

DMP NEWSLETTER

Division of Materials Physics

A Division of The American Physical Society • www.aps.org/units/dmp

Summer 2003

Call For Invited Speaker Suggestions

Please find below the Division of Materials Physics Focused Topic program for the 2004 APS March Mtg. (Montreal, CANADA; March 22-26, 2004). Focused Topics include a number of sessions per topic with typically 1 invited speaker per session. The rest of the session consists of contributed presentations.

If you would like to make suggestions for invited speakers for a Focus Topic, you may use the web-based form, at http://positron.aps.org/wcgi/dmp_invited.pl, or contact the appropriate organizers (listed below) by Friday, Aug. 29, 2003. The web-based form will include fields for:

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DATES TO REMEMBER:

Aug. 29, 2003:
Deadline for Submitting
Suggestions for
Invited Speakers

Dec. 5, 2003
Abstract Deadline
(submitted via web)

March 22-26, 2004:
March Mtg. in Montreal,
Quebec, Canada

List of DMP-Sponsored or Co-Sponsored Topics and Sorting Categories for the 2004 APS March Meeting

- 2.9.2 Wide-band-gap Semiconductors
- 3.9.1 Dynamics in Ice
- 3.9.2 (Same as 14.9.5) Mechanical Properties of Glasses, Foams, Gels and Granular Media
- 3.9.3 (Same as 9.9.3) Lattice dielectric properties of complex oxides and interfaces (DMP/FLAP)
- 3.9.5 (Same as 14.9.4) Properties of Weakly Bound Adsorbates on Materials at the Nanoscale.
- 4.14.5 Organic Nano- and Mesostructures for Electronic & Photonic Applications (DMP/DPOLY)
- 6.11.1 Theory and Simulation of Magnetism and Spin Dependent Properties (DCOMP/DMP/GMAG)
- 6.11.2 Magnetic Nanostructures and Heterostructures (DMP/GMAG)
- 6.11.3 Magnetoresistance and Phase Complexity in Oxides
- 6.11.4 Spin Transport and Spin Dynamics in Metal-Based Systems (GMAG/DMP)
- 6.11.5 Spin-Dependent Phenomena in Semiconductors (DMP/GMAG)
- 7.9.1 Simulations and Theory of Complex Materials
- 7.9.2 Nanotubes and Nanowires: Devices and Applications
- 7.9.3 Light Emission from Silicon
- 7.9.4 Novel and Complex Oxides
- 7.9.5 Carbon Nanotubes and Related Nanomaterials
- 7.9.6 Computational Nanoscience (DAMOP/DCOMP/DMP)
- 7.9.7 Theory of Nanotubes and carbon Based Nanostructures (DCOMP/DMP)
- 9.9.1 Intrinsic Inhomogeneity in Multiferroic Materials
- 9.9.2 Metamaterials for Negative Refraction and Related Phenomena
- 12.9.1 Deformation, Friction and Fracture (DMP, joint with GSNP)
- 13.9.1 Asymmetrical Nanoparticles: Spheres, Rods, Disks and Complex Shapes
- 13.9.2 Optical Properties of Nanostructures and Nanophotonics
- 13.9.3 Materials for Molecular Electronics
- 13.9.4 Materials and Device Physics Issues for Quantum Computing
- 14.9.1 Mechanical Properties of Nano-structured Thin Films and Coatings
- 14.9.2 Growth, Stability and Dynamics of Nanostructures and Films.
- 14.9.3 Fundamental Challenges in the Transport Properties of Nanostructures
- 16.9.1 Front-End Materials and Processes for Scaled Silicon CMOS (FIAP/DMP)
- 19.9.1 Earth and Planetary Materials
- 19.9.2 Simulation of Matter at Extreme Conditions (DCOMP/DMP)

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- **Visa Information Website**
- **List of Sessions and Sorting Categories**
- **DMP 2004 March Mtg. Focused Topic Program - Call for Abstracts**

Call for Invited Speaker Suggestions, Continued...

- Nominator (affiliation, phone and e-mail)
- Suggested speaker (affiliation, address, phone, fax, e-mail and title of talk)
- Abstract justification (880 character limit)

Once the nominator completes the form, there is a “submit” button at the bottom of the page. The nomination submission is sent by e-mail to the proper focus topic organizer. If you contact the organizers directly, please include all the information listed above.

Contributed (and invited speaker) abstracts are due Dec. 5, 2003 at APS (submitted via web); contributors are welcome to send a duplicate copy to the organizers listed below, but please be sure to send the original to APS, on time, being sure that the abstract conforms to APS regulations.

Note that it is possible that the printed version of this newsletter delivered via the postal system might not reach you in a timely fashion, but we are also disseminating it electronically, so hopefully all interested members will have an adequate chance to participate in the process.

DMP 2004 March Meeting Focus Topic Program Call for Abstracts

2.9.2 Wide-band-gap Semiconductors

Wide-band-gap semiconductors have become a focus of intense basic and applied research, based on their current and projected use in numerous optoelectronic and electronic device applications. This DMP Focus Topic will include presentations on the growth, characterization, processing, and theory of wide-band-gap semiconductors and related alloys. Abstracts are encouraged for work that advances the state of the art from either fundamental or technological standpoints. Heterostructures, quantum dots, nanocrystals, and devices such as light emitters, electronic devices, and radiation detectors will be discussed. Materials systems to be considered include III-V nitrides, silicon carbide, II-VI semiconductors, and diamond.

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3.9.1 Dynamics in Ice

Ice is the most ubiquitous molecular solid found in nature. Like liquid water, however, ice is a much more complicated material than its everyday familiarity might lead one to assume. In particular, the surface structure and dynamics of ice have many features that remain incompletely understood despite the most intense scientific scrutiny. Furthermore, interactions of various other molecules with the

surfaces of crystalline and amorphous ice are of fundamental interest in many diverse areas of science from atmospheric chemistry to biology. Therefore, and despite its complexity, ice is often considered to be a model system for studies of fundamental properties of molecular solids. With the objective of advancing our current knowledge of the physics and chemistry of ice, we are soliciting abstracts on the following areas: microscopic structure of ices formed under various conditions; morphology and properties of ice/vapor, ice/solid, and ice/liquid interfaces; bulk and interfacial phase transitions; surface and bulk transport phenomena in ice; homogeneous, and heterogeneous ice nucleation; chemical reactions at ice interfaces; photochemistry at ice interfaces. We emphasize both novel experimental and computational and theoretical approaches.

VISA INFORMATION WEBSITE:

APS has set up a site with useful
visa information:

[http://www.aps.org/intaff/visa/
index.html](http://www.aps.org/intaff/visa/index.html)

You are urged to familiarize yourself with
it, especially if you anticipate any problems.

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3.9.2 (Same as 14.9.5) Mechanical Properties of Glasses, Foams, Gels and Granular Media

New experimental methods and expanded computational capabilities have provided increased insight into the fundamental processes by which disordered materials respond to stress. This focus topic will provide a forum for new research that aims to understand macroscopic mechanical behavior in terms of microstructural evolution in the absence of long-range order. As an integral part of this topic sessions will explore models of ageing, ripening and domain coarsening and their consequences for mechanical and rheological properties. Materials of interest include: wet and dry foams, gels, polymer glasses, metallic glasses, silicate glasses, granular materials, adsorbed monolayers, and other disordered systems. Contributions are sought regarding theory, experiment and simulations that pertain to plastic deformation, rheology, ageing, fracture and failure as well as shear induced dissipation, localization and phase separation. Of particular interest are applications of modern experimental methods to the characterization of the changes in structure that occur under applied stresses.

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3.9.3 (Same as 9.9.3) Lattice dielectric properties of complex oxides and interfaces (DMP/FIAP)

A thorough understanding of the lattice dielectric and piezoelectric properties of complex oxides, especially in the context of heterostructures and heterointerfaces, will be a prerequisite for much future device technology development. This session will focus on theoretical and fundamental

experimental advances in this area. Special attention will be given to perovskite ferroelectrics and their solid solutions, and to high-K dielectrics (including “alternative” epitaxial single-crystal perovskites as well as “conventional” transition-metal oxides and silicates) and their interfaces with Si or GaAs. Some of the areas to be included are: computation of lattice dielectric and piezoelectric properties (including dynamical charges) at various levels of theory, from ab-initio or quantum-chemical methods to effective-Hamiltonian approaches to semi-empirical schemes; understanding of how the lattice dielectric constant varies with crystal structure, composition, and chemical substitution; role of soft modes in dielectric and piezoelectric response; the consequences of band alignment, charge accumulation, and defects for the properties of semiconductor-oxide interfaces; and novel effects of electrostatic boundary conditions, such as electric-field induced structural phase transitions.

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3.9.5 (Same as 14.9.4) Properties of Weakly Bound Adsorbates on Materials at the Nanoscale.

Weakly bound adsorbates provide examples where fundamental issues of energy transfer and energy dissipation can be tracked in nanoscale structures. The dynamics of the adsorbates are an essential component of understanding macroscopic phenomena such as friction. The recent progress in the experimental capabilities of atomic-scale imaging, quasi-elastic scattering, and the control of materials could be exploited more readily by the promotion of constructive interactions with the community that studies weakly-bound adsorbates using experimental, analytical and simulation based techniques. This focus topic will emphasize the structure and dynamics of weakly bound adsorbates on metallic and graphitic materials and the modeling of relaxation and dissipative processes in such systems. Adsorbates to be included are inert gases, small molecules such as H₂ and N₂, and larger molecules such as the alkane series. Submissions on new or improved experimental and theoretical techniques are encouraged.

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4.14.5 Organic Nano- and Mesostructures for Electronic & Photonic Applications (DMP DPOLY)

Organic based devices are being actively investigated for a wide range of applications. This focus topic considers the latest developments in electronic and photonic materials and structures comprising organics. Contributions are solicited in the areas of organic semiconductor device physics (e.g., FETs, LEDs, photovoltaics, lasers, and sensors), theories and measurement of transport, optical, and magnetic and spin properties in molecular-scale devices as well as other novel device structures and materials systems. Also sought are contributions on non-linear optics, photonic devices, photonic crystals, and nano-photonic structures involving organics.

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6.11.1 Theory and Simulation of Magnetism and Spin Dependent Properties (DCOMP/DMP/GMAG)

The purpose of this focus topic is to explore recent advances in theory and modeling of magnetic and spin dependent properties of materials. The topic will include methods and materials systems as well as magnetic and spin dependent properties. Of particular concern are magnetic materials in reduced dimension where surface and interface effects become increasing dominant and influence the spin structure, spin dynamics and spin transport. Thus it is expected that a significant part of this focus topic will be devoted to theoretical and computational issues in connection with magnetic nanosystems such as 2D-multilayers, 1D-wires, 0D-particles, molecules, and impurities; including metals, alloys, magnetic semi-conductors, magnetic oxides and magnetic molecules in various environments (isolated structures as well as embedded in the bulk and on surfaces). Properties include magnetic structure, mechanisms of exchange coupling, anisotropy, spin-dynamics, damping mechanisms, domain structure, hysteretic phenomena, phase transitions, magneto-optics, spin-transport, spin injection and quantum tunneling. Methods include first principles density functional theory based methods (LDA, etc) as well as new developments for strongly correlated systems (such as LDA plus dynamical mean field theory), spin models, Monte Carlo and spin dynamics methods, and micromagnetic modeling. Of particular interest

are methods for multiscale modeling that bridge length scales and approaches to extend the time scale of simulations.

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6.11.2 Magnetic Nanostructures and Heterostructures (DMP/GMAG)

The magnetic properties of nanometer-scale structures can differ significantly from bulk properties, giving rise to interesting and technologically important behavior. This focus topic will cover magnetic structures such as thin films, multilayers, nanocomposites, nanowires, nanoparticles, nanoparticle arrays, and patterned films. All aspects of these structures are of interest, including theory, fabrication, characterization, measurement, and modeling. Areas of interest include low-dimensional magnetism, proximity effects, interlayer magnetic coupling, exchange spring, exchange bias, magnetic quantum confinement, magnetic anisotropy, effects of structural disorder, hysteresis, coercivity enhancement, and other magnetic phenomena. Of special interest are the fabrication of nanostructures with atomic-scale control, synthesis and assembly of nanoparticles and arrays, high-resolution characterization methods with site and/or element specificity, novel techniques for the creation of nanoscale magnetic features, and unusual physical phenomena present in these systems.

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6.11.3 Magnetoresistance and Phase Complexity in Oxides

The complex nature of transition-metal oxides such as manganites, cobaltites, and ruthenates, display a variety of interesting physical phenomena including colossal magnetoresistance (CMR), half-metallicity, ferro and antiferromagnetic, charge- and orbital-ordering, as well as phase separation and

percolative properties both at the nano and mesoscopic scales. This focused topic will address experimental, computational, and theoretical investigations in this context, both of fundamental and applied nature. Among the main goals is to understand the relation between magnetic and electronic properties with other physical phenomena such as magneto-transport, lattice, elastic and magnetic excitations, surface behavior, and electron correlation effects. The similarities between the many compounds will be emphasized. Analogies with materials that also present nanoscale inhomogeneities, such as the high-Tc cuprates, will be addressed.

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6.11.4 Spin Transport and Spin Dynamics in Metal-Based Systems (GMAG/DMP)

This focus topic concerns experimental and theoretical investigations that elucidate and/or utilize the transport and transfer of spin, at the nanoscale, in metal-based magnetic systems. Studies that emphasize spin phenomena in semiconductor systems will be covered in a separate focused topic. Topics of interest include all aspects of spin-dependent transport and scattering, in the diffusive, ballistic, “tunneling and hot electron transport regimes as evidenced, for example, in giant magnetoresistance (GMR), tunneling magnetoresistance (TMR), ballistic magnetoresistance, tunneling spectroscopy of spin states, spin filtering and related effects. Also of particular interest are studies of the transfer of spin between charge carriers and magnetic elements resulting in either the excitation or damping of the magnetic element, and the use of magnetoresistance and spin-transfer phenomena to investigate nanomagnetic behavior and dynamics. Additional topics include, but are not limited to, interfacial spin transport, spin injection and spin lifetime studies in ferromagnetic — normal metal and ferromagnetic- superconductor systems, as well as the use of such systems to study spin polarization.

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6.11.5 Spin-Dependent Phenomena in Semiconductors (DMP/GMAG)

The field of spin-dependent phenomena in semiconductors has developed rapidly in the past several years. Considerable progress has been realized in electrical injection, transport, manipulation and detection of spin-polarized carriers in semiconductor heterostructures. Optical and high-speed electrical manipulation of electron spin coherence, and polarization/imprinting of the nuclear spin system in GaAs by an adjacent ferromagnet has been explored and demonstrated. The understanding and control of ferromagnetic order in semiconductor hosts such as the III-Mn-V alloys has significantly improved, and offers great potential for new device functionality. A number of new semiconducting materials which exhibit ferromagnetism at relatively high temperatures (in some cases in excess of 300 K) have been reported, although many of these materials remain to be fully characterized and the origin of their ferromagnetism clarified. In addition, room temperature magnetoelectronic devices such as magnetic tunnel junctions and magnetic tunneling transistors continue to develop rapidly. For example, giant magnetocurrents (>3400%) with large output currents have recently been reported for GaAs magnetic tunneling transistors. This focus topic solicits abstracts in each of these areas. Abstracts of particular interest include: magnetic semiconductors: fabrication, characterization and theory, clarification of the origin of high temperature ferromagnetism in semiconducting hosts; manipulation of electron and nuclear spin in quantum structures; electrical spin injection into semiconductors from magnetic metals and semiconductors; magnetoelectronic devices including spin-LEDs, spin transport/manipulation in heterostructures such as spin-FETs, magnetic tunnel junctions involving semiconducting barriers or functional integration with semiconductors, magnetic tunneling transistors.

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7.9.1 Simulations and Theory of Complex Materials (DCOMP/DMP)

Advances in computational methods to address materials and condensed matter problems continue to develop in producing exceedingly realistic simulations of physical phenomena as well as providing predictions and enhancement

of various properties for length and time scales that span from the subatomic, to atomic, to mesoscopic and even to the continuum limit. In this focused topic the recent progress in such simulations will be demonstrated for a wide spectrum of applications. Here complex systems signify those systems with spatial complexity, systems with a large number of structural units (atoms or molecules) and/or systems of multidimensional and multi-component character. The computational approaches may include implementation of large scale density functional calculations, model Hamiltonians in many-body theory, simulations based on empirical potentials, as well as Monte Carlo, coarse graining, accelerated dynamics and kinetic theory techniques. Applications of these methods are suitable to simulate the behavior of periodic, disordered and defect-containing systems including metallic, semiconducting, insulating and magnetic states of matter. Abstracts with applications to biological systems and those that directly link computational findings to experimental data are also encouraged.

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7.9.2 Nanotubes and Nanowires: Devices and Applications

Carbon nanotubes and semiconductor nanowires are seeing a rapid increase in interest in their applications to nanoscale devices. This focus topic concerns recent developments in the science and technology of nanotube and nanowire devices. This includes, but is not limited to: (i) applications of nanotubes and nanowires to electronic, mechanical, electromechanical, electro-optic, and sensing devices, (ii) the theory of operation of nanotube and nanowire devices (iii) the physics needed to understand the materials properties of nanotubes and nanowires relevant to device applications, and (iv) understanding and controlling materials synthesis, assembly, functionalization, etc. for the purpose of controlling device performance. Experimental and theoretical submissions are solicited in the following topical areas: a) electronic devices (e.g. transistors, Schottky and Ohmic contacts), b) electro-optic devices (e.g. photoelectric effects, light emitting diodes), c) mechanical, electromechanical, and field-emission devices

(e.g. field-emission tips, mechanical resonators, mechanical switches, scanned probe tips), and d) chemical and biological sensors.

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7.9.3 Light Emission from Silicon

One of the significant challenges in silicon technology has been the development of an efficient light emitter. Several recent developments have catapulted silicon light emission into the headlines, promising room temperature lasing in the near future. Several different approaches have been used to increase internal efficiencies to more than 10%. In this focus topic we plan to evaluate progress and discuss the physics of visible and near IR light emission from silicon-based light emitters. The areas of interest are: (1) silicon nanostructures – nano-crystalline (nc) Si, quantumwires, quantumdots; (2) Er-based light emission of silicon-based materials; (3) Efficient intrinsic and impurity-related light emission in silicon.

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7.9.4 Novel and Complex Oxides

Transition metal oxides (TMOs) have been at the forefront of materials physics since the discovery of superconductivity in the cuprates in 1986. In general, TMOs are characterized by physical complexity resulting from the coexistence and competition between different kinds of order involving charge, orbital, lattice, and spin degrees of freedom. The complexity of TMOs is directly responsible for their tunability; the bal-

ance between competing phases is subtle and small changes in the composition of a sample or its external environment can produce large changes in its physical properties. An astonishing variety of ground states and new phenomena have been uncovered in recent years. It is both their complexity and tunability that make TMOs attractive for applications. This focus topic concerns novel phenomena and new forms of order in oxides other than the well-studied cuprates and manganites.

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7.9.5 Carbon Nanotubes and Related Nano-materials

Broad interest in the fundamental properties of carbon nanotubes and their exploitation in a wide range of applications continue at an increasing pace, due in large part to their unique chemical, mechanical, thermal, optical and electrical properties. This focused topic concerns recent developments in (i) the fundamental understanding of nanotube synthesis, processing, purification, electrical, optical, thermal, mechanical, and chemical properties, and (ii) on potential applications, other than nanoelectronic devices, such as nanosensors, nanoprobe, field emitters, display devices, composite materials, and high surface area storage media. Experimental and theoretical contributions are solicited in the following areas: a) synthesis and characterization of carbon nanotubes, nanohorns, and nanotube peapods, b) optical spectroscopy of carbon nanotubes, c) electrical transport in carbon nanotubes, d) thermal and magnetic properties of carbon nanotubes, e) mechanical properties of nanotubes and their composites, f) chemical functionalization, properties, and separation techniques g) electronic properties and devices, h) gas adsorption and storage, i) field emission, j) structure and properties of filled carbon nanotubes, k) multifunctional nanotube composites, and l) other experimental and theoretical results from quasi-one dimensional systems which relate to carbon nanotubes.

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7.9.6 Computational Nanoscience (DAMOP/DCOMP/DMP)

Nanometer-scale physical systems often possess basic physical properties - electronic structure, chemical coordination, transport coefficients, and the like - that are distinctly different from those of single atoms or molecules and those of bulk materials. First-principles simulations play an increasingly important role in understanding the structure and dynamics of nanoscale systems, and are coming to have predictive value for custom design of these new materials. Papers are solicited in all areas of first-principles simulation of nanoscale systems, with a focus on discovery of novel physical and chemical properties.

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7.9.7 Theory of Nanotubes and carbon Based Nanostructures (DCOMP/DMP)

Within the few years since their discovery, carbon nanotubes have emerged as pioneering materials of the flourishing research field of nanotechnology. This field experienced a rapid expansion with the recently realized ability of creating new complex carbon-based nanostructures. Some of these are obtained by functionalizing nanotubes or filling them with nanostructures such as fullerenes, others are very different carbon-based nanostructures such as schwarzites or diamondoids. All of these systems exhibit an ever expanding range of intriguing physical phenomena. Unlike in other emerging areas of nanotechnology, research effort in carbon nanostructures has been driven by theoretical predictions of unexpected properties such as their conductance depending crucially on their chirality, their high mechanical rigidity and toughness, their unusual high thermal conductivity. Other fundamental predictions, such as realization of one-dimensional magnets or the statistics of the electron gas related to that of a Luttinger liquid, have not yet been confirmed definitely by the experiment. This focus topic is designed to provide an updated and comprehensive overview of the recent theoretical work in the field of nanotubes and carbon based nanostructures. Theoretical abstracts are solicited to address all issues related to nanotubular materials, their composites, and other carbon based nanostructures including nanocrystalline

diamond, fullerenes, metallofullerenes, and nanotube peapods. Subjects to be covered include: growth, structural, mechanical, electronic, transport, optical and field emission properties, electronic excitations and correlation effects, phenomenology, device development, functionalization, and energy storage.

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9.9.1 Intrinsic Inhomogeneity in Multiferroic Materials

This is a focus topic on the ubiquitous presence of intrinsic inhomogeneity (as opposed to disorder induced extrinsic inhomogeneity) in complex multiferroic materials such as perovskite manganites and cuprates, shape memory alloys, magnetic martensites and relaxor ferroelectrics in both thin film and bulk form. These are examples of materials where elasticity, by itself or coupled with other functionalities, plays a crucial role in determining the inhomogeneity observed at nanoscale which in turn leads to anomalous properties of these materials, particularly just above the relevant transition temperature and below a certain temperature T^* . Materials that have a strong coupling between two or more magnetic, electric, and structural order parameters, resulting in simultaneous ferromagnetism and/or ferroelectricity and/or ferroelasticity, are known as multiferroics. Most multiferroic materials exhibit complex structures with many atoms per unit cell. The origin of multiferroic behavior and the accompanying inhomogeneity as well as the nature of the coupling between the magnetic, electric polarization, and structural order parameters are not well understood. One approach to the inherent complexity and intrinsic inhomogeneity is to merge techniques from traditional materials science, statistical physics and nonlinear condensed matter to relate nano/mesoscale materials structure to local (e.g. electronic or magnetic) functionalities. This focused topic aims at fostering dialogue among experimentalists and theorists, bringing scientists together from academia and industry, identifying key questions, and seeking broader understanding and a common language.

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9.9.2 Metamaterials for Negative Refraction and Related Phenomena

This focus topic will address the emerging field of electromagnetic metamaterials. Areas of interest include fundamental aspects of negative refraction and their implication for novel optical elements such as perfect lenses and antennas. Both bulk effective medium and transmission line approaches will be discussed. Of particular interest is the possibility of metamaterials that exhibit negative refraction at terahertz and beyond.

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12.9.1 Deformation, Friction and Fracture (DMP, joint with GSNP)

This focused topic will explore recent developments in the areas of deformation, friction and fracture in materials; research areas that have recently drawn renewed interest within the physics community. Areas of interest include: dislocation patterning and strain localization in materials; scaling behavior and size effects; brittle/ductile transition phenomena; high strain rate effects; fracture initiation and dynamic crack propagation, including earthquake mechanics; avalanches; tribological contact in solid and/or granular materials; microstructure, interfacial and grain boundary effects; nanoscale mechanics. The topic welcomes experimental, theoretical, and/or numerical studies of atomistic, mesoscopic, statistical, and multiscale aspects of deformation, friction, and fracture instabilities in various classes of solids, including granular, crystalline, amorphous, and nano-structured solid systems of metals, ceramic, glasses, or polymeric type.

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13.9.1 Asymmetrical Nanoparticles: Spheres, Rods, Disks and Complex Shapes

Recent work on nanometer scale particles has uncovered a wealth of quantum effects and changes in electronic and magnetic properties. In this focus topic, we invite submissions of research on single or multicomponent nanoparticles. spherical, and especially non-spherical (such as rods, disks and more complicated shapes) nanoparticles of metals, semiconductors, and insulators are all of current interest. The reduced of asymmetrical nature of the nanoparticles creates opportunities for deep understanding of nanoscale materials properties ranging from electric/magnetic interactions and coupling to mechanical control and assembly. Asymmetrical nanoparticles, and libraries of them, can be made by colloidal chemistry and electrochemistry, as well as by micro-, and nano lithographic techniques. These particles may exhibit “easy” and “hard” directions of magnetization, alignment in electromagnetic fields, phase transitions, and anisotropic transport properties (spin, electron, phonon, or photon). Abstracts are sought in modeling (band structure calculations, micromagnetic simulations, spin transport, mechanical motion in a fluid) and in experiment (nanoparticle synthesis, characterization, self-assembly, and applications).

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13.9.2 Optical Properties of Nanostructures and Nanophotonics

Recent advances in materials research and novel structure designs have brought the dimensions of photonic structures and devices to the scale of the wavelength of the light they emit, transmit, and detect. In this realm, quantum nature of light dominates, enabling more efficient and fast devices. The nano-photonics with unprecedented characteristics could have a huge impact in world's economy as well as in our daily lives. However, fundamental issues including the reduced size effects (and surface effects) on the optical and optoelectronic properties, light and matter interaction, spin-carrier interaction, and carrier dynamics in nano-scale structures and devices must be fully explored before their potential becomes a reality. The aim of this focused topic will be on fundamental and technical challenges of nanostructures and photonic devices, emphasizing optical and optoelectronic properties of these systems. Areas of interest include but not limited to: optical and optoelectronic properties of nano-scale structures and devices, epitaxial

growth, smart self-assembling and patterning methods for nano-structures and devices, novel physical properties of extremely high quantum efficiency nano-photonic structures and devices, the interaction between light and matter in the both weak and strong coupling regimes, quantum optics concepts in nanophotonic structures and devices, nano-optical spectroscopy studies. Both experimental and theoretical contributions in these and other related areas are solicited.

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13.9.3 Materials for Molecular Electronics

This focus topic will address issues surrounding the use of materials for the emerging field of molecular electronics. Materials will range from single-molecule to single crystals (e.g. pentacene) of molecular conductors. We will address linear and nonlinear transport, trapping mechanisms, and field effect devices. Of special interest are abstracts that address the differences between single crystal (or molecule) conduction and polycrystalline conduction, especially for device applications.

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13.9.4 Materials and Device Physics Issues for Quantum Computing

The area of quantum computing has emerged in the past decade from a theoretical curiosity to a significant sub-field of many physics departments and other research institutions. The time seems ripe for a more concerted effort to explore materials and device issues for potential hardware realizations of important quantum computing and quantum information science applications. This focused topic is aimed toward this goal: to define the current state-of-the-art of quantum computing strategies and hardware devices, to define new device concepts and materials issues associated with them, and to determine the limitations of current proposed quantum computing devices and strategies. Abstracts in any of these areas are encouraged. For further information please contact

one of the co-organizers listed below.

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14.9.1 Mechanical Properties of Nano-structured Thin Films and Coatings

A variety of materials with microstructures at the nanometer scale are being developed for application in microelectronic devices, data storage, imaging, and MEMS/NEMS. These materials often derive their functional properties from their extraordinary microstructure. Thus, understanding the mechanical behavior of materials with nanometer scale microstructures is essential in order to ensure optimum design and reliability of this type of devices. The goal of the focus topic is to provide a discussion forum for researchers in the area of thin-film mechanics, with a particular emphasis on nano-structured thin films and coatings. Areas of interest include but are not limited to the mechanical behavior of nano-structured thin films, theoretical models describing the mechanical behavior of these films, new experimental techniques for studying mechanical properties on the nanometer scale, mechanisms for residual stress development in nano-structured coatings, and the role of mechanics in the development of nanoscale microstructures.

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14.9.2 Growth, Stability and Dynamics of Nanostructures and Films.

The controlled growth of nanostructures and films represents one of the largest fundamental problems in materials physics. An understanding of why these structures form, the dynamics of their growth, if and why they are stable, and the physical forces that determine their morphology are the core problems for next generation electronics. This focus

topic will be concerned with recent experimental and theoretical developments associated with the growth, structure, and electronic properties of nanostructures, and 2D thin films and interfaces.

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14.9.3 Fundamental Challenges in the Transport Properties of Nanostructures

Nanotechnology has become one of the most prominent and visible disciplines in science and technology, encompassing fields as diverse as physics, chemistry, engineering and biology. The technology of “small structures” holds great promise for revolutionary applications ranging from microelectronics to medical research. However, many key challenges remain to be addressed, and fundamental issues await exploration and understanding. This focus topic concerns the outstanding challenges in understanding the transport phenomena of nanostructures and in exploiting them to design and build novel devices. We include here the synthesis, characterization and modeling of nanostructures, and their relation with novel transport properties. Semiconductor nanostructures and metallic and magnetic nanoparticles will be discussed, with potential applications such as electronic components, interconnects, heat sinks, lasers, photovoltaics, waveguides, and biological labels and sensors. This focus topic will include experimental, theoretical and computational abstracts, with special emphasis on inter-disciplinary contributions.

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16.9.1 Front-End Materials and Processes for Scaled Silicon CMOS (FIAP/DMP)

As silicon CMOS continues to scale, innovative physics and

chemistry research becomes increasingly crucial. Scaling is no longer simply reducing dimension to improve speed and density. Many new materials are being introduced to improve performance, including advanced high-k gate dielectrics, new approaches to fabricating poly-Si gates, metal gates, strained silicon-germanium alloys, strained silicon channels on relaxed SiGe buffers, nanoparticles, ferroelectrics for embedded memories, barrier materials, and single electron devices. There are also many new processes being developed to facilitate scaling, such as laser doping, atomic layer chemical vapor deposition, and epilayer formation. This focus topic concerns the physics and chemistry associated with these new materials and processes, and how they will impact the performance and reliability of silicon integrated circuits. Abstracts are solicited in all aspects of materials, processes, performance, and reliability of scaled silicon for the 90 nm node and beyond. There is also an interest in ideas for novel materials and processes that are beyond the current roadmap, and that provide new functionality to silicon such as wafer bonding and the integration of molecular devices with silicon.

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19.9.1 Earth and Planetary Materials

Materials physics, theoretical or experimental, focuses its attention mainly on technological, man-made materials, usually produced under strict control. We feel it is appropriate and desirable to introduce a focused topic concentrating on natural, earth and planetary materials. Technological-methodological advances in materials physics have encouraged the exploration of more challenging, complex, or imperfect materials in the last decade. The result has been a greater interest and activity in the area of earth and planetary materials (as well as biomaterials). We want to explore research in this area, the technological edge that makes it possible, and the science that inspires it. The range of thermodynamic

conditions spanned by these materials is enormous and the types of materials produced are mind-boggling - ices, rocks, fluids, and plasmas. The focus topic will be organized around these factors.

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19.9.2 Simulation of Matter at Extreme Conditions (DCOMP/DMP)

Such varied phenomena as the atmosphere of a white dwarf star, the interior of an extrasolar planet, an atomic cluster subjected to an intense radiation field, shock compression phenomena, or a cell membrane under strain, all represent basic materials under extreme conditions. Despite their diversity, a close correlation exists among the methods employed in the description of these media. This focused topic concerns recent advances in theoretical and computational studies and methodologies applied to metallic, organic/inorganic, and biological materials as well as liquids, plasmas, and atomic/molecular clusters exposed to high pressures, temperature extremes, external fields, or interactive environments. Contributed and invited presentations will include such diverse computational approaches as atomistic (quantum, semi-classical, and classical), mesoscopic (grain-scale), continuum, and multi-scale. Representative scientific areas of interest are: 1) deformation and fracture, 2) equation of state, 3) phase transitions, 4) chemical events, 5) shocked energetic materials, 6) unusual behavior, 7) intense field interactions, 8) biological systems, and 9) environmental effects.

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