exhibit many unique and diverse electronic, transport, and chemical properties, due in large part to the complexity of their 5*f* electronic structure. This Symposium will focus on the physics, chemistry, and materials science of the actinide materials. Particular emphasis will be placed upon the 5*f* magnetic and electronic behaviors, surface sciences, radiation damage and Pu aging, and bulk, thin-film, and nanoparticle properties and their applications to nuclear energy and security related issues. Fundamental actinide science and its role in resolving challenges in environmental and technical issues with actinide materials will be stressed, particularly regarding energy applications, including energy generation, novel nuclear fuels and structural materials, waste remediation, and waste disposal. Both basic and applied experimental approaches, including state-of-the-art experimental techniques and synchrotron-radiation-based and neutron-based investigations, as well as theoretical modeling and numerical simulations, are parts of the Symposium. Several important issues related to non-proliferation, homeland security, nuclear forensics, and the potential renaissances in Nuclear Energy, including fuel synthesis, oxidation, corrosion, intermixing, stability in extreme environments and biological media, prediction of properties via bench-marked simulations, separation science, formulation science, environmental impact and disposal of waste products will also be discussed. This would be the 11th Actinides Symposium at the meetings of the Material Research Society. The previous ten were held in Boston, San Francisco, Phoenix, and Seattle.

Topics will include:

- 5*f* electronic structure and emerging electronic behaviors including strong electron-electron correlations, heavy-fermions, magnetism, and superconductivity
- Synthesis and characterizations of actinide materials
- Theory, modeling, and simulations
- Actinide chemistry and Environmental science
- Surface science, oxidation, corrosion
- Radiation damage, aging and related physical properties
- Nuclear forensics
- Advanced spectroscopies and actinide science at user facilities
- Energy applications, nuclear fuels, waste remediation and waste disposal

Joint sessions are being considered with **SF01 - Materials Research Needs to Advance Nuclear Fuels, Structural Materials and Wasteforms**. Also, a **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Thomas Albrecht-Schmitt	Florida State University, USA	**Shinsaku Kambe**	Japan Atomic Energy Agency, Japan
Polly Arnold	Lawrence Berkeley National Laboratory, USA	**Jindrich Kolorenc**	The Czech Academy of Sciences, Czech Republic
Nick Butch	National Institute of Standards and Technology, USA	**Dominik Legut**	Technical University of Ostrava, Czech Republic
Ken Czerwinski	TerraPower, LLC., USA	**Boris Maiorov**	Los Alamos National Laboratory, USA
Franz Freibert	Los Alamos National Laboratory, USA	**Emily Moore**	Lawrence Livermore National Laboratory, USA
Thomas Gouder	European Commission Joint Research Centre, Germany	**Chris Stanek**	Los Alamos National Laboratory, USA
Itzhak Halevy	Nuclear Research Center Negev, Israel	**Eteri Svanidze**	Max Planck Institute for Chemical Physics of Solids, Germany
Fuminori Honda	Tohoku University, Japan	**James Tobin**	University of Wisconsin Oshkosh, USA
Jason Jeffries	Lawrence Livermore National Laboratory, USA	**Dan Wachs**	Idaho National Laboratory, USA
Colin Judge	Idaho National Laboratory, USA	**Maria Wallenius**	European Commission Joint Research Centre, Germany

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Symposium SF03: Paper-Based Packaging—21st Century Perspectives on an Ancient Material

Paper, paperboard, and corrugated board have been in use as packaging materials for centuries. However, during recent years the functionality of paper-based packaging has increased greatly due to the introduction of new raw materials and the integration of active and smart components. This symposium will highlight the latest progress in materials science and technology that is driving these developments. We will bring together researchers and application experts from a wide range of disciplines to discuss a multitude of aspects of modern paper-based packaging. A major focus will be on novel functional materials, coatings and other methods for material and surface modification, which provide added functionalities. These include better mechanical performance, robustness and reliability, barrier properties against gas and moisture penetration and improved safety against pathogens. Another central topic will be large-area and printed electronics on paper substrates to provide intelligence and prepare devices for sensing, data transmission and power generation. Also included in the scope of the program is research on new types of fibers from non-traditional sources which have been introduced to produce papers and cardboard with novel and unprecedented properties. The developments covered in this symposium will significantly widen the functionalities of paper-based packaging materials, enhance their performance and provide a multitude of novel applications and end user experiences. At the same time, the increasing compositional complexity introduced by these developments has created new challenges for the end-of-life fate of modern packaging materials based on corrugated board, paperboard and paper. Package performance issues and possible solutions, including recyclability, will be dealt with in dedicated sessions.

Topics will include:

- Paper and corrugated board mechanics and dimensional stability
- Packaging materials from non-traditional fibers
- Novel characterization techniques for paper and corrugated board
- Theoretical modeling of paper and corrugated board properties
- Functional printing, coating and surface treatment methods for paper-based substrates
- Paper-based materials for active packaging
- Controlled release of active substances from papers
- Gas and moisture barrier coatings on paper
- Antimicrobial and antiviral paper coatings
- Paper and corrugated board as smart packaging materials
- Paper-based electronics and batteries
- Recycling and bio-degradation of modern paper-based packaging materials

Joint sessions are being considered with **CH01 - Frontiers of *In Situ* Materials Characterization—From New Instrumentation and Method to Imaging Aided Materials Design**, **EN07 - Sustainable Polymeric Materials by Green Chemistry—Degradability and Resilience**, **MF03 - Materials and Methods for Fabricating Flexible and Large-Area Electronics**, **DS02 - Advanced Manufactured Materials—Innovative Experiments, Computational Modeling and Applications**, and **SF16 - Advanced Materials for Antibacterial, Antiviral and Antifungal Applications—From Micro to Nano**.

Invited speakers include:

Warren Batchelor	Monash University, Australia	**Mikael Nygards**	BillerudKorsnäs AB, Sweden
Julien Bras	Université Grenoble Alpes, France	**Lokendra Pal**	North Carolina State University, USA
Seokheun Choi	Binghamton University, USA	**Peter Rättö**	RISE Research Institutes of Sweden, Sweden
Magnus Lestelius	Karlstad University, Sweden	**Feng Xu**	Beijing Forestry University, China
Yonghao Ni	University of New Brunswick, Canada	**Xuejun Zou**	FPInnovations, Canada

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Symposium SF04: Progress in Materials Genomics, Synthesis and Characterization of Functional Polymers and Polymer Nanocomposites

In the era of data driven material design, processing, structure and properties is inextricably linked with the development and usage of materials data repositories, analytical tools and machine learning methods. This symposium will focus on functional polymeric and polymer nanocomposite materials whose performance is derived from the nanoscale structure and whose data is necessarily complex and high dimensional. Systems of interest include materials that are responsive to thermal, chemical, biological, optical, electro, or magnetic stimulation, as well as those useful in separations, electronics, and medicine. To meet the full promise of these materials, data driven design approaches, and materials data resources are critical. Such design approaches and resources rely on data and modeling of synthesis, structure-property relationships, as well as fundamental characterization of structure and properties. Thus, this symposium will bring together those working in new synthetic methods, the use of optical stimuli to produce materials, control of surface properties through synthesis, production of core-shell and other complex structures, the use of advanced characterization methods together with those working to annotate, store, and reuse this data on these complex soft materials to develop understanding as well as design new materials. The symposium will also host a range of topics including development of data repositories for soft materials and their composites, creation and deployment of associated tools, data driven modeling efforts, and the use of machine learning to bridge length scales. Demonstration cases of materials design loops enabled by MGI (Materials Genome Initiative) methodologies applied to polymers and their composites are encouraged, as are demonstrations using ensemble data and data mining tools to enable fundamental discoveries which illuminate new areas of the processing-structure-property spectrum. Next generation applications of these materials such separation of ions and complex fluids, energy storage and conversion, biomedical imaging agents, and non-linear optical materials are also encouraged.

Topics will include:

- Synthesis, characterization, and evaluation of functional nanocomposite materials
- Materials schemas and ontologies and intersection with soft materials
- Structure-property relationships of assembled colloidal systems
- Lessons learned in creating data repositories for soft materials
- Development of common software tools for data descriptors, standardization and translation for soft materials
- Biological applications of multifunctional structures
- Control of the surface chemistry of nanoparticles; its impact on and quantification of dispersion in composites
- Optical stimulation to create functional polymeric materials
- Theory and simulation of mechanical dynamics of organic-inorganic hybrid systems
- The use of machine learning to bridge multi-scale models in polymers and composites
- Characterization of the properties of mesoscale structures, quantum, and non-linear optical materials
- Synthesis, self-assembly, and applications of composite nanoparticles
- Data driven discovery applied to any functional polymer or nanocomposite

Joint sessions are being considered with **EN07 - Sustainable Polymeric Materials by Green Chemistry—Degradability and Resilience**.
Also, a **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Cyrille Boyer	The University of New South Wales, Australia	**Junko Morikawa**	Tokyo Institute of Technology, Japan
Juan de Pablo	The University of Chicago, USA	**Rampi Ramprasad**	Georgia Institute of Technology, USA
Amalie Frischknecht	Sandia National Laboratories, USA	**Javier Read de Alaniz**	University of California, Santa Barbara, USA
Cherie Kagen	University of Pennsylvania, USA	**Elena Shevchenko**	Argonne National Laboratory, USA
Xiao-Min Lin	Argonne National Laboratory, USA	**Mercedes Taylor**	University of Maryland, USA
Sergiy Minko	University of Georgia, USA	**Ryo Yoshida**	The University of Tokyo, Japan

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Symposium SF05: Autonomous Materials for the Next-Generation of Smart Systems

An autonomous function is the ability to perform the cycle of sensing, communicating, computing, and reacting to stimuli. Nature provides us with engineered examples of autonomous systems; investigating the governing mechanisms of such provides the fundamental principles for realizing autonomous function at the material, device, and system levels. The goal of Autonomous Materials is to create a new and exciting vision for material composites. These composite materials will encompass effort from the “Smart Materials” and “Smart Systems” community (PZTs for example), as well as new work in soft structural sensing (e.g., stretchable photonic networks), structural energy, dynamic mechanical energy (electrohydraulic energy storage), material computation (e.g., BZ reactions), self healing, ionotronics, stretchable electronics, etc. One specific difference in our goals from prior topics such as Smart Materials is that we will prioritize research at scales and properties that allow for processing as materials (e.g., injection molding, 3D printing, layup, etc). Further, we expect that many of the proposed advances in Autonomous Materials will stem from bioinspiration; we will use the nervous systems of animals and to what levels the nervous systems (i.e., sympathetic or parasympathetic) are mimicked as a yard stick towards our progress. Finally, we will focus utility of this topic towards applications; as such, we expect there to be a broad span of technology readiness levels represented in our space (robots, medical devices, analytical chemistry, rheology, additive manufacturing, etc). Essentially, this symposium aims to bring together an interdisciplinary group of researchers from chemistry, materials science, physics, robotics, biology, medicine, and engineering to discuss recent developments in autonomous materials, devices and systems, and their applications. We aim to reinstitute autonomous systems at the forefront of material science and innovation, emphasizing the potential for industrial applications.

Topics will include:

- Sensing, responsive, adaptive materials and system
- Programmed materials for multifunctionality, morphing and adaptivity
- Self-healing polymers
- Soft matter for autonomous function
- Stimuli-responsive hydrogels
- Bio-active materials and systems
- Bio-inspired autonomous material
- Autonomous biological material and system
- Autonomous microfluidic device
- Simulation and modelling of autonomous systems
- Robotics with autonomous function
- Application-driven design of Autonomous systems based on AI or machine learning
- Energy harvesting and storage in multifunctional systems

Joint sessions are being considered with **EQ04 - Advanced Soft Materials and Processing Concepts for Flexible Printed Optoelectronic Devices and Sensors**.

Invited speakers include:

Hyeon Seok An	Cornell University, USA
Tommy Angelini	University of Florida, USA
Yoel Fink	Massachusetts Institute of Technology, USA
Philippe H. Geubelle	University of Illinois at Urbana-Champaign, USA
Daniel I. Goldman	Georgia Institute of Technology, USA
Jiyun Kim	Ulsan National Institute of Science and Technology, Republic of Korea
Shingo Meada	Shibaura Institute of Technology, Japan
Markus P. Nemitz	Worcester Polytechnic Institute, USA
Ralph G. Nuzzo	University of Illinois at Urbana-Champaign, USA
Jang-Ung Park	Yonsei University, Republic of Korea
James Pikul	University of Pennsylvania, USA
Jeong-Yun Sun	Seoul National University, Republic of Korea
Michael Tolley	University of California, San Diego, USA
Ryan L. Truby	Northwestern University, USA
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Symposium SF06: Recent Advances in Structural Materials from Bulk to Nanoscale

Mechanical properties of structural materials for a variety of engineering applications require the use of microstructural engineering at varying length scales. Completely new alloys such as the complex concentrated alloys, self-healing metals are receiving much attention as up-to-date method in achieving improved mechanical properties in bulk alloy systems. In addition, nanoscale metals are known to have excellent strength due to their unique deformation mechanisms, and there are efforts in utilizing the nanoscale metals in 3D hierarchical structures. The aim of this symposium is to cover recent advances in fabrication, advanced microstructural characterization, mechanical properties analysis, and modeling of structural materials with the focus of understanding the effect of different microstructural engineering at varying length scales.

Topics will include:

- Strength and plasticity at different length scales and the deformation mechanisms.
- Nanocomposites and multilayers
- 3D hierarchical structures composed of metal nanostructures
- High and medium entropy alloys
- Self-healing alloys
- Alloy fabrication and processing methods
- Advanced characterization tools for microstructure analysis
- Numerical model for designing of new alloys and mechanical behavior analysis

Invited speakers include:

Wei Cai	Stanford University, USA	**Sangho Oh**	SungKyunKwan Univ, Republic of Korea
Karsten Durst	Technische Universität Darmstadt, Germany	**Eun Soo Park**	Seoul National University, Republic of Korea
Jaafar El-Awady	Johns Hopkins University, USA	**George M. Pharr**	Texas A&M University, USA
Marc Fivel	Université Grenoble Alpes, France	**Ruth Schwaiger**	RWTH Aachen University, Germany
Juyoung Kim	Ulsan National Institute of Science and Technology, Republic of Korea	**Gi-Dong Sim**	Korea Advanced Institute of Science and Technology, Republic of Korea
Kyung-Suk Kim	Brown University, USA	**Douglas Stauffer**	Bruker Nano Surface, USA
Hojun Lim	Sandia National Laboratories, USA	**Masato Wakeda**	National Institute for Materials Science, Japan

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Symposium SF07: *In Situ* Material Performance and Dynamic Structure Characterization Under Coupled Extremes

This symposium will focus on the dynamic behavior, structure, and performance of structural and functional materials in response to coupled extreme environments. Focus will be restricted to these coupled environments where two or more environmental factors are present, including but not limited to extreme temperatures, cyclic fatigue, radiation exposure, corrosive environments, high pressures, or high magnetic fields. Driving materials with such environmental factors often produces unique dynamic changes in structures and properties which are otherwise impossible to achieve, for example the generation of gas bubble superlattices in metals exposed to high temperatures, gas loading, and irradiation. A connection between materials physics and engineering systems of interest will be encouraged as many systems such as future fusion power plants, high efficiency turbines, and satellites may involve these environmental conditions. One portion of the symposium will particularly focus on emerging *in situ* experimentation capable of providing time-resolved performance and structure insight into these dynamic and/or transient processes. Besides novel *in situ* instruments and observations, innovative approaches and algorithms developed to synchronize, track, and classify *in situ* data and to generate high throughput analysis are encouraged to push boundaries for quantitative understanding of materials dynamics and transformations. A second portion of the symposium will focus on modeling and simulation of materials under these coupled extremes across multiple length scales, from the atomic resolution calculation of defect generation to time-accelerated dynamics of degradation over complete system lifetimes. A final, linking component will specifically target modeling and simulation that attempts to connect directly to *in situ* experimental modalities either as a tool for the design and implementation of experiments or as a pathway to understand in detail measured properties and structures.

Topics will include:

- Novel (destructive and non-destructive) *in situ* techniques for coupled extremes
- *In situ* small scale mechanical property testing (SEM or TEM length scales)
- Advanced diffraction techniques coupled to extreme environments
- Direct observation of radiation-induced microstructural transformations in real time
- Corrosive attack combined with other environmental drivers (thermal field, strain, radiation, etc.)
- Synergistic effects of coupled extremes relating to materials degradation
- Computer-assisted defect recognition and tracking for *in situ* time series
- Coupling experimental results with predictive modeling and simulation
- Synchronization and integration of *in situ* structure and property/performance data
- Emergent behavior under coupled extremes
- Expansion of length and time scales in modeling and simulation

Invited speakers include:

M. Grace Burke	University of Manchester, United Kingdom
Shen Dillon	University of Illinois at Urbana-Champaign, USA
Steve Donnely	University of Huddersfield, United Kingdom
Lynne Ecker	Brookhaven National Laboratory, USA
Aurelie Gentils	Université Paris-Saclay, France
Krzysztof Gofryk	Idaho National Laboratory, USA
Khalid Hattar	Sandia National Laboratories, USA
Djamel Kaoumi	North Carolina State University, USA
Daniel Kiener	Montanuniversität Leoben, Austria
Meimei Li	Argonne National Laboratory, USA
Christian Linsmeier	Forschungszentrum Jülich GmbH, Germany
Pui-Wai (Leo) Ma	Culham Center for Fusion Technology, United Kingdom
Chad Parish	Oak Ridge National Laboratory, USA
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Symposium SF08: Far From Equilibrium Microstructure Evolution in Metals

This symposium will explore the scientific frontiers of driven and non-equilibrium microstructure evolution in metals. The microstructure of metallic materials evolves continuously during processing and in service. This evolution is often described as a gradual approach to thermodynamic equilibrium, as solutes partition, defects anneal, and grains grow. However, under intense, external driving forces, metal microstructures may evolve in different and often unanticipated ways: high strain rate compression forms metastable phases, irradiation causes grain refinement, and continuous cyclic loading generates complex defect aggregates. Such driven microstructure evolution leads to early failure, in some cases. In others, it gives rise to steady-state, far-from-equilibrium microstructures with enhanced performance. Similarly, far-from-equilibrium processing methods open opportunities for the synthesis of unconventional, hitherto unexplored metal microstructures.

This symposium will provide a forum for presenting cutting-edge research on far-from-equilibrium microstructure evolution in metallic materials during processing and under exposure to external drivers.

Topics will include:

- Microstructure evolution across length scales—from atoms, to defects, to grains, to grain aggregates—and across time scales: from atomic vibrations to long-term aging
- Diverse external driving forces, including deformation at all strain rates, irradiation, rapid heating/cooling, and exposure to electromagnetic fields
- Far-from-equilibrium microstructure processing, such as laser rapid solidification, physical vapor co-deposition, and severe plastic deformation
- Investigation of microstructure evolution through advanced experiments, simulations, and theory
- All classes of metallic materials: crystalline and amorphous, single- and multi-phase, conventional and novel
- Technological implications of far-from-equilibrium microstructure evolution

Invited speakers include:

Nesma Aboulkhair	The University of Nottingham, United Kingdom	**Thomas Niendorf**	Universität Kassel, Germany
Allison Beese	The Pennsylvania State University, USA	**Kai Nordlund**	University of Helsinki, Finland
Pascal Bellon	University of Illinois at Urbana-Champaign, USA	**Tresa Pollock**	University of California, Santa Barbara, USA
Brad Boyce	Sandia National Laboratories, USA	**Bruce Remington**	Lawrence Livermore National Laboratory, USA
Amy Clarke	Colorado School of Mines, USA	**Michael Sangid**	Purdue University, USA
Zachary C. Cordero	Massachusetts Institute of Technology, USA	**Jan Schroers**	Yale University, USA
Eric Detsi	University of Pennsylvania, USA	**Matteo Seita**	Nanyang Technological University, Singapore
Avinash Dongare	University of Connecticut, USA	**Iain Todd**	The University of Sheffield, United Kingdom
Lynne Ecker	Brookhaven National Laboratory, USA	**Janelle Wharry**	Purdue University, USA
Jaafar El-Awady	Johns Hopkins University, USA	**Justin Wilkerson**	Texas A&M University, USA
Amit Misra	University of Michigan, USA	**Yanwen Zhang**	Oak Ridge National Laboratory, USA
Maylise Nastar	Commissariat à l'énergie atomique et aux énergies alternatives, France		

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Symposium SF09: High Entropy Materials II—From Fundamentals to Potential Applications

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

Topics will include:

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

Invited speakers include:

Hyejung Chang	Korea Institute of Science and Technology, Republic of Korea
Katharine Flores	Washington University in St. Louis, USA
Easo George	Oak Ridge National Laboratory, USA
Daniel S. Gianola	University of California, Santa Barbara, USA
Haruyuki Inui	Kyoto University, Japan
Hyoung Seop Kim	Pohang University of Science and Technology, Republic of Korea
M.J. Kramer	Ames Laboratory, USA
K.J. Laws	The University of New South Wales, Australia
Evan Ma	Johns Hopkins University, USA
Andrew Minor	Lawrence Berkeley National Laboratory, USA
Danial Miracle	Air Force Research Laboratory, USA
B.S. Murty	Indian Institute of Technology Madras, India
Robert Ritchie	Lawrence Berkeley National Laboratory, USA
Koichi Tsuchiya	National Institute for Materials Science, Japan

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Abstract Submission Opens—Thursday, September 23, 2021

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Symposium SF10: Emerging Functional Materials and Interfaces

Progress in delicate control of interfaces, defects, surfaces, and geometrical configurations, plays a key role in the development of emerging materials with novel functionalities. This symposium focuses on recent advances in the area of functional materials and their interfaces displaying diverse properties, such as ferroelectricity, ferromagnetism, multiferroicity, high-*k* dielectrics, ion conduction, and novel quantum phenomena.

Topics of interest include the advances in modeling, rational design of new functional oxides, control over strain, interfaces, composition, defects and dopants, structural and functional imaging, such as scanning probe and electron microscopies providing information on local functionality including electronic and dielectric properties with a broad range of spectroscopies. The goal of this symposium is to provide an interdisciplinary forum for researchers from academia, national laboratories, and industry with expertise in theory and modeling, growth, characterization, and device fabrication and measurements to discuss novel functionalities, key challenges and opportunities in these multifunctional oxides and interfaces. We will also encourage submissions that are focused on new approaches to functional material discovery by using new high-throughput strategies in combination with materials informatics.

Topics will include:

- Interplay of charge, spin, orbital, lattice correlations for novel multiferroicity and quantum phenomena
- Thickness, interface, composition, defects, strain engineering in oxides and heterostructures
- Ferroelectricity in hafnium oxide thin films and novel high-*k* dielectrics
- Interfacial ion transport behavior
- Structural and functional imaging at the atomic scale
- Material discovery, modeling, and machine learning-assisted characterizations

Invited speakers include:

Nina Balke	North Carolina State University, USA	**Robert Klie**	University of Illinois at Chicago, USA
Laurent Bellaiche	University of Arkansas, USA	**Eunha Lee**	Samsung Advanced Institute of Technology, Republic of Korea
Albina Y. Borisevich	Oak Ridge National Laboratory, USA	**Stephen McVitie**	University of Glasgow, United Kingdom
Woo Seok Choi	Sungkyunkwan University, Republic of Korea	**Ramesh Ramamoorthy**	University of California, Berkeley, USA
Sung-Yoon Chung	Korea Advanced Institute of Science and Technology, Republic of Korea	**Quentin Ramasse**	SuperSTEM, United Kingdom
Michele Conroy	Imperial College London, United Kingdom	**Jayakanth Ravichandran**	University of Southern California, USA
Alexander A. Demkov	The University of Texas at Austin, USA	**Wenhao Sun**	University of Michigan, USA
Sinead Griffin	Lawrence Berkeley National Laboratory, USA	**Jiaqiang Yan**	Oak Ridge National Laboratory, USA
Ryo Ishikawa	The University of Tokyo, Japan	**Xiuzhen Yu**	RIKEN, Japan

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Symposium SF11: Advances in Design, Synthesis and Characterization of Functional Heteroanionic Materials

This symposium will cover recent advances and emerging opportunities in the design, synthesis and characterization of bulk (powders), thin films, and single crystal materials hosting multiple anions. Heteroanionic materials are novel compounds where the anion sublattice involves two or more anionic species and are distinct from polyanionic compounds with oxyanions. They have generated growing interest within the materials science, solid state chemistry, and physics communities arising from the tremendous possibilities they offer to tune chemical bonding through multiple anions, leading to diverse functional properties.In addition, the symposium will highlight worldwide efforts focused on material families such as oxyhydrides, oxyhalides, oxynitrides, and oxychalcogenides that exhibit enhanced or novel function in areas such as catalysis, optical responses, electronic and resistive switching behavior, electrochemical energy storage, ionic conductivity, magnetism, ferroelectricity, and spin-orbit-based phenomena. Computational approaches will be presented that deliver materials design guidelines to accelerate new multiple anion materials discovery as well as provide insight into relationships between anionic bonding environments and electronic band structure. Talks will feature advances in synthesis activities to realize new heteroanionic materials, including energy efficient approaches or those that can be applied to epitaxial heterostructures in thin films. The application of advanced imaging, scattering, and spectroscopic characterization techniques to elucidate structure-property relationships, as well as performance in energy and electronic applications will be covered in the symposium. Speakers will also identify emerging opportunities and future directions, for instance in heteroanionic topological/quantum materials, in situ characterization of topochemical or other synthetic approaches, and data-centered materials discovery.

Topics will include:

- Theory, simulations, artificial intelligence, and combinatorial approaches for design of new anion-controlled materials design and property predictions
- Theoretical concepts for novel physics induced by multiple anions
- Synthesis of bulk compounds and thin films of oxyhydrides, oxyhalides, and oxynitrides, oxychalcogenides, and other multi-anion systems
- New approaches for energy efficient and environmentally sound processing of heteroanionic materials
- Approaches to stabilize and characterize local structure and anion order
- Synchrotron, neutron, and electron microscopy approaches to understand crystallographic implications of anionic substitutions and anionic order
- Impact of anionic substitutions, alloying, and anionic order on electronic structure, optical responses, and magnetic ordering
- Technical challenges in the analytical and functional properties characterization of heteroanionic materials
- Ferroic and multiferroic responses and property design in mixed-anion compounds
- Heteroanionic materials for the production and storage of energy: photocatalysts, solid electrolytes, fuel cell materials, supercapacitor and battery electrodes, hydrogen storage materials, ionic conductors, and thermoelectric materials
- Topological heteroanionic materials and/or applications in quantum information systems

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

Invited speakers include:

Ulrich Aschauer	University of Bern, Switzerland
Paul Attfield	The University of Edinburgh, United Kingdom
Akira Chikamatsu	The University of Tokyo, Japan
Simon Clarke	University of Oxford, United Kingdom
Oliver Clemens	Universität Stuttgart, Germany
Alain Demourgues	Centre National de la Recherche Scientifique, France
Amparo Fuertes	Institut de Ciència de Materials de Barcelona, Spain
Joke Hadermann	University of Antwerp, Belgium
Shiv Halasyamani	University of Houston, USA
Tetsuya Hasegawa	The University of Tokyo, Japan
Michael Hayward	University of Oxford, United Kingdom
Daigorou Hirai	The University of Tokyo, Japan
Yoji Kobayashi	King Abdullah University of Science and Technology, Saudi Arabia
Kazuhiko Maeda	Tokyo Institute of Technology, Japan
Emma McCabe	Durham University, United Kingdom
Julia Medvedeva	Missouri University of Science and Technology, USA
Olivier Mentre	University of Lille, France
Rohan Mishra	Washington University in St. Louis, USA
Matt Rosseinsky	University of Liverpool, United Kingdom
David Scalon	Imperial College London, United Kingdom
Anke Weidenkaff	Technische Universität Darmstadt, Germany
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Symposium SF12: Bioinspired Structural Composites—Advances in Experiments, Simulations and AI-Based Design

Next-generation structural composites for the aerospace, biomedical, and automobile industry necessitate materials with light weight, high strength, and high toughness with smart functionality to sense, adapt, self-repair, morph, and restore. Nature has provided unprecedented examples of unique combinations of these properties which are produced at ambient condition. A combination of hierarchy and precision on materials choice not only makes them structurally robust but exhibit multifunctionality. The symposium solicits recent developments in the bioinspired design of composites with particular focus on molecular engineering of interfacial regions in (bio)organic-inorganic, ceramic, and multi-component polymer systems, and design of hierarchical architectures and their characterization using experiment, simulation, and approaches based on artificial intelligence (AI). Tailoring the interfaces and hierarchical design could be obtained from grafting to/from, layer-by-layer assembly, physical adhesion, vapor deposition, and self-assembly. Advances are specifically invited in electron microscopy (STEM, EELS, and electron tomography), scanning probe microscopy (AFM, AFM-IR, peak force, K-AFM, SThm-AFM, C-AFM), fluorescence microscopy, spectroscopy, and nano X-ray tomography to visualize and assess morphology-property relationships at multiple length scales. In parallel, new developments in data analysis, autonomous optimization, and multiscale simulation (quantum-mechanical, atomistic, coarse-grained) are solicited for a better understanding of molecular and interfacial interactions, chemical reaction kinetics, growth of different phases (nodules, amorphous, crystalline, interdigitated), and property predictions. Properties may include, for example, glass transition temperatures, modulus, strength, toughness, conductivity (electrical/thermal), EMI shielding, plasmonic, photonics, self-healing, and sensing. Joint experimental-computational contributions that advance the area of light-weight/high-strength nanocomposites, intelligent bioinspired materials, biomedical materials, and multifunctional composites are encouraged. Advances in in-situ experiments based on scanning probe microscopy and electron microscopy to understand nanoscale confinement, intrinsic toughening mechanisms, locally probe damage at the nanoscale, and state-of-the-art characterization to visualize the morphology and assess the mechanical properties at multiple length scales are solicited.

Topics will include:

- Hierarchical architectures from self-assembly and directed assembly of polymers, biopolymers, and colloids (including MXenes, graphene, TMD, CNT, CNC, Cellulose, Chitin, and Silk based composites)
- Nanoscale confinement of polymers near interfaces and interfacial chemistry to generate high strength and toughness
- State-of-the-art characterization to visualize the morphology, functional properties (electrical, optical, thermal, photonic, magnetic) and assess mechanical properties at multiple length scales
- Atomistic, coarse-grain, and multiscale models of composite-related interfaces and hierarchical architectures
- Advances in experiment, simulation, and artificial intelligence related to processing and property prediction

Joint sessions are being considered with **SB10 - Complex States in the Observation, Control and Utilization of Biomimetic Functionalities—From Fundamentals to Applications**.

Invited speakers include:

Pulickel Ajayan	Rice University, USA	**Rajesh Naik**	Air Force Research Laboratory, USA
L. Catherine Brinson	Duke University, USA	**Ruth Pachter**	Air Force Research Laboratory, USA
Peter Coveney	University College London, United Kingdom	**Ajit Roy**	Air Force Research Laboratory, USA
Reinhold Dauskardt	Stanford University, USA	**George Schatz**	Northwestern University, USA
Arthi Jayaraman	University of Delaware, USA	**Sabu Thomas**	Mahatma Gandhi University, Kerala, India
David Kaplan	Tufts University, USA	**Vladimir Tsukruk**	Georgia Institute of Technology, USA
Sinan Keten	Northwestern University, USA	**Richard Vaia**	Air Force Research Laboratory, USA
David Kisailus	University of California, Irvine, USA	**Silvia Vignolini**	University of Cambridge, United Kingdom
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Symposium SF13: From Actuators and Energy Harvesting Storage Systems to Living Machines

Technological innovations and requirements of modern applications have driven research towards active materials, capable to perform functions in specific system environments. The realization of directed movement has increased the attention paid towards polymeric materials, such as liquid crystalline elastomers or shape-memory hydrogels. Fascinating advances in materials science, including multifunctional soft materials, energy harvesting and actuation-schemes open up innovative paths to design and operate appliances and robots. Autonomous systems like soft robots, which could be realized by integrating multiple functions including energy generation and harvesting (e.g., catalysis, motion, photovoltaic, osmosis), energy storage (batteries, mechanical storage, thermal energy), sensory functions, and the capability of motion could be imagined. Nature has extensively served as a great source of inspiration for humans to design and develop innovative technologies. Plant-inspired robotic systems consider how plants perform and adapt their growth as well as how they vary biomechanical properties (stiffness and rigidity) to anchor, attach, and climb. This symposium will focus on all kinds of advances in designing and constructing living machines as a new generation of robots, and in increasing the efficiency, autonomy and lifespan of the systems.

Topics will include:

- Soft robotics and electrically conductive soft or stretchable materials for force sensing, actuating, and electronics.
- Application-driven design of multifunctional materials with capabilities of intelligent systems
- Life-like technologies inspired by the scientific investigation of biological systems
- Bionic principles for multifunctionality, bio-inspired design, and biomorphous materials design e.g. biologically derived adhesives
- Self-sensing and self-healing materials
- Stimuli-responsive polymer-based systems that respond to e.g. pH, temperature, (bio)molecules, light, electrical, strain
- Liquid-crystalline elastomers, shape-memory polymers, adaptive polymers
- Energy harvesting and storage in multifunctional systems
- Ferroelectric, magnetostrictive, and magnetoelectric materials
- Characterization methods for functions and structures
- Integrated Multi-material Fabrication 3D/4D Printing
- Virtual material design, computational design, multiscale modelling and simulation

Joint sessions are being considered with **SB03 - Robotic Materials for Advanced Machine Intelligence**.
Also, a **tutorial** complementing this symposium is tentatively planned. Further information will be included in the MRS Program that will be available online in January.

Invited speakers include:

Sung-Hoon Ahn	Seoul National University, Republic of Korea	**Barbara Mazzolai**	Istituto Italiano di Tecnologia, Italy
Marc Behl	Helmholtz-Zentrum Hereon, Germany	**Bradley Nelson**	ETH Zürich, Switzerland
Michael Dickey	North Carolina State University, USA	**Philippe Poulin**	Centre National de la Recherche Scientifique, France
Peer Fischer	Max Planck Institute for Intelligent Systems, Germany	**H. Jerry Qi**	Georgia Institute of Technology, USA
David H. Gracias	Johns Hopkins University, USA	**Patricia Soffiatti**	Federal University of Parana State, Brazil
Sung Hoon Kang	Johns Hopkins University, USA	**Bozhi Tian**	University of Chicago, USA
Kyung-Suk Kim	Brown University, USA	**Victoria Webster-Wood**	Carnegie Mellon University, USA
Christopher Lynch	University of California, Riverside, USA	**Shu Yang**	University of Pennsylvania, USA
Shlomo Magdassi	The Hebrew University of Jerusalem, Israel	**Huichan Zhao**	Tsinghua University, China
Carmel Majidi	Carnegie Mellon University, USA	**Hongli (Julie) Zhu**	Northeastern University, USA

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Symposium SF14: Novel Frontiers in 3D and 4D Multi-Photon Micro-Fabrication—Materials, Methods and Applications

Microfabrication techniques that allow a fine 3-dimensional spatial control are revolutionizing the ways we design functional microdevices. By combining the possibility of obtaining complex architectures with high reproducibility and fast-throughput, researchers from diverse fields and backgrounds are pushing the boundaries of micromachinery, photonics, surface design, microrobotics, and biomedical sciences. Multi-photon lithography (also known as direct laser writing) is an established technique that combines the advantages of 3D-printing with sub-micron resolution. Recent developments have shown the potential of this technology to realize structures with unprecedented complexity, innovative functionalities, and dynamic functions. To achieve this, focus has been divided between material and method. Material scientists have achieved significant development of functional photoresists, which encompasses nanomaterial inclusion, photoinitiators with enhanced two-photon absorption and biocompatibility, and soft and responsive hydrogels. Concurrently, greater understanding of reaction mechanisms, computational analysis, and development of optical systems, have made considerable inroads in extending the limits of resolution, fabrication speed, and application. This symposium aims to congregate scientists working in the broader direct laser writing field, to document recent progress, and to critically analyze the opportunities and challenges for the future.

Topics will include:

- Fundamental understanding of multi-photon absorption
- Novel photoresist formulation for multi-photon polymerization
- Functional and responsive materials for direct laser writing
- Post-fabrication chemical functionalization and modification
- Template generation for replication on the micro-/nanoscale
- Fast prototyping methods for 3D-microfabrication
- 4D microstructures
- Novel approaches toward improved resolution
- Subtractive manufacturing at the micro- nanoscale
- Integration of 3D microstructures into functional devices and prototypes
- Application of 3D microstructures (e.g. anti-counterfeiting technology, microelectronics, biomedical devices, tissue scaffolds, micro-robotics, microfluidics, optics and photonics)
- Bioinspired solutions via direct laser writing
- Novel MEMS fabrication technologies and designs

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

Invited speakers include:

Christopher Barner-Kowollik	Queensland University of Technology, Australia
Chiara Daraio	California Institute of Technology, USA
Maria Farsari	Institute of Electronic Structure and Laser, Foundation for Research and Technology - Hellas, Greece
John Fourkas	University of Maryland, USA
Qi Ge	Southern University of Science and Technology, China
Harald Giessen	Universität Stuttgart, Germany
Julia Greer	California Institute of Technology, USA
Bradley Nelson	ETH Zürich, Switzerland
Sara Nocentini	University of Florence, Italy
Benjamin Richter	Nanoscribe GmbH, Germany
Metin Sitti	Max Planck Institute for Intelligent Systems, Germany
Martin Wegener	Karlsruhe Institute of Technology, Germany

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Symposium SF15: Thermal Processes and Management Under Unconventional Conditions

Functional materials and devices under unconventional conditions such as ultralow/ultrahigh temperature, high pressure/strain, high electric/magnetic field, and corrosions are hailed as a revolutionary field for practical applications. Unconventional environmental conditions will induce both physical properties related to device geometry, and new quantum and coupling states. For instance, the combination of high magnetic fields of 60 T and pressure of 4 GPa has recently shed new light on the subtle competition between the hidden-order state and neighboring magnetically ordered quantum states. The resultant external condition change of thermal management based on phonon/electric transports will challenge device performance including durability of material component stability, data communication, and measurement reliability. Discovering and understanding thermal properties in functional materials and devices under unconventional conditions is fundamentally important to harnessing thermal management. The recent experimental development in advanced scattering, spectroscopy, and microscopy measurements made the studies in unconventional conditions feasible.

This symposium will cover fundamental thermal transport theory and modeling of functional materials and devices, elucidating how controlled external unconventional conditions can enable new materials properties and device functions with well-managed thermal performance. Interdisciplinary topics in thermal science at the interaction of mechanical engineering, physics, manufacturing and materials science and engineering will be presented by invited speakers in order to accelerate the understanding of thermal management in unconventional conditions. Interdisciplinary presentations from invited speakers are also aimed to motivate synergistic research collaborations in the field of functional thermal materials, structures and devices.

Topics will include:

- Theory and modeling of thermal transport under unconventional conditions
- Nano- and Quantum- thermal science under unconventional conditions
- Design and manufacturing of functional thermal materials and devices
- Extreme thermoelectric properties of functional materials
- In situ thermal characterization under unconventional conditions
- Adaptive thermal structures and devices
- Strain engineering in thermal science
- Thermal management in wearable technology
- Data science applications in thermal management

Joint sessions are being considered with **DS03 - Phonon Properties of Complex Materials—Challenges in Data Generation, Data Availability and Machine Learning Approaches**.

Invited speakers include:

Alexander Balandin	University of California, Riverside, USA	**Ajit Roy**	Air Force Research Laboratory, USA
David Cahill	University of Illinois at Urbana-Champaign, USA	**Xiulin Ruan**	Purdue University, USA
Timothy Fisher	University of California, Los Angeles, USA	**Kenneth Sandhage**	Purdue University, USA
Samuel Graham	Georgia Institute of Technology, USA	**Li Shi**	The University of Texas at Austin, USA
Joseph Heremans	The Ohio State University, USA	**Ying Sun**	Drexel University, USA
Lucas Lindsay	Oak Ridge National Laboratory, USA	**Yaguo Wang**	The University of Texas at Austin, USA
Austin Minninch	California Institute of Technology, USA	**Xianfan Xu**	Purdue University, USA
Michael Pettes	Los Alamos National Laboratory, USA	**Yongwei Zhang**	Singapore University of Technology and Design, Singapore
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Symposium SF16: Advanced Materials for Antibacterial, Antiviral and Antifungal Applications—From Micro to Nano

With the growing concerns over the consequences of pathogenic agents on human health, the search for more effective antibacterial, antiviral and antifungal solutions is at the forefront of efforts in materials and surface sciences. On one hand, pathogen agents, in the sessile state, have the ability to organise themselves in a protective biofilm, making conventional solutions often ineffective in the prevention of bacterial, fungal and viral infections. On the other hand, the chemistry and topography from nanoscale to microscale of surfaces and interfaces have proven to be critical to hinder key phenomena associated with the interactions between pathogen agents and materials. Therefore, the design of the next generation of viable solutions is today increasingly moving towards novel micro- and nano-materials as well as more effective surface modification processes with tunable antibacterial, antiviral and antifungal effects at short-medium and long term.

This symposium will cover current and emerging strategies to integrate antibacterial, antiviral and antifungal properties in technological applications, ranging from biomedical devices and surgical tools to antimicrobial touch surfaces and antifouling coatings. The symposium will broadly cover relevant aspects in the field, such as synthesis and fabrication, physicochemical characterization, structure-function relationships and biological mechanisms associated with antibacterial, antiviral and antifungal properties of micro- and nano-materials.

Topics will include:

- Nano- and micro-structured surfaces and coatings for antibacterial, antiviral and antifungal applications
- Structure-function relationships between materials properties and antibacterial, antiviral and antifungal performance
- Antibacterial wound dressings
- Antimicrobial nanocomposite textiles
- Antiviral nanoparticles and nanomaterials
- Nanostructured antifouling surfaces/coatings
- Nanostructured photocatalytic/self-cleaning surfaces/coatings
- Superhydrophobic surfaces/coatings
- Drug-eluting surfaces/coatings and drug-delivery systems
- Ion-releasing surfaces and materials for antibacterial, antiviral and antifungal applications
- Nanomaterials and nanotechnology-based strategies for antibiotic-resistant microorganisms
- Materials for food packaging and preservation
- Nanomaterials for water disinfection

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

Invited speakers include:

Bikramjit Basu	Indian Institute of Science, Bangalore, India	**Ipsita Roy**	The University of Sheffield, United Kingdom
Aldo Boccaccini	Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany	**Francesco Stellacci**	École Polytechnique Fédérale de Lausanne, Switzerland
Annabel Braem	KU Leuven, Belgium	**Nathalie Tufenkji**	McGill University, Canada
Christophe Drouet	Toulouse INP, France	**Krasimir Vasilev**	UniSA, Australia
Elena Ivanova	RMIT University, Australia		

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