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Dates to Remember

September 14, 2012 (Friday) Deadline for submitting invited speaker suggestions for DMP Focus Topics. DMP online nomination at <http://go.aps.org/dmpinvited> or communicate directly with one of the focus topic organizers.

November 9, 2012 (Friday) Abstract deadline for the 2013 APS March Meeting. Submission is via the web at <http://abstracts.aps.org>

February 1, 2013 DMP Deadline for APS Fellowship Nomination

March 18 - March 22, 2013 (with tutorials, etc., March 17): APS March Meeting in Baltimore, Maryland

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 Baltimore (March 18 - March 22, 2013).

This year, the DMP Executive Committee has been continuing to work with the Executive Committee of the Division of Condensed Matter Physics and other APS Units to systematically revisit and update numerous sorting categories for the March Meeting. These updates are aimed toward better sorting of abstracts, and will further improve the organization of what is already a spectacular contributed program of talks. We will naturally welcome feedback and advice for further improvements in years to come, since the field is dynamic and constantly evolving.

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, David Cahill, 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 aspects 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, 2013, 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 David J. Sellmyer and Nicola Spaldin, who have stepped down as Members at Large. And a special thanks to Robert Nemanich, 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 Boston!

Darrell Schlom, DMP Chair

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

The Iris Ovshinsky Student Travel Awards have been established to assist the career of student researchers. The Awards are named after 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 eight \$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 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 2012 March Meeting were presented to: Lyudmyla Adamska (University of South Florida), Erik Haroz (Rice University), Xiaoxiao He (University of California, Riverside), Halyna Hodovanets (Iowa State University), Bin Li (The Ohio State University), Jian Liu (University of Arkansas), Kathleen McCreary (University of California, Riverside), Duming Zhang (The Pennsylvania State University)

Pictures taken at the 2012 March Meeting Awards Reception



2012 Ovshinsky Student Travel Award winners together with the DMP officers: Chris Palmstrøm (Secretary/Treasurer), Darrell Schlom (Chair Elect) and Peter Schiffer (Chair).



2012 APS-DMP Fellows Awards Recipients together with Darrell Schlom (Chair Elect)

Nominations for DMP Officers and Executive Committee Members

A DMP election will be held late in 2012 to elect a Vice-Chair, 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, Peter Schiffer (pschiffe@illinois.edu). In addition, candidates can be nominated directly 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 Palmström cpalmstrom@ece.ucsb.edu) by September 11, 2012.

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 2013 APS March Meeting (Baltimore, Maryland, March 18 - March 22, 2013). 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 4, 2012 is the deadline to submit suggestions for DMP Focus Topic invited speakers for the 2013 March Meeting.

DMP is sponsoring or co-sponsoring 31 different Focus Topics for the 2013 March Meeting. DMP members are encouraged to make suggestions for invited speakers for these Focus Topics via the web --> <http://go.aps.org/dmpinvited>
Your nomination will go to the organizers of the Focus Topic you suggest an invited speaker for and 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 2013 APS March Meeting

01. Polymers and Soft Matter Physics

01.1.2 Polymers for Energy Storage and Conversion (DMP/GERA)

Co-organizers: **Enrique Gomez** (Pennsylvania State University; edg12@psu.edu)
Michael Chabinyc (The University of California, Santa Barbara; mchabinyc@engineering.ucsb.edu)

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.

01.1.8 Organic Electronics and Photonics (DMP/ DPOLY)

Co-organizers: **Richard Lunt** (Michigan State University; rlunt@msu.edu);
C. Daniel Frisbie (University of Minnesota; frisbie@umn.edu)
Michael S. Arnold (University of Wisconsin-Madison; msarnold@wisc.edu)

The electronic, excitonic, and photonic properties of 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 transport, injection, and recombination
- Exciton dynamics and transport
- Organic-organic and organic-inorganic interfaces
- Optical and optoelectronic properties
- Correlations to primary chemical structure, nanostructure, microstructure, and morphology
- Fundamental progress in device design, processing, degradation, and modeling, including work on light-emitting devices, photovoltaic cells, field-effect transistors, switches, sensors, and lasers

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

Co-organizers: **Mark Stevens** (Los Alamos National Laboratory; msteve@sandia.gov);
Jim DeYoreo (Lawrence Berkeley National Laboratory; jjdeyoro@lbl.gov)
Alex Noy (University of California-Merced; anoy@ucmerced.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

04.1.21 Structures and Dynamics of Biomembranes (DBIO/DCOMP/DMP)

Organizer: **Mu-Ping Nieh** (University of Connecticut; mu-ping.nieh@ims.uconn.edu)

Amphiphilic molecules such as lipids, surfactants, polymers or their mixtures can self-assemble into a variety of structures, one of which is bilayered membrane. Because of their similarity to the structure of cell membrane, bilayered membranes can serve as a native substrate for membrane-associated proteins to study the structures, dynamics and interactions of membrane proteins and their host membranes. Moreover, in many cases, fundamental physics of self-assembly, exchange and kinetics of the amphiphilic molecules in aqueous solutions are not well understood. This session will include the presentations in regard to the structural and dynamic studies of amphiphilic molecules forming membranes and their applications and implications to the associated biomolecules.

07. Insulators and Dielectrics

07.1.1 Dielectric and Ferroic Oxides (DMP/DCOMP)

Co-organizers: **Nicole Benedek** (University of Texas-Austin; benedek@utexas.edu)
Albina Y. Borisevich (Oak Ridge National Laboratory; albinab@ornl.gov)
Gustau Catalan (Centre d'Investigacions en Nanociència i Nanotecnologia (CIN2); gustau.catalan@cin2.es)

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 and Characterization (DMP)

Co-organizers: **Nicholas P. Butch** (Lawrence Livermore National Laboratory; butch1@llnl.gov)
Jagadeesh Moodera (Massachusetts Institute of Technology; moodera@mit.edu)

There has been rapid growth in the study of topological insulators, materials in which the combined effects of the spin-orbit interaction and fundamental symmetries yield a bulk energy gap and novel gapless surface states. Moreover, the field has expanded in scope to include superconductors and semimetals with nontrivial topology. 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 states. This topic will focus on fundamental advances in the synthesis of candidate topological materials in various forms including bulk single crystals, exfoliated and epitaxial thin films, epitaxially modulated heterostructures, nanowires, and nanoribbons - as well as theoretical studies that illuminate the synthesis effort and identify new candidate materials. Of equal interest is the characterization of these samples using structural, electrical, magnetic, optical and other techniques, with particular focus on identifying samples whose properties are dominated by the surface states.

08. Semiconductors

08.1.2 Dopants and Defects in Semiconductors (DMP)

Co-organizers: **Mary Ellen Zvanut** (University of Alabama-Birmingham; mezvanut@uab.edu)
Matt McCluskey (Washington State University; mattmcc@wsu.edu)

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 low-dimensional 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: **John Tranquada** (Brookhaven National Laboratory; jtran@bnl.gov)
Igor Mazin (Naval Research Laboratory; Igor.Mazin@nrl.navy.mil)
Wai-Kwong Kwok (Argonne National Laboratory; wkwok@anl.gov)

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 for New Superconductors (DMP)

Lead organizer: **Horst Rogalla** (University of Twente; h.rogalla@utwente.nl);
Co-organizers: **Warren Pickett** (University of California-Davis; pickett@physics.ucdavis.edu)
Ivan Bozovic (Brookhaven National Laboratory; bozovic@bnl.gov)
James N. Eckstein (University of Illinois; eckstein@illinois.edu)

This topic will focus on fundamental advances in the growth, characterization, and experimental as well as theoretical understanding of new superconducting materials with the exclusion of the recently discovered magnesium diborides, pnictides, and calcoginides. The main goal of this focus topic is to explore non-conventional ideas in superconductivity, and to foster the exchange of information about discoveries that may conceive a change in our understanding of superconductivity. Its purpose is to promote interaction among theorists and experimentalists and seed new directions in superconductivity research, especially in areas cutting across traditional disciplinary boundaries. Areas of interest include new approaches in the study of superconductivity in complex materials, metamaterials, heterojunctions, and hybrid structures. The focus topic will cover a wide range of novel superconductors such as organics and intercalation compounds. The creation of superconducting nanostructures with atomic scale control using physical and chemical methods is also of interest. The focus topic will specifically include research on understanding of mechanisms for improvements in superconducting materials, engineering superconductors with ab initio methods, empirical approaches in the search for novel superconductors, and theoretical predictions leading past serendipitous discovery to predictive design.

10. Magnetism

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

Co-organizers: **Kristen Buchanan** (Colorado State University; Kristen.Buchanan@colostate.edu)
Z. Q. Qiu (University of California at Berkeley; qiu@socrates.berkeley.edu)

This topic focuses on 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)

Co-organizers: **Laurent Chapon** (Rutherford Appleton Laboratory; chapon@ill.fr)
Tsuyoshi Kimura (Osaka University; kimura@mp.es.osaka-u.ac.jp)
Jeff Lynn (National Institute of Standards and Technology; jeffrey.lynn@nist.gov)

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. Included in this class 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. This Focus Topic explores the nature of various exotic states observed in bulk specimens of complex oxides 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. Note there is some overlap in topic with other DMP and GMAG sessions on oxides. The organizers of all of the related focus sessions will share information and work together to make an optimal meeting program.

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

Co-organizers: **Anand Bhattacharya** (Argonne National Laboratory; anand@anl.gov)
Chris Leighton (University of Minnesota; leighton@umn.edu)
Yayoi Takamura (University of California Davis;
ytakamura@ucdavis.edu)

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. The organizers of all of the related focus sessions will share information and work together with the March Meeting Program Committee to ensure an optimal meeting program.

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

Co-organizers: **Jordan Katine** (HGST; Jordan.Katine@hgst.com)
Joo-Von Kim (CNRS; joo-von.kim@u-psud.fr)
Jonathan Sun, (IBM; jonsun@us.ibm.com)

Spin-related effects in metals and in ferromagnetic heterostructures are generally robust and observable at room temperature. Discoveries such as giant and tunnel 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)

Co-organizers: **Jean Heremans** (Virginia Tech; heremans@vt.edu)

Hideo Ohno (Tohoku University; ohno@riec.tohoku.ac.jp)

Jairo Sinova (Texas A&M University; sinova@physics.tamu.edu)

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)

Co-organizers: **Collin Broholm** (Johns Hopkins University; broholm@jhu.edu)

Andreas Läuchli (Universität Innsbruck; andreas.laeuchli@uibk.ac.at)

Ashvin Vishwanath (University of California at Berkeley;
ashvinv@socrates.berkeley.edu)

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)

Co-organizers: **Christoph Boehme** (University of Utah; boehme@physics.utah.edu)
Gernot Guntherodt (Aachen University; gernot.guentherodt@physik.rwth-aachen.de)
Minn-Tsong Lin (National Taiwan University; mtlin@phys.ntu.edu.tw)

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. 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. Research at the intersection of several forefront areas in condensed-matter and material physics will be covered: spin injection at the metallic ferromagnet to graphene and inorganic to organic interface, the degree of spin polarization attainable by organic based solids, spin coherence and relaxation related to extrinsic spin-orbit coupling effects, hyperfine interaction between the electronic spin and nuclear magnetic moments, as well as magnetic exchange, magnetic ordering and correlation effects. 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.

10.1.8 Low-Dimensional and Molecular Magnetism (GMAG/DMP)

Co-organizers: **Stephen Hill** (Florida State University; shill@magnet.fsu.edu)
Stefano Carretta (University of Parma; stefano.carretta@unipr.it)
Sebastian Loth (Max-Planck Institute for Solid State Research; Sebastian.loth@mpsd.cfel.de)

The control and manipulation of spin and charge degrees of freedom in nanoscale systems has become a major challenge during the last decades, triggered by exciting applications in emerging technologies such as quantum computation and spintronics among others. For this goal to be accomplished, a complete understanding of the quantum behavior of interacting electronic and even nuclear spins in solid state systems is necessary. For conventional three-dimensional magnetic materials a robust framework for describing the low temperature structures, phase transitions, and excitations exists. However, when fluctuations are enhanced by low dimensionality, qualitatively new behavior can emerge. Low dimensional magnetic systems have become prototype systems in this direction. For example, the synthetic flexibility of molecule-based magnets allows the magnetic quantum response of the system to be engineered. This Focus Topic solicits abstracts that explore inorganic and organic molecule-based as well as solid state systems, and both theoretical and experimental aspects of the field. Topics of interest include: magnetism in zero, one, and two dimensions (e.g. quantum dots, single molecule magnets, spin chains, lattices), order by disorder, the role of magnetoelastic, spin-orbit and exchange couplings, quantum critical low dimensional spin systems, topological excitations, quantum tunneling of magnetization, coherence phenomena and novel field-induced behavior.

12. Complex Structured Materials, Including Graphene

12.1.1 Graphene: Synthesis, Defects and Properties (DMP)

Co-organizers: **Jun Zhu** (The Pennsylvania State University; jzhu@phys.psu.edu)
Luigi Colombo (Texas Instruments; colombo@ti.com)

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 (i) 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 (ii) methods of doping (iii) templated growth of nanostructures and bottom-up integration with other materials (iv) characterization and modeling of the structural, mechanical, electronic, and optical properties of the synthesized graphene, and (v) methods for transferring synthesized graphene to other substrates and the impact of the transfer process.

12.1.2 Graphene: Structure, Stacking, and Interactions (DMP)

Co-organizers: **Debdeep Jena** (University of Notre Dame; djena@nd.edu)
Randall Feenstra (Carnegie Mellon University; feenstra@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: (i) the physics of structurally or chemically modified graphenes, including the effect of defects, edges, adatoms, adsorbates, and strain on graphene's material properties, (ii) the physics of epitaxial graphenes, including the properties of multilayer graphene films, (iii) interactions of exfoliated or chemically grown graphenes with different substrates and the environment.

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

Co-organizers: **James Hone** (Columbia University; jh2228@columbia.edu)
Michael Fuhrer (University of Maryland; mfuhrer@umd.edu)
Deji Akinwande (University of Texas-Austin; deji@ece.utexas.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.

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

Co-organizers: **Eric A. Stach** (Brookhaven National Laboratory; estach@bnl.gov)
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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 existing and potential applications for interconnects, transistors, thermal management, composites, super-capacitors, nanosensors, nanoprobe, field emitters, storage media, and magnetic devices. Experimental and theoretical contributions are solicited in the following areas:

- Synthesis and characterization of nanotubes, nanohorns, and related nanostructures;
- Control or optimization of growth, including chirality 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 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; and
 - New generations of magnetic and electronic devices

12.1.5 Van der Waals Bonding in Advanced Materials (DMP)

Co-organizers: **Per Hyldgaard** (Chalmers University; hyldgaard@chalmers.se)
Roberto Car (Princeton University; rcar@princeton.edu)
Jacqueline Krim (North Carolina State University; jkrim@unity.ncsu.edu)

Van der Waals bonds occur in all materials and are particularly important in regions with low electron concentration. van der Waals forces impact material structure and behavior, both when they dominate the binding, and when they compete with other binding mechanisms like covalent or ionic binding. This topic session will focus on the materials physics of van der Waal interactions. It will highlight recent advances in theory, and applications that lead toward a deeper understanding, more quantitative descriptions, or establish links between van der Waals bonding and materials properties. Experimental work that details a van der Waals nature in cohesion or function and theoretical treatments of specific materials problems are featured to stimulate further experiment-theory exchange and open possibilities for stronger tests of materials modeling.

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

Co-organizers: **Richard Hennig** (Cornell University; rhennig@cornell.edu)
Kristin Persson (Lawrence Berkeley Laboratory; KAPersson@lbl.gov)

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 structure-composition 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: **Matthew Pelton** (Argonne National Laboratory; pelton@anl.gov)
David Smith (Duke University; drsmith@duke.edu)

Shaping materials on the sub-wavelength scale allows for an unprecedented control over light-matter interaction. Carbon nanomaterials, quantum-confined semiconductor nanostructures, and plasmonic metal nanoparticles all have size- and shape-dependent optical properties, while metamaterial structures provide unique opportunities to control 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.

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

Co-organizers: **Blanka Magyari-Kope** (Stanford University; blankamk@stanford.edu)
Seungbum Hong (Argonne National Laboratory; hong@anl.gov)

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: **James Rondinelli** (Drexel University; jrondinelli@coe.drexel.edu)
John Freeland (Argonne National Laboratory; freeland@aps.anl.gov)
Guus Rijnders (University of Twente; a.j.h.m.rijnders@utwente.nl)

The ability to achieve atomically precise interfaces between complex oxide compounds provides a platform to explore novel ground states through advances in materials physics, chemistry and theory, providing exciting directions for fundamental and applied research. Successes include stabilizing phases at the interface, which are absent in the bulk constituent oxides combined to create the heterostructure: magnetism, superconductivity ferroelectricity, orbitally ordered states, and two-dimensional electron gases along with examples of electric-field control over metal-insulator transitions. Crucial features of

these artificial materials include elastic strain, cation ordering, changes in symmetry and superlattice periodicity—features that modify the stability of new phases emerging in proximity to an interface due to interface-mediated interplay between the electronic, orbital, spin, and structural degrees of freedom. This focus topic aims at bringing together experimental and theoretical researchers working on all aspects of interface-related behavior in complex oxide materials. This includes the growth and characterization of oxide heterostructures, development and application of new interface-related measurement techniques, experiment and theory related to interface-induced changes in physical properties and new or modified interface-mediated macroscopic responses or collective states. Especially welcome are abstracts focusing on the search for new interface-related phenomena and the use of oxide interfaces as a test-bed for rational design of materials with desirable electronic, magnetic, and transport properties for technological applications.

There is some overlap in topic with other focus topics related to complex oxide materials; as a rule of thumb, if the interface plays a key role in the investigation or the properties observed, then the talk is appropriate for this focus topic.

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

Co-organizers: **Li Shi** (University of Texas-Austin; lishi@mail.utexas.edu)
Austin Minnich (California Institute of Technology; aminnich@caltech.edu)
David Singh (Oak Ridge National Laboratory; singhdj@ornl.gov)

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 $ZT = S^2 T / \rho k$ where S , ρ , k , 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. 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:

1. 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.
2. 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.

3. 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.
4. Device physics and interface physics, including innovations in device architectures based on different thermoelectric effects.
5. 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)

Co-organizers: **Ivan K. Schuller** (UC-San Diego; ischuller@ucsd.edu)
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Mark Ratner (Northwestern University; ratner@northwestern.edu)

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 electro-luminescence 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-electro-mechanical 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 Nanostructure Control, Novel Stabilizing Mechanisms, and Collective Dynamics in Epitaxial Growth (DMP)

Co-organizers: **Michael C. Tringides** (Iowa State University; mctringi@iastate.edu)
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Bene Poelsema (University of Twente; b.poelsema@utwente.nl)

This focus topic encompasses the ongoing investigation of epitaxial growth and nanostructure formation at surfaces and interfaces. The search to grow predictable nanoscale structures requires finding robust ways to control their dimensions, morphology, stability, and electronic properties. New properties can emerge on the nanoscale because of the reduced dimensionality, electron confinement, and low atom coordination. Ultrathin films, nanoislands, and quantum dots can be widely used in many areas in physics and material science relevant to microelectronics, spintronics, nanocatalysis, photonics, sensors, energy conversion, and computer memories. Hence, the session will be of interest to different communities aiming at nanostructure control.

A particular emphasis this year regards the recognition that building these nanostructures using fast and error-free methods requires efficient mass transport; but conventional random-walk type diffusion is stochastic and based on the motion of single atoms. Recently, novel collective processes were found in several systems, with nanoislands and nanoscale complex patterns built exceedingly fast and in some cases well below room temperature. The characterization of these processes with several experimental techniques (LEEM, STM, surface diffraction, TEM, etc.) and their theoretical modeling will lead to better understanding of nanostructure formation. It will also stimulate the search to discover other systems where collective transport, nanostructure self-organization, and predictability of structural and electronic properties of nanostructures become attainable.

16. General Theory/Computational Physics

16.1.8 Materials in Extremes: Bridging Simulation and Experiment

(DCOMP/DMP/GSCCM) [same as 18.5]

Co-organizers: **Ivan Oleynik** (University of South Florida; oleynik@usf.edu)
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The behavior of matter under extreme conditions of high pressures, high temperatures, high strains, and high strain rates is a scientific issue of fundamental importance, which requires understanding of the fundamental mechanisms of materials response at the atomic, microstructural, and continuum levels. Recent developments in the experimental realization of such extreme conditions in the laboratory, advances in ultrafast and ultra-high spatial resolution characterization, extensive efforts to extend simulations to experimental time and length scales by utilizing both the enormous increases in computational power and new simulation methods, all promise new scientific discoveries and important technological breakthroughs.

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) properties of matter in the warm dense regime; (4) ultrafast laser-matter interactions; (5) static high pressure and shock-induced materials behavior, including plasticity, phase transitions, and chemical reactions; (6) static and dynamic properties of energetic materials, including detonation phenomena;

and (7) new computational methods including development of interatomic potentials and multi-scale simulations.

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

Co-organizers: **Chris Johnson** (Argonne National Laboratory; cjohnson@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.