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Dates to Remember

September 6, 2013 (Friday) Deadline for submitting invited speaker suggestions for DMP Focus Topics.

November 8, 2013 (Friday) by 5pm EST. Abstract deadline for the 2014 APS March Meeting. Submission is via the web at <http://abstracts.aps.org>

February 1, 2014 DMP Deadline for APS Fellowship Nomination

March 03 - March 07, 2014 (with tutorials, etc., March 02): APS March Meeting in Denver, Colorado

A Note from the Chair

It is a pleasure to extend a welcome from the Executive Committee of the Division of Materials Physics. This Summer Newsletter contains important information for the upcoming March Meeting in Denver (March 03 - March 07, 2014).

As in previous years, DMP is organizing interdisciplinary Focus Topics for the March Meeting that will cover many different facets of materials physics. The process is being coordinated by Chair Elect, Laura Greene, and all the members of the Executive Committee helped to select the topics and to invite the organizers. The Focus Topics are a major contribution of DMP to the March Meeting, and we encourage you to review the topics, suggest invited speakers to the organizers, and plan to submit contributed talks to the topics that overlap with your interests. Your input of invited speaker suggestions is particularly important to the success of the meeting, and we hope you will be able to offer your advice to the organizers of the various topics.

Student presenters are invited to apply for an Iris Ovshinsky Student Travel Award, available to students whose abstracts are placed in DMP-sponsored contributed sessions. Information is included below.

While the deadline is not immediate, we also encourage all members to plan nominations for APS Fellowship. Nominating a deserving colleague is a great way to acknowledge their contributions. While the deadline is February 1, 2014, starting early is always a good idea, and detailed instructions are available on the DMP website.

Finally, I would like to take this opportunity to thank the members of the DMP Executive Committee who have recently completed their service, for the generous donation of their

time and expertise in carrying out the work of DMP. These are Philip Duxbury and Amanda Petford-Long, who have stepped down as Members at Large; and Ted Einstein who completed a four-year term as APS Councillor. And a special thanks to Peter Schiffer, who has completed four years of leadership as Vice-Chair, Chair-Elect, Chair, and Past-Chair of the Division of Materials Physics.

Looking forward to seeing you in Denver!

David Cahill, DMP Chair

The American Physical Society - Division of Materials Physics Ovshinsky Student Travel Awards

The Ovshinsky Student Travel Awards have been established to assist the career of student researchers. The Awards are named after Stanley and Iris Ovshinsky, who had a very strong interest and commitment to scientific education. The awards have been endowed by the Ovshinsky family, their colleagues at Energy Conversion Devices (ECD) companies and all their numerous friends from many social, intellectual and business relationships.

We anticipate that there will be ten \$500 awards each year to enable students to participate in the APS March Meeting sessions, which are sponsored by the Division of Materials Physics. The selection will be based on merit and the committee will consist of the following officers of the Division of Materials Physics: Secretary/Treasurer, Vice Chair and Past Chair.

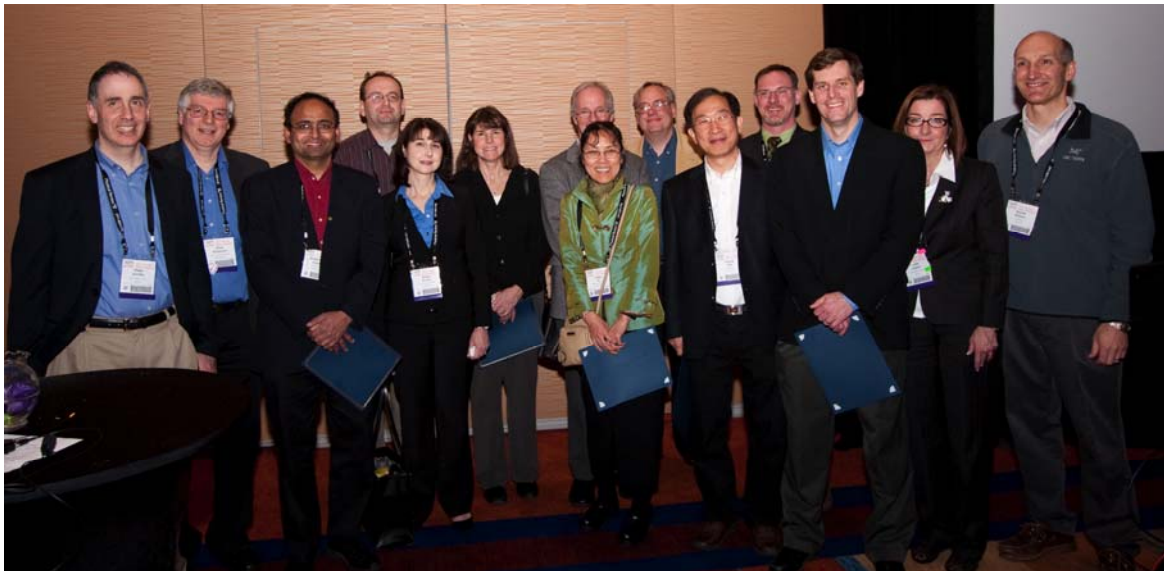
Students interested in being considered for an award must apply online at <https://orgs.cems.umn.edu/ovshinsky-award>

The **Iris Ovshinsky Student Travel Awards** for the 2013 March Meeting were presented to: Phillip Barton (University of California, Santa Barbara), Stephen Boona (Michigan State University), Dwaipayana Dasgupta (University of Massachusetts Amherst), Yanan Geng (Rutgers University), Jason Kawasaki (University of California, Santa Barbara), Moureen Kemei (University of California, Santa Barbara), Hyunsoo Kim (Iowa State University), and Xiaochang Miao (University of Florida).

Pictures taken at the 2013 March Meeting Awards Reception



2013 Ovshinsky Student Travel Award winners together with Robin Dibner (Stanley and Iris Ovshinsky's daughter, front row 3rd from left), Brian Schwartz (back row 2nd from right) and the DMP officers: Chris Palmstrøm (Secretary/Treasurer, left), Laura Greene (Chair-Elect, right front row) and Darrell Schlom (Chair, right back row).



2013 APS-DMP Fellows Awards Recipients together with Peter Schiffer (Past Chair), Chris Palmstrøm (Secretary/Treasurer, Laura Greene (Chair-Elect) and Darrell Schlom (Chair)

Nominations for DMP Officers and Executive Committee Members

A DMP election will be held late in 2013 to elect a Vice-Chair, a Secretary-Treasurer, and two new at-large Executive Committee Members. The Nominating Committee shall nominate at least two candidates for the ballot for each office. Suggestions for candidates for these offices can be made to the Chair of the Nominating Committee, Darrell Schlom (schlom@cornell.edu). In addition, candidates can be directly nominated to be placed on the ballot by petition of five percent of the membership of the Division. Such petitions must be received by the Secretary-Treasurer (Chris Palmstrøm cpalmstrom@ece.ucsb.edu) by September 13, 2013.

Call for Invited Speaker Suggestions

With this issue of the Newsletter, the Division of Materials Physics announces the program of DMP Focus Topics for the 2014 APS March Meeting (Denver, Colorado, March 03 - March 07 2014). A Focus Topic generally consists of a series of sessions, each of which is typically seeded with one invited talk, the remainder of the session being composed of contributed presentations.

September 6, 2013 is the deadline to submit suggestions for DMP Focus Topic invited speakers for the 2014 March Meeting.

DMP is sponsoring or co-sponsoring 23 different Focus Topics for the 2014 March Meeting. DMP membership nominators should send their nominations directly to the Focus Topic Organizers by e-mail with a few supporting sentences. These nominations will aid the organizers in their selection of invited speakers. A complete listing of DMP-sponsored Focus Topics and their descriptions are given below.

In suggesting speakers please keep in mind that speakers who gave an invited talk at the previous March Meeting are ineligible.

Thank you in advance for your help in making the March Meeting a success.

Finally, note that the contents of this Newsletter will be available electronically on the DMP website at <http://www.aps.org/units/dmp>. In case of any need for corrections or updates, these will also be posted at this location.

List of DMP-Sponsored or Co-Sponsored Focus Topics and Sorting Categories for the 2014 APS March Meeting

01. Polymers and Soft Matter Physics

01.1.8 Organic Electronics and Photonics (DMP/ DPOLY)

Co-organizers: **Vitaly Podzorov** (Rutgers) podzorov@physics.rutgers.edu
Bryan Boudouris (Purdue) boudoirs@purdue.edu

The electronic, photonic, and thermal properties of optoelectronically-active organic materials, including small molecules and polymers, continue to be the subject of active fundamental and applied research. This focus topic covers recent developments in this field with particular attention to the following areas related to organic and excitonic semiconductor materials and devices:

- Charge carrier injection, transport and recombination
- Exciton dynamics and transport
- Organic-organic and organic-inorganic interfaces
- Optical and optoelectronic properties
- Correlations between optoelectronic properties and primary chemical structure, crystal structure, microstructure, and morphology
- Effects of disorder and impurities
- Thermal properties
- Advances in single-crystal organic devices
- Fundamental progress in device design, processing, degradation, and modeling, including work on light-emitting devices, photovoltaic cells, field-effect transistors, switches, sensors, and lasers

01.1.9 Polymers for Energy Storage and Conversion (DPOLY/DMP)

Organizers: DPOLY

Advances in the development of polymeric materials and polymer based devices for energy applications have generated new knowledge, concepts and strategies for energy conversion, generation of light and energy storage. This symposium covers recent progress in these fields. Contributions are solicited for research related to the above topics such as utilizing multijunction polymer-based devices for solar energy conversion or light emission, polymer – nanofillers or multilayers for energy capture and conversion schemes including thermoelectrics, polymers as variable band gap materials, and polymeric materials for energy storage devices such as lithium ion batteries or capacitors. Theoretical, computational or experimental approaches are welcome

01.1.30 Assembly and Function of Biomimetic and Bioinspired Materials (DMP/DBIO)

Co-organizers: **Daniel Blair** (Georgetown) blair@physics.georgetown.edu
David Weitz (Harvard) weitz@seas.harvard.edu

This focus topic addresses experimental and theoretical research in the discovery, design, synthesis and characterization of functional biomimetic and bioinspired materials. The emphasis is on design, synthesis and understanding of robust materials and systems with emergent behavior that work with the extraordinary effectiveness of molecules and processes of the biological world. Areas include:

- Understanding, controlling, and building complex hierarchical structures by mimicking nature's self- and directed-assembly approaches
- Design, synthesis and characterization of multi-component (e.g., inorganic, polymeric, and biological) materials and systems that deliver robust functionality and/or are environmentally adaptive and self-healing
- Development of functional systems with collective properties not achievable by simply summing the individual components
- Investigations of the inherently nonequilibrium dynamics of biomaterials (e.g. biopolymer gels)
- Elucidating the physical principles behind self- and directed-assembly, membrane dynamics, flow through pores, conformational and mechanical response, and signal transduction in biomimetic systems

04. Biological Physics

04.1.10 Bacteria Biophysics (DBIO/DMP/DCOMP)

Organizers: DBIO

Bacterial biofilms are integrated, multi-species communities of cells that adhere to almost any surface and are fundamental to the ecology and biology of bacteria. Such communities of cells also provide a rich source of complex physical problems that impact human health. Bacteria are active anisotropic particles that can sense their environments, adaptively use their motility appendages, self-organize into communities. In the last few years, physicists have adapted their tools, both conceptual and technological, to the study of bacteria. In this contributed session, we aim to bring together a diverse range of physics approaches to engage this important microbiological problem.

07. Insulators and Dielectrics

07.1.1 Dielectric and Ferroic Oxides (DMP/DCOMP)

Co-organizers: **Nicole Benedek** (University of Texas, Austin)

nicole.benedek@austin.utexas.edu

Roman Engel-Herbert (Penn State) rue2@psu.edu

Stanislav Kamba (Academy of Sciences of the Czech Republic, Institute of Physics) kamba@fzu.cz

This topic focuses on dielectric, ferroelectric, and piezoelectric phenomena in oxides, their characterization by a broad range of techniques, and the growth of such materials in bulk, thin-film, superlattice, and nanostructured forms. Experimental results as well as theoretical, modeling/simulation, and materials-by-design approaches will be discussed. Specific areas of interest include domain structure and dynamics, lattice dielectric properties, physics of phase transitions, the coupling and/or interplay between (anti-)ferroelectric, piezoelectric, optical, transport, elastic and magnetic properties and the effect of interfaces and nanoscale geometries on these properties. Contributions addressing the design and synthesis of dielectric, ferroelectric and piezoelectric oxides for energy conversion and storage devices are particularly encouraged, as are those addressing the design or investigation of the previously mentioned properties using interdisciplinary, e.g. solid-state chemical, approaches. As there is potential overlap with other focus topics in the areas of energy, multiferroics and interfaces, the organizers will share information to group abstracts in a consistent fashion. In general, authors in these areas are encouraged to submit their abstracts to this topic if the presented work focuses on ferroelectric or piezoelectric properties.

07.1.2 Topological Materials: Synthesis, Characterization and Modeling (DMP)

Co-organizers: **Arun Bansil** (Northeastern University) ar.bansil@neu.edu

Judy Cha (Yale) jeeyoung.cha@yale.edu

N. Peter Armitage (Johns Hopkins University) npa@pha.jhu.edu

There has been explosive growth in the study of topological materials in which the combined effects of the spin-orbit coupling and fundamental symmetries yield a bulk energy gap with novel gapless surface states robust against scattering. Moreover, the field has expanded in scope to include superconductors, semimetals and thin-films capable of harboring exotic topologically nontrivial states of quantum matter. The observation of theoretical predictions depends greatly on sample quality and there remain significant challenges in identifying and synthesizing the underlying materials having properties amenable to the study of the surface and interface states of interest. This topic will focus on fundamental advances in the synthesis, characterization and modeling of candidate topological materials in various forms including bulk single crystals, exfoliated and epitaxial thin films, epitaxially modulated heterostructures, nanowires and nanoribbons, and theoretical studies that illuminate the synthesis effort and identify new candidate materials. Of equal interest is the characterization of these samples using structural, transport, magnetic, optical and other spectroscopic techniques, and related theoretical efforts aimed at modeling various properties and the underlying spin-textures, spin-

splittings and substrate effects, with particular focus on identifying samples whose properties are dominated by the surface and interface states.

08. Semiconductors

08.1.2 Dopants and Defects in Semiconductors (DMP)

Co-organizers: **Suhuai Wei** (National Renewable Energy Laboratory)

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Filip Tuomisto (Aalto University) filip.tuomisto@aalto.fi

Impurities and native defects profoundly affect the electronic and optical properties of semiconductor materials. Incorporation of impurities is nearly always a necessary step for tuning the electrical properties in semiconductors. In some cases, as in dilute III-V alloys, impurities even modify the band gap. Defects control carrier concentration, mobility, lifetime, and recombination; they are also responsible for the mass-transport processes involved in migration, diffusion, and precipitation of impurities and host atoms. The control of impurities and defects is the critical factor that enables a semiconductor to be engineered for use in electronic and optoelectronic devices as has been widely recognized in the remarkable development of Si-based electronics, the current success of GaN-based blue LED and lasers, and the emergence of ZnO for nanoelectronics sensors, and transparent conducting displays. The fundamental understanding, characterization and control of defects and impurities are essential for the development of new devices, such as those based on novel wide-band gap semiconductors, spintronic materials, and lowdimensional structures.

The physics of dopants and defects in semiconductors, from the bulk to the nanoscale, including surfaces and interfaces, is the subject of this focus topic. The electronic, structural, optical, and magnetic properties of impurities and defects in elemental and compound semiconductors, SiO₂ and alternative dielectrics, wide band-gap materials such as diamond, SiC, group-III nitrides, and oxide semiconductors are of interest. Abstracts on experimental and theoretical investigations are solicited.

09. Superconductivity

09.1.1 Fe-based Superconductors (DMP/DCOMP)

Co-organizers: **Elbio Ruben Dagotto** (University of Tennessee, Knoxville)

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Wei-Cheng Lee (University of Illinois, Urbana) leewc@illinois.edu

Greg Stewart (University of Florida) stewart@phys.ufl.edu

Substantial experimental and theoretical progress has been made toward understanding the unusual normal and superconducting state properties of iron based superconductors. Yet, many challenges and controversies exist, some driven by recent discoveries of new materials that differ radically from the original set. This focused session will cover the latest experimental and theoretical issues pertaining to the normal and superconducting

properties of Fe-based superconductors and their parent compounds. The goal is to understand the relationship between different crystalline, magnetic and electronic structures related to the high critical temperatures and to cultivate the potential for discovering new superconducting systems.

09.1.2 Search and Understanding of Superconductivity in Single Crystals and Films (DMP)

Co-organizers: **Athena Sefat** (Oak Ridge National Laboratory) sefata@ornl.gov
Mercouri Kanatzidis (Northwestern) m-kanatzidis@northwestern.edu
Hai-Hu Wen (Nanjing University) hhwen@nju.edu.cn

The careful design of new or improved superconducting materials is of crucial importance for understanding the fundamental nature of the superconducting state, and if superconductive materials are to fulfill their promise for widespread use in energy-related needs. Contributions of particular interest for this Focus Topic are those pertaining to the combined synthesis and characterization on the variety of material forms of polycrystalline materials, single crystals, and films. In the past year, the synthesis of iron-based superconductors (FeSC) has undergone extensive advances in single-crystal growth using a variety of fluxes, and film deposition using techniques such as pulsed laser deposition (PLD) and molecular beam epitaxy (MBE). Such quality materials have led path to thorough property measurements and diversified characterizations, and hence new findings. The goal of this Focus Topic is to bring together leading researchers that are actively investigating quality superconducting materials (or their related undoped parents) and to identify material and behavioral breakthroughs in understanding of FeSC. Theoretical predictions for the design of new or improved superconducting materials are well-received. Moreover, submissions on the exploratory synthesis of materials with superconductor-like structural types or features are accepted. Also, contributions in synthesis advances and characterization in the cuprates, organic and intercalated superconductors are welcomed.

09.1.3 Engineering Vortex Matter (DMP)

Co-organizers: **Leonardo Civale** (Los Alamos National Laboratory) lcivale@lanl.gov
Alexander V. Gurevich (Old Dominion University) agurevic@odu.edu

Control of vortex matter in superconductors remains a grand challenge to develop the next generation conductors for transmission lines, rotating applications such as motors and generators, and for their use in high-field superconducting magnets for SMES, accelerators, and fusion reactors. In high-temperature cuprate superconductors enormous progress has been achieved in understanding, controlling and improving vortex pinning through the introduction of artificial disorder by several routes, such as chemical incorporation of oxide nanoprecipitates, particle irradiation and interface manipulation. The effects of correlated linear and planar disorder, as well as random nanoparticles and point defects continue to be extensively explored, with increasing focus on hybrid pinning landscapes. Some of these experimental approaches and accumulated knowledge have already been applied to Fe-based superconductors. This symposium will address experimental, computational, and theoretical directions in our drive to engineer pinning of vortex matter in cuprates, Fe-based superconductors and other conventional, unconventional, and multiband superconductors.

10. Magnetism

10.1.1 Magnetic Nanostructures: Materials and Phenomena (GMAG/DMP)

Organizers: GMAG

Reduced dimensionality, confinement, and reduced scale often lead to magnetic structures and spin behavior that is markedly different from that of the bulk. This Focus Topic explores the advances in magnetic nanostructures and the novel properties that arise in magnetic materials at the nanoscale. Magnetic nanostructures of interest include thin films, multilayers, superlattices, nanoparticles, nanowires, nanorings, nanocomposite materials, hybrid nanostructures, spin phenomena in nanoscale organics, magnetic point contacts and self-assembled as well as patterned magnetic arrays. Sessions will include talks on the methods used to synthesize such nanostructures, the variety of materials used, and the latest, original theoretical and experimental advances. Synthesis and characterization techniques that demonstrate nano- or atomic-scale control of properties will be featured. Phenomena and properties of interest include: magnetization dynamics, magnetic interactions, magnetic quantum confinement, spin tunneling and spin crossover, proximity and structural disorder effects, strain effects, microwave resonance and microwave assisted reversal, magnetic anisotropy, and thermal and quantum fluctuations.

10.1.2 Emergent Properties in Bulk Complex Oxides (GMAG/DMP)

Organizers: GMAG

The emergence of exotic states of matter from the intricate coupling of the electronic and lattice degrees of freedom is a unique feature in strongly correlated electron systems. This Focus Topic explores the nature of various exotic states observed in bulk specimens of complex oxides and multi-ferroics and their competing interactions, the ways in which the spin, lattice, charge, and orbital degrees of freedom respond on a variety of length scales, and how they interact and compete with each other to produce novel phenomena. It provides a forum to discuss recent developments and results covering basic aspects (new materials synthesis, experiment, theory and simulation) of bulk systems. Included in this class of materials are the complex oxides of 3-, 4-, and 5-d transition metal compounds that exhibit a wide range of novel physical properties stemming from the complex nature of the competing interactions and nearly degenerate multiple ground states. Associated with this complexity is a tendency for new forms of order such as the formation of stripes, ladders, checkerboards, or phase separation, and an enhanced response to external influences.

10.1.3 Magnetic Oxide Thin Films and Heterostructures (GMAG/DMP)

Organizers: GMAG

Magnetism in complex oxides has long been a rich field of study in condensed matter physics due to the strong interactions between the spin, charge, lattice, and orbital degrees of freedom. When magnetic oxides are prepared in the form of thin films they can exhibit additional effects due to epitaxial strain, reduced dimensionality, interfacial charge transfer, electronic reconstruction, proximity effects, etc. These effects generate

exciting new prospects both for discovery of fundamental physics and development of technological applications. This Focus Topic is dedicated to developments in the understanding of the electronic and magnetic properties of oxide thin films, heterostructures, superlattices, and nanostructures, with an emphasis on synthesis, characterization, theoretical modeling, and novel device physics. Specific areas of interest include, but are not limited to, growth of oxide materials, control of their magnetic properties and ordering, magnetotransport, strongly correlated or “Mott” systems, strong spin-orbit coupling effects, and recent developments in theoretical prediction and materials-design approaches. Advances in techniques to probe and image magnetic order in complex oxide thin films (including optical and electron-probes, and neutron/synchrotron-based techniques) are also emphasized. Note that overlap exists with other DMP and GMAG focus sessions. As a rule of thumb, if magnetism plays a key role in the investigation or the properties observed, then the talk is appropriate for this focus topic.

10.1.4 Spin Transport and Magnetization Dynamics in Metals-Based Systems (GMAG/DMP/FIAP)

Organizers: GMAG

Spin-related effects in metals and in ferromagnetic heterostructures are generally robust and observable at room temperature. Discoveries such as giant and tunnelling magnetoresistance and spin-transfer torque are moving from discovery to applications rapidly. Fundamental spin-dependent transport physics, novel materials and thin film structures are being actively explored in metallic multilayer-based junctions and magnetic tunnel junctions for deeper understanding and potentially new functional materials and devices. This Focus Topic aims to capture new developments in these areas, including experimental and theoretical aspects of spin transport and magnetization dynamics in mostly metal-based systems, such as ultrathin films, lateral nanostructures, perpendicular nanopillars, and tunnel junctions. In particular, contributions describing new results in the following areas are solicited: (i) The interplay between spin currents and magnetization dynamics in magnetic nanostructures; spin-transfer, spin pumping and related phenomena, including current-induced magnetization dynamics in heterostructures and domain wall motion in magnetic wires; (ii) Theoretical predictions and/or experimental discovery of half-metallic band structures, both in bulk solids and at the surfaces of thin films. Spin transport and magnetization dynamics in magnetic nanostructures (e.g. TMR, CPP-GMR and lateral spin valve structures) based on half-metallic materials; (iii) Effects of spin-orbit interaction on steady-state and dynamic properties of nanostructures including: the (inverse) spin-Hall and anomalous-Hall effects, microscopic mechanisms of magnetization damping, the effects of interface spin-orbit interaction, and spin-orbit interaction as a means for spin-current generation; (iv) Electric field control of magnetic properties (e.g. anisotropy, phase transition, exchange bias,...), including but not limited to: hybrid metals/oxide structures, piezoelectric layer coupled to ferromagnetic films, electrolyte/ferromagnetic systems; (v) Ultrafast magnetization response to (and reversal by) intense laser pulses; magnetization dynamics at elevated temperatures and thermally assisted magnetization reversal; (vi) Thermoelectric spin phenomena such as giant-magneto thermopower and Peltier effects, spin-Seebeck effect, spin and anomalous Nernst and Ettingshausen effects (spin caloritronics); (vii) Thermal gradient and/or RF driven magnonic magnetization dynamics in nanostructures including spin

wave excitation, propagation, and detection. Interactions between electronic spin-current and magnon propagations in thin film and device structures; (viii) General considerations of spin-angular momentum current flow, energy flow, and entropy flow, conservation laws and Onsager-reciprocal relationships.

10.1.5 Spin Dependent Phenomena in Semiconductors (GMAG/DMP/FIAP)

Organizers: GMAG

The field of spin dependent phenomena in semiconductors shows rapid advances as well as challenges in a widening range of new effects and materials systems (e.g. heterostructures, III-Vs, Si and Ge, diamond, graphene and organics), and new structures (e.g. semiconductor quantum structures and nanostructures, wires and carbon nanotubes, hybrid ferromagnetic/semiconductor structures). This Focus Topic solicits contributions aimed at understanding spin dependent processes in magnetic and non-magnetic structures incorporating semiconducting materials. Topics include: (i) electrical and optical spin injection, spin Hall effects, spin dependent topological effects, spin interference, spin filtering, spin lifetime effects, spin dependent scattering, and spin torque; (ii) growth, characterization, electrical, optical and magnetic properties of (ferro-)magnetic semiconductors, nanocomposites, and hybrid ferromagnet/semiconductor structures, including quantum dots, nanocrystals, and nanowires; (iii) spin dependent transport, spin dependent thermal effects, and dynamical effects in semiconductors with or without spin-orbit interactions; (iv) manipulation, detection, and entanglement of electronic and nuclear spins in quantum systems such as dots, impurities and point defects; (v) ferromagnetism in semiconductors and semiconductor oxides; and (vi) spin dependent devices and device proposals involving ferromagnets and semiconductors.

10.1.6 Frustrated magnetism (GMAG/DMP)

Organizers: GMAG

Simple antiferromagnets on bipartite lattices have well-understood ground states, elementary excitations, thermodynamic phases and phase transitions. At the forefront of current research are frustrated magnets where competing interactions suppress magnetic order and may lead to qualitatively new behavior. Frustrated magnets may realize novel quantum-disordered ground states with fractionalized excitations akin to those found in one-dimensional antiferromagnets, but with a number of novel features. They are also sensitive to nominally small perturbations and interact in a non-trivial way with orbital and lattice degrees of freedom. This Focus Topic solicits abstracts for presentations that explore both theoretical and experimental aspects of the field. The themes to be represented are united by geometrical frustration: valence-bond solids and other exotic orders, spin ice, quantum spin liquids, order from disorder, magnetoelastic coupling, and novel field-induced behavior. Also of interest are the effects of strongly fluctuating spins on properties beyond magnetism including transport, thermal transport and ferroelectricity.

10.1.7 Spin-Dependent Physics in Carbon-Based Materials (GMAG/DMP)

Organizers: GMAG

Research at the intersection of several forefront areas in condensed-matter and carbon-based material physics have led to new spin-dependent physics with technologically significant applications. These issues are of great current interest because of advances in spin relaxation times in graphene and breakthrough results in the field of ‘organic spintronics’, a new research area focused not only on the traditional topics of spintronics such as spin-polarization and spin-orbit effects but more importantly on spin-selection rules and spin-permutation symmetry effects. This Focus Topic is on spin transport, spin dynamics and exchange phenomena in carbon-based materials, such as carbon nanotubes, graphene, diamond as well as organic and molecular solids, organic radical systems, and π -conjugated organic/polymeric systems. Subjects such as spin injection at the metallic ferromagnet to graphene and inorganic to organic interface, the degree of spin polarization attainable within organic based solids, the spin coherence and relaxation related to extrinsic spin-orbit coupling effects, the hyperfine interaction between the electronic spin and nuclear magnetic moments, as well as the magnetic exchange, magnetic ordering and correlation effects in these materials are appropriate for this topic. Phenomena, materials of interest and the application for advanced devices include hybrid ferromagnetic/organic structures, spin transport in graphene and carbon nanotubes, spin qubits in diamond, quantum tunneling of the magnetic moment, magnetic field effects (e.g., organic magnetoresistance), singlet/triplet issues, spin resonance in organic semiconductors, organic spin valves and spin-polarized organic light emitting diodes.

12. Complex Structured Materials, Including Graphene

12.1.1 Graphene: Synthesis, Defects and Properties (DMP)

Co-organizers: **D. Kurt Gaskill** (U.S. Naval Research Laboratory)

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Graphene continues to attract strong interest within the scientific community because of its unique physical and chemical properties and prospects in a wide range of applications from RF transistors to supercapacitors. A number of scalable approaches have been developed to produce single- and few-layer films of graphene. Two major synthetic routes are epitaxial growth on SiC wafers and chemical vapor deposition on metal and non-metal substrates. This graphene focus topic will cover:

- experimental, theoretical, and computational studies illuminating various aspects of the growth process including e. g. layer number and stacking geometry control, the formation of topological and structural defects, grain size and grain boundary control, and the effect of substrate chemistry, crystallography and strain
- methods of doping
- templated growth of nanostructures and bottom-up integration with other materials

- characterization and modeling of the structural, mechanical, electronic, and optical properties of the synthesized graphene, and
- methods for transferring synthesized graphene to other substrates and the impact of the transfer process

12.1.2 Beyond Graphene: Synthesis, Defects, Structure, and Properties Interactions (DMP) (DMP)

Co-organizers: **Tony F. Heinz** (Columbia) tony.heinz@columbia.edu
Di Xiao (Carnegie Mellon University) dixiao@cmu.edu

The study of graphene, a single atomic plane of graphite, remains a rapidly growing field of research. This topic will focus on the materials physics of graphene produced by mechanical or chemical means, including single layer, bilayer, trilayer, and higher multilayer graphenes as well as structurally or chemically modified graphenes. We invite experimental and theoretical contributions in the following areas:

- the physics of structurally or chemically modified graphenes, including the effect defects, edges, adatoms, adsorbates, and strain on graphene's material properties,
- the physics of epitaxial graphenes, including the properties of multilayer graphene films,
- interactions of exfoliated or chemically grown graphenes with different substrates and the environment.

12.1.3 Graphene Devices: Fabrication, Characterization and Modeling (DMP)

Co-organizers: **Jeanie Lau** (UC Riverside) lau@physics.ucr.edu
Masa Ishigami (University of Central Florida) ishigami@ucf.edu
Dimitri Basov (University of California, San Diego) dbasov@physics.ucsd.edu

The unique properties of graphene have led to great excitement about its potential device applications. However, numerous open questions surround the challenges and promise of creating such devices at a practical level. This Focus Topic relates to experimental and theoretical studies of devices based on single- and multi-layered graphene. The devices considered include (but are not limited to) electronic, optical, mechanical, thermal, and chemical graphene devices. We invite contributions on topics including: (i) the fabrication, measurements, and modeling of graphene devices, (ii) proposals for or tests of devices that exploit the unique properties of graphene, and (iii) materials, environmental, or other issues that enable or limit graphene devices.

12.1.3b Beyond Graphene Devices: Function, Fabrication, and Characterization (DMP)

Co-organizers: **Roger Lake** (University of California, Riverside) rlake@ee.ucr.edu
Yong Chen (Purdue) yongchen@purdue.edu

Research exploring 2D materials beyond graphene is rapidly expanding including different material systems such as nitrides (e.g., h-BN), transition metal dichalcogenides (e.g., MoS₂), topological insulators (e.g., Bi₂Se₃ or Bi₂Te₃), layered high-T_c superconductors (eg. Cu or Fe based superconductors BSCCO and FeSe), germanane, and silicene. There is enormous interest in building devices and functional materials based on these 2D materials including their integration with graphene. The isolation and synthesis of these novel 2D materials has become an important area of materials physics research. This symposium will cover growth, synthesis, characterization, theory, and computation. Particular focus will be on the electronic, thermal, magnetic, and optical properties and functions of few-layers and monolayers of these materials and their heterostructures. Devices exploiting these properties are also included.

12.1.4 Carbon Nanotubes and Related Materials: Synthesis, Properties, and Applications (DMP)

Co-organizers: **Chongwu Zhou** (University of Southern California) chongwuz@usc.edu
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marc.bockrath@ucr.edu
Vince Crespi (Penn State) vhc2@psu.edu

Interest in the fundamental properties and applications of carbon nanotubes and related materials remains high. This is because of their unique combination of electrical, chemical, mechanical, thermal, optical, spectroscopic and magnetic properties. This focus topic addresses recent developments in the fundamental understanding of nanotubes and related materials, including synthesis, characterization, processing, purification, chemical, mechanical, thermal, electrical, optical, and magnetic properties. This session will highlight how these properties lead to new fundamental physical phenomena and existing or potential applications for interconnects, transistors, thermal management, composites, super-capacitors, nanosensors, nanoprobe, field emitters, storage media, magnetic devices, etc.. Experimental and theoretical contributions are solicited in the following areas:

- Synthesis and characterization of nanotubes, nanohorns, nanocones, and related nanostructures;
- Control or optimization of growth, including helicity control and in-situ studies;
- Purification, separation, chemical functionalization, alignment/assembly;
- Structure and properties of hybrid systems, including filled and chemically modified carbon nanotubes and nanotube peapods;
- Mechanical and thermal properties of these nanostructures and their composites;
- Electrical and magnetic properties of these systems;
- Mesoscopic, structural, optical, opto-electronic and transport properties as well as their spectroscopic characterization.
- BN and other inorganic nanotubes; other 3D forms of sp²-carbon
- The focus topic will also cover the broad applications of these nanosystems, including:
 - Electronic devices including interconnects, supercapacitors, transistors, memory;
 - Thermal management applications;

- Multifunctional nanotube composites;
- Chemical and bio-sensing applications;
- Field emission;
- New generations of magnetic and electronic devices

12.1.5 Van der Waals Interactions in Complex Materials: Bridging Theory and Experiment (DMP)

Co-organizers: **Alexandre Tkatchenko** (Fritz Haber Institute, Germany) tkatchen@fhi-berlin.mpg.de
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Van der Waals interactions are ubiquitous in nature and play an important role in the structure, stability, and function of molecules and materials studied across all of the major disciplines of science, ranging from structural biology to supramolecular chemistry and condensed matter physics. These non-bonded interactions are inherently quantum mechanical phenomena resulting from dynamical correlation among collections of electrons, and remain a substantial challenge to date for both accurate first-principles theoretical calculations and direct experimental characterization. Hence, the aim of this focus session is to directly address this challenge by highlighting the current state-of-the-art in both the theoretical description and experimental measurement of van der Waals interactions in materials of interest. In doing so, we hope to bridge the gap between theory and experiment, thereby laying the groundwork for future collaborative research---an approach that is necessary for describing these fundamental interactions in materials of increasing complexity.

12.1.6 Computational Discovery and Design of Novel Materials (DMP/DCOMP)

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Advances in theoretical understanding, algorithms and computational power are enabling computational tools to play an increasing role in materials discovery, development and optimization. For example, recently developed data mining techniques and genetic algorithms enable the "virtual synthesis" of novel materials, with their properties being predicted on a computer before ever being synthesized in a laboratory. This focus topic will cover recent methodological developments and applications at the frontier of computational materials discovery and design, ranging from quantum-level prediction to macro-scale property optimization. Of particular interest are computational and theoretical studies that features a strong connection to experiment. Topics include but are not limited to first principles materials discovery, algorithm to search structurecomposition design space, data mining techniques, innovations that improve the scope, accuracy, and efficiency of computational materials discovery and design, and applications ranging from energy conversion and storage materials (thermoelectrics, batteries, fuel cells, photovoltaics), to novel materials for data processing (spintronics, 2D materials).

13. Superlattices, Nanostructures, and other Artificially Structured Materials

13.1.1 Nanostructures and Metamaterials: Synthesis, Fabrication, and Characterization (DMP)

Co-organizers: **Jon Schuller** (University of California, Santa Barbara) jonschuller@ece.ucsb.edu
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Shaping materials on the sub-wavelength scale enables unprecedented control over light-matter interactions. Carbon nanomaterials, quantum-confined semiconductor nanostructures, and plasmonic metal nanoparticles all exhibit size- and shape-dependent optical properties. In metamaterials, assemblies of these sub-wavelength structures collectively generate optical properties not found in conventional materials. As such, nanostructures and metamaterials provide unique opportunities to manipulate electromagnetic radiation at all frequencies, from optical and infrared to terahertz and microwave. This focus topic aims to bring together experimental and theoretical colleagues from different disciplines to advance our understanding of novel optical phenomena in nanosystems and engineered composite media.

13.1.2 Phase Transitions in Strongly Correlated Electron Systems (DMP)

Co-organizers: **Tyrel McQueen** (Johns Hopkins University) mcqueen@jhu.edu
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Due to the interplay between competing degrees of freedom with similar energy scales, strongly correlated electronic systems exhibit a plethora of emergent behaviors including to high-temperature superconductivity, ferroelectricity, colossal magnetoresistance, non-Fermi liquid behaviors and metal-insulator transitions. Often the electronic structure and lattice dynamics are tightly coupled, resulting in stunningly large changes in materials properties at phase transitions. Significant progress has been made in the tuning of such phase transitions both internally, via chemical control of the structure, and externally, through strain/interface engineering and electric gating, in materials ranging from vanadium oxides and manganites to ruthenates and iridates.

This tunability, when combined with recent advances in probing both the structures and dynamics at all length scales, is allowing for unparalleled insights into the origin of complex and useful emergent phenomena in strongly correlated oxides.

13.1.3 Electron, Ion, and Exciton Transport in Nanostructures (DMP)

Co-organizers: **William Vandenberghe** (University of Texas, Dallas) wxv101020@utdallas.edu
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Most of the novel device technologies rely on processes involving charge, mass, or energy transport through layered materials system. This focus topic will address fundamental challenges and new opportunities to understand and control electron, ion,

and exciton transport in nanostructures, with a particular interest in the influence of interfaces between different materials and phases. Contributions are solicited in areas that reflect recent advances in experimental characterization and theory of transport mechanisms in inorganic nanoscale structures. Specific topics of interest include, but are not limited to: experimental and theoretical studies of transport properties of nanostructures and ultrathin films, understanding the dynamics of interfacial charge transfer processes, electron and ion transport through interfaces between metals, oxides and/or semiconductors, and studies addressing memory effects in resistive and capacitive systems.

13.1.4 Complex Oxide Interfaces and Heterostructures (DMP)

Co-organizers: **Sohrab Ismail-Beigi** (Yale) sohrab.ismail-beigi@yale.edu
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Heterostructures combining complex oxides with properties as diverse as superconductivity, ferroelectricity, magnetism, colossal magnetoresistance and metal-insulator transitions, offer seemingly endless possibilities for fundamental studies of the interactions between the structural and electronic degrees of freedom that give rise to these fascinating phenomena, as well as for the development of new multifunctional materials and devices. The effects of strain, confinement and interactions between the constituent materials, particularly at interfaces, lead to rich physics as, time and again, oxide heterostructures are found to play host to new and often unexpected phenomena. Local symmetry breaking, charge transfer, magnetic and electrostatic interactions, and coupling between structural modes are just some of the many mechanisms that can lead to the appearance of novel interfacial functionalities and can be employed for rational design of artificial materials with desirable structural, electronic and magnetic properties. The aim of this focus session is to provide a forum for the discussion of recent results of experimental and theoretical studies of complex-oxide heterostructures and their interfaces. The topics covered in this session will include advances in the growth and characterization of complex-oxide heterostructures, development of interface-related measurement techniques, theory and modelling of oxide heterostructures and interfaces, experimental investigation and tuning of interface-related properties in conducting, insulating and magnetic oxides, applications based on interface-related phenomena in complex-oxide heterostructures, and new phenomena appearing in complex oxides due to heterostructuring.

13.1.6 Thermoelectric Phenomena, Materials, Devices, and Applications (DMP/GERA/FIAP)

Co-organizers: **Eric Toberer** (Colorado School of Mines) etoberer@mines.edu
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Solid-state thermoelectric devices can directly convert energy between heat and electricity and can be used for either cooling or power generation. For conventional thermoelectric devices based on the Seebeck effect and Peltier effect, the energy conversion efficiency depends on the thermoelectric figure of merit (ZT) of the material, which is defined as $ZT = S^2\sigma T/\kappa$ where S , σ , κ , and T are the Seebeck coefficient, electrical resistivity, thermal conductivity, and absolute temperature, respectively.

Although there is no fundamental upper limit to ZT, over the last 50 years the ZT of commercially available materials has increased only marginally, from about 0.6 to slightly above unity. Following the advances in nanotechnology, the ZT values has increased in the last five years to values slightly above two in research laboratories. The goal of this session is to bring together scientists working on both bulk and nanostructured thermoelectric materials to examine the approaches and infuse cross-disciplinary themes for increasing ZT of thermoelectric materials and to discuss other solid-state thermoelectric energy conversion approaches. Topics will range broadly from the fundamentals to the applications of thermoelectric transport phenomena and materials physics and chemistry.

Topics of particular interest include, but are not limited to:

- Theoretical and experimental investigations of the thermoelectric effects and electron transport phenomena in thermoelectric materials, for example novel electronic structure features that lead to enhanced Seebeck coefficient as well as the recently discovered Spin-Seebeck effect.
- Fundamental understanding of thermal transport by phonons, electrons, magnons, and other energy carriers, including approaches to suppressing the lattice thermal conductivity by anharmonicity, nano- or complex structures, or other mechanisms.
- Fundamentals of electrical transport, coupling of different carrier types and strategies to enhance the thermoelectric power factor by modifying the density of states or scattering rates.
- Computational design and chemical synthesis of bulk and nanostructured thermoelectric materials, including both known thermoelectric materials such as those based on PbTe, Bi₂Te₃, and SiGe, and other less known thermoelectric materials especially earth-abundant materials.
- Device physics and interface physics, including innovations in device architectures based on different thermoelectric effects.
- Applications of thermoelectric devices ranging from nanoscale spot cooling to large scale vehicle waste heat recovery and solar energy utilization.

13.1.7 Mesoscopic Materials and Devices (DMP)

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The scope of this Focus Topic is the study of mesoscale materials, that are in the regime where classical, microscale and nanoscale science meet. It spans two areas: (i) facilities and tools needed to make, characterize and describe mesoscale materials, and (ii) new mesoscale phenomena and functionality. In particular, contributions describing new results in the following areas are solicited:

- **Mesoscale synthesis:** high-resolution electron lithography, focused ion beam (FIB) and scanning-force-microscopy (SFM) lithography, SFM-stimulated growth, imprint lithography, self-assembly.

- Mesoscale characterization: ballistic-electron emission microscopy (BEEM) and SFM, optical and tunneling, phase coherence, noise, THz and electroluminescence studies in small structures.
- **Mesostructures and devices:** quantum wires and dots, ultra-scaled FETs, quantum single-electron transistors (SETs), magnetic and multiferroic, photonic and plasmonic, ferromagnetic and spin devices, superlattice arrays, molecular electronic, meso-electromechanical systems.
- **Correlated electron systems:** quantum chaos, non-equilibrium transport, instabilities, phase coherence and breaking, new developments in single and bilayer graphene, topological states of matter, quantum critical phenomena in metallic systems.
- **Quantum-coherent transport:** the quantum Hall effect, ballistic quantum systems, quantum-computing implementations and theory, coherence and decoherence, magnetic spin systems.

14. Surfaces, Interfaces and Thin Films

14.1.2 Surfaces and Interfaces in Nonoxide Nanostructures: Growth, Structure, and Characterization (DMP)

Co-organizers: **Shirley Chiang** (University of California, Davis)

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The search to grow predictable nanoscale structures requires finding robust ways to control and predict their dimensions, morphology, stability and electronic properties. New properties different from bulk properties can emerge on the nanoscale because of electron confinement and reduced dimensionality. Ultrathin films, nanoislands, and quantum dots can be widely used in many areas of physics and material science relevant to microelectronics, spintronics, nanocatalysis, photonics, sensors, energy conversion, and computer memories, so that the session will be of interest to different communities aiming at nanostructure control. Building these nanostructures fast and defect-free is the key for realizing promising applications. Studies involving traditional complementary tools (STM, surface diffraction, TEM, etc.) for studying epitaxial growth and models of atomistic processes in terms of classical random-walk diffusion are welcome for this session. Recently, novel collective processes were found in several systems where mass transport is exceedingly fast and involves multi-atom collective diffusion, in some cases well below room temperature. The use of LEEM has been essential for these discoveries because it allows the real-time monitoring of these unusual mass transport processes, which can involve millions of atoms transferred over mesoscopic distances within a few seconds. A better understanding of the mechanisms behind these unusual processes can lead to better nanostructure selectivity and control.

16. General Theory/Computational Physics

16.1.5. Materials in Extremes: Bridging Simulation and Experiment (DCOMP/DMP/GSCMM)

Co-organizers: **Ivan Oleynik** (University of South Florida) oleynik@usf.edu
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The behavior of matter under extreme conditions of high pressure, temperature, strain and strain rate is of fundamental scientific importance, therefore, a profound understanding of material response at the atomic, microstructural, and continuum levels is urgently sought. Experimental approaches are achieving ever more extreme conditions of pressure, temperature and strain rates while applying novel diagnostics to increase the extent and fidelity of the measured data. Similarly, advances in theory and modeling, due to enormous increase in computer power combined with new computational techniques, have made it possible to extend simulations to the time and length scales of the experiments. This focus session, consisting of several invited and contributed talks, will assess recent experimental and computational efforts towards exploring the fundamental properties of materials at extreme conditions, including (1) high-pressure and high temperature synthesis and characterization of novel materials; (2) high strain rate phenomena occurring upon ultrafast energy deposition; (3) static high pressure and shock-induced materials behavior, including plasticity, phase transitions, and chemical reactions; (4) static and dynamic properties of energetic materials, including detonation phenomena; (5) properties of matter in the warm dense regime; and (6) new computational methods including development of interatomic potentials and multi-scale simulations.

16.1.6. Computer simulations of interaction of electromagnetic fields and nanostructures (DCOMP/DMP)

Co-organizers: **Kalman Varga** (Vanderbilt University) kalman.varga@vanderbilt.edu
Carsten Ullrich (University of Missouri) ullrichc@missouri.edu

The advance of high power, high quality light sources offers unprecedented opportunities to investigate the interaction of electromagnetic fields and nanomaterials. The understanding and control of light-matter interaction is of considerable current interest both from technological and fundamental physics points of view. Various approaches have been developed to solve the time-dependent Schrödinger equations coupled to electric fields, but the description of electron dynamics in electromagnetic fields is still a challenge. Multiple time and length scales have to be bridged and a computational platform unifying quantum mechanics and the Maxwell equations has to be developed. The proposed focus session will overview the present state of art of computational methods and their applications to describe the interaction of light and metallic nanostructures, linear and nonlinear optical response, interaction of condensed matter and strong laser pulses, Coulomb explosion, and electron dynamics at the attosecond time scale. The computational methods over-arch powerful approaches ranging from time-dependent density functional theory (TDDFT) to finite-difference time-domain simulations. Owing to the interdisciplinary nature of this topic, we expect to attract

contributions from a broad variety of areas, including plasmonics, strong-field atomic and molecular physics, graphene, semiconductor optics in bulk and nanostructures, photonics, and photochemistry.

16.1.7. Friction and Wear at the Nano- and Micro-Scales (DCOMP/DMP)

Co-organizers: **Michael Chandross** (Sandia National Laboratory) mechand@sandia.gov
Corbett Battaile (Sandia National Laboratory) ccbatta@sandia.gov

This focused session will investigate the fundamental mechanisms of friction, wear and adhesion at the nano and microscales. Applications include energy conversion in automotive, aerospace and electronics industries; micro-electromechanical systems; and biotribology. A wide range of researchers from government, academia and industry spanning modeling (atomistic and finite element), synthesis (thermal spray, plasma sintering, PVD/CVD and powder metallurgy), characterization (novel surface techniques and in situ studies), and manufacturing (environmentally robust coatings, biological implants and mining/drilling) are anticipated.

16.1.11 Materials for Electrochemical Energy Storage (DMP/GERA/FIAP/DCOMP)

Co-organizers: **Maria Chan** (Argonne National Laboratory) mchan@anl.gov
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The worldwide demand for energy storage continues to grow at unprecedented pace. Consumer and transportation applications dominate the market, but grid-storage needs are increasing as green energy technologies such as wind, and solar energy conversion become more prevalent. To meet these needs, electrochemical power sources that include batteries are providing a solution, but new advanced energy materials in such devices are needed to push beyond the barriers of current technologies. In this regard, the subject areas for this focus topic will cover a variety of electrochemical phenomena that encompass energy storage, but specifically new batteries that are lithium-ion, lithium-sulfur, lithium-air, redox flow batteries, as well as alternative multivalent and sodium-ion batteries. Other technologies such as ultracapacitors are included in the topic as these electrochemical devices are critical for absorbing or releasing power quickly. New chemistry and physical insights in materials for energy storage are especially encouraged. Other areas of interest to the topic that are also receiving recent attention: nanoarchitectures for energy storage, intercalation processes, modeling, new trends and techniques for measurements in-operando, and organic cathodes and anodes.

19. Instrumentation and Measurements

19.1.6 Imaging and Modifying Materials at the Limits of Space and Time Resolution (GIMS/DMP)

Organizers: GIMS

No description available