DMP NEWSLETTER
Division of Materials Physics

A Division of The American Physical Society • www.aps.org/units/dmp Summer 2016

In this Issue

IMPORTANT DATES

August 29, 2016 Deadline for submitting invited speaker suggestions for DMP Focus Topics.

November 11, 2016 (Friday) by 5pm EST Abstract deadline for the 2017 APS March Meeting. Submission is via the web at http://abstracts.aps.org

November 18, 2016 Deadline DMP Ovshinsky Student Travel Awards.

November 18, 2016 Deadline DMP Post Doctoral Travel Awards.

March 13–March 17, 2017 (with tutorials, etc. March 11-12) APS March Meeting in New Orleans, Louisiana.

The contents of this Newsletter will be available electronically on the DMP website at http://www.aps.org/units/dmp. Corrections or updates will also be posted at this location.

A Note from the Chair

Throughout the spring and summer months your DMP Executive Committee has been hard at work, and it is my pleasure to bring you an update on our progress as well as a call for your participation in upcoming important DMP activities.

At the top of this list is our preparation for the APS March Meeting to be held in New Orleans, March 13-17, 2017. Developing and running the strong slate of diverse DMP Focus Topics that comprise one of the largest blocs at the March Meeting is a year-long process. Focus Topic sessions provide a high profile venue for contributed talks at the March Meeting as a typical Focus Topic session has one invited talk and twelve contributed talks, and ideally a series of sessions related by the topic will run sequentially in the same room. This year, the Program is in the able hands of DMP Chair-Elect, Dan Dessau, with help from the entire Executive Committee. As detailed in this newsletter, Dan has assembled a strong line-up of 19 Focus Topics, each organized by leaders in their respective fields. From 2D Materials, to Complex Oxides, to superconductors to topological materials, 2017 is shaping up to be another outstanding showing for the DMP-led part of the program.

Now it's your turn: I encourage you to look over these Focus Topic descriptions and to please encourage your students and colleagues to contribute abstracts to those sessions most closely related to their work; contributed talks breathe life into the sessions and are an excellent opportunity for younger scientists among us to showcase their work to a receptive audience. In addition please nominate invited talks for these Focus Topics either through the DMP link or by emailing the organizers directly. Further information is below.

In addition to running an important part of the March Meeting, DMP sponsors or co-sponsors a number of awards, and we likewise depend on DMP membership to nominate or support candidates for receiving these awards.

For those of you who have nominated candidates for the James C. McGroddy Prize for New Materials, and the David Adler Lectureship in Materials Physics, I thank you. Nominations are time consuming and take considerable thought, and no one wins without strong backing. This is the third year of the Richard L. Greene Dissertation Award in Experimental Condensed Matter Materials Physics. Having chaired last year's session, I can attest to the value of such an award to the early career scientists it recognizes. We are grateful to Rick for this philanthropic contribution and expect to see many deserving candidates from which to choose the second annual award. Please consider nominations for this award for March Meeting 2018. The nomination deadline is July 1, 2017. Please see www.aps.org/programs/honors/dissertation/greene.cfm for full details.

This year DMP will be making Post Doctoral Travel Awards. Please consider the application process, detailed below.

DMP also recognizes the Young Scientist Prize in the Structure and Dynamics of Condensed Matter Physics. The International Union of Pure and Applied Physics (IUPAP), Commission 10, awards this prize and the winner is recognized with an invited talk in a DMP-sponsored Symposium, and at our Reception at the March Meeting.

Student presenters are invited to apply for a Stanford and Iris Ovshinsky Student Travel Award. These highly competitive and prestigious awards are available to students whose abstracts are submitted to DMP-sponsored contributed sessions. The award provides travel support, and the awardees will be publicly recognized in our Reception at the March Meeting.

Finally, this is my opportunity to thank the members of the DMP Executive Committee who have recently completed their service. I thank them for their generous donation of time and expertise in serving the DMP community. These are: Julie Borchers and David Tanner who have stepped down as Members at Large. I also want to give a special thanks to Laura Greene who has completed four years of leadership as Vice-Chair, Chair-Elect, Chair, and Past-Chair of the Division of Materials Physics. Laura has provided invaluable advice to me over the past couple of years, making my job a lot easier. Thank you, Laura!

Enjoy the rest of your summer, and I look forward to seeing you in New Orleans!

—Michael Flatté, DMP Chair

The Division of Materials Physics March Meeting Post Doctoral Travel Awards

To recognize innovative materials physics research by post doctoral researchers, the Division of Materials Physics has initiated March Meeting Post Doctoral Travel Awards. The Awards are supported by the Division of Materials Physics.

We anticipate that there will be four $800 Travel Awards in 2017 to support participation in DMP Focus Topic sessions at the APS March Meeting sessions. The selection will be based on the research quality, the impact of the research at the March Meeting and the innovative contribution of the post doctoral researcher, The selection committee will consist of members of the DMP Executive Committee.

Post doctoral researchers interested in being considered for an award must apply online (to be updated).

The Division of Materials Physics Ovshinsky Student Travel Awards

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

We anticipate that there will be ten $500 Travel Awards and ten $150 Honorable Mention recognitions each year to enable students to participate in the APS March Meeting sessions that are sponsored by the Division of Materials Physics. The selection will be based on merit and the committee will consist of the following officers of the Division of Materials Physics: Secretary/Treasurer, Vice Chair and Past Chair. Students interested in being considered for an award must apply online (to be updated).

The Ovshinsky Student Travel and Honorable Mention Awards were presented at the 2016 March Meeting and were listed in the 2016 Winter DMP Newsletter.

Nominations for DMP Officers and Executive Committee Members

The DMP Officer election will be held late in 2016 to elect a Vice-Chair, a Secretary-Treasurer, a Divisional Councilor, and two new at-large Executive Committee Members. According to the Bylaws, the Nominating Committee shall nominate at least two candidates for the ballot for each office. We are inviting your suggestions for candidates, which should be emailed to the DMP Past Chair, John Mitchell, (mitchell@anl.gov) by September 15, 2016.

It is important to remember the membership of APS is diverse and global, so the Executive Committees of the APS should reflect that diversity. Nominations of women, members of underrepresented minority groups, and scientists from outside the United States are especially encouraged.

In addition, candidates can be directly nominated by petition of five percent of the membership of the Division. Such petitions must be received by the DMP Secretary/Treasurer, Robert Nemanich (robert.nemanich@asu.edu) by October 1, 2016.

DMP Focus Topics for the 2017 APS March Meeting

With this issue of the Newsletter, the Division of Materials Physics announces the program of DMP Focus Topics for the 2017 APS March Meeting (New Orleans, Louisiana, March 13 – March 17, 2017). 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.

For the 2017 March Meeting, DMP is the lead organization unit on 19 different Focus Topics and co-sponsoring unit for an additional 15. See lists below. We encourage Invited speaker nominations for the DMP led Focus Topics. Deadline: Aug. 29, 2016. Submission: http://www.aps.org/units/dmp/meetings/invited.cfm

In suggesting speakers please keep in mind that speakers who gave an invited talk at the previous March Meeting are ineligible. Your nomination will go to the organizers of the Focus Topic for which you have suggested a candidate and will aid the organizers in their selection of invited speakers.

The DMP Executive Committee

Chair: Michael E Flatté, Univ of Iowa (04/16–03/17)
Chair-Elect: Dan Dessau, Univ of Colorado Boulder (04/16–03/17)
Vice Chair: Amanda K Petford-Long, Argonne Natl Lab (04/16–03/17)
Past Chair: John F Mitchell, Argonne Natl Lab (04/16–03/17)
Councilor: James Robert Chelikowsky, Univ of Texas, Austin (01/13–12/16)
Secretary/Treasurer: Robert J Nemanich, Arizona State Univ (04/14–03/17)

Members-at-Large:
Emilia Morosan, Rice Univ (04/14–03/17)
Jeffrey B Neaton, Lawrence Berkeley Natl Lab (04/14–03/17)
Peter M Gehring, NIST - Natl Inst of Stds & Tech (04/15–03/18)
John Singleton, Los Alamos Natl Lab (04/15–03/18)
Scott Chambers, Pacific Northwest Natl Lab (04/16–03/19)
Michelle Dawn Johannes, Naval Research Lab (04/16–03/19)

2016 March Meeting Awards Reception

Dr. Wenzhong Bao receives recognition for the IUPAP 2016 Young Scientist Prize (C10 Commission on Structure and Dynamics of Condensed Matter). With Dr. Bao are (L to R) Sharon Glotzer (DCMP Chair), Laura Green (DMP Past Chair) and John Mitchell (DMP Chair). (APS photo|Ken Cole)

2016 Ovshinsky Student Travel and Honorable Mention Award winners together with John Mitchell (DMP Chair, right) and Bob Nemanich (Secretary/Treasurer, left). (APS photo|Ken Cole)

2016 APS-DMP Fellows Awards Recipients together with DMP Executive Members (right) John Mitchell (Chair) Michael Flatte (Chair Elect), Dan Dessau (Vice Chair), Left Bob Nemanich (Sec/Treas) and Laura Greene (Past Chair). (APS photo|Ken Cole)

List of DMP-Sponsored or Co-Sponsored Focus Topics and Sorting Categories for the 2017 APS March Meeting

7.1.1: Dielectric and Ferroic Oxides [Same as 11.1.1]

Organizers:
Guangyong Xu (Brookhaven National Laboratory) gxu@bnl.gov
Eric Cockayne (National Institute of Standards and Technology) eric.cockayne@nist.gov

Complex oxides exhibit a rich variety of order parameters, such as polarization, magnetization, strain, charge and orbital degrees of freedom. The vast range of functional properties that emerge from their mutual coupling (e.g., ferroelectricity, magnetoelectricity, multiferroicity, metal-insulator transitions, defect-related properties) are the main topics of interest for this symposium. Examples of current grand challenges include:

- Novel mechanisms to break inversion symmetry in heterostructures and layered oxides.
- Viable routes to achieve a strong coupling between polarization and ferromagnetism at room temperature.
- Band-filling and bandwidth control in complex oxides (a prerequisite to harnessing charge/orbital order, magnetic transitions and metal insulator transitions).
- Electric- or magnetic-field control of these phenomena - a very exciting prospect for both fundamental science and technology.
- Structure and properties of magnetoelectric domains and domain walls of these materials.
- Emerging avenues to controlling polarization, magnetism and electronic properties via strain and/or strain gradients and/or defects. Breakthroughs and progress in the theory, synthesis, characterization, and device implementations in these and other related topics are solicited for this Focus Topic.

7.1.2: Topological Materials: Synthesis and Characterization

Organizers:
Liang Fu (MIT) liangfu@mit.edu,
Judy Cha (Yale) Judy.cha@yale.edu,
Madhab Neupane (u Central Florida) madhab.neupane@ucf.edu

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

7.1.3: Dirac and Weyl semimetals: prediction, synthesis, characterization and new phenomena (same as 12.1.10)

Organizers:
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Ni Ni (UCLA) nini@physics.ucla.edu

Dirac and Weyl semimetals are low carrier density metals whose low energy excitations can be described by the Dirac or Weyl equation, respectively. Distinct from conventional low carrier density systems, Dirac and Weyl semimetals are expected to possess exotic properties due to their novel electronic structures and nontrivial topologies. A subset of the novel properties predicted include Berry phase contributions to transport properties, protected Fermi arc surface states, suppressed scattering, and non-local transport. While promising candidate materials exist for both Dirac and Weyl semimetals, many phenomena have yet to be clearly resolved.

This focus topic aims to explore Dirac and Weyl semimetals and the novel phenomena associated with them. We solicit contributions on predictions, new materials synthesis and characterization, new phenomena of Dirac and Weyl semimetals, as well as studies on both conventional and unconventional semimetals that provide or clarify alternative explanations for signatures that may be interpreted as a consequence of the novel electronic structure of Dirac and/or Weyl fermions.

7.1.5: Hybrid Organic-Inorganic Halide Perovskites [Same as 12.1.11]

Organizers:
Feliciano Giustino (Oxford) feliciano.giustino@materials.ox.ac.uk
Oana Jurchescu (Wake Forest University) jurchescu@wfu.edu

During the last few years hybrid organic-inorganic lead halide perovskites emerged as disruptive materials for a wide range of optoelectronics applications, from solution-processable solar cells to light-emitting diodes and lasers. Solar cells based on methylammonium/formamidinium lead trihalides with energy-conversion efficiency in excess of 22% were recently demonstrated, making perovskite photovoltaics the first solution-processable solar technology to have surpassed thin film silicon and polycrystalline silicon solar cells. The outstanding energy conversion efficiency of perovskite cells owes largely to the unique optoelectronic properties of these materials, such as a direct optical band gap in the visible range, very strong optical absorption coefficient, small effective masses, and extremely long-lived photo-excited carriers. While enormous progress has been made towards understanding the origin of these extraordinary properties, many fundamental questions remain unanswered, such as for example the origin of the low recombination rates, the role of spin-orbital couplings, and the effects of lattice dynamics on the photophysics of these compounds. From a more applied perspective, research on lead-halide perovskites faces two key challenges: how to improve the materials stability over technologically relevant timescales, and how to identify potential abundant and nontoxic replacements for lead.

The aim of this focus session is to bring together experimentalists and theorists working on the physics, chemistry, and materials science of hybrid perovskites, report on the most recent progress, and discuss current and future challenges. Contributions addressing the fundamental properties of these emerging materials, both from the point of view of materials characterization and modelling, as well as reports on new materials belonging to the wider family of halide perovskites, lead-free perovskites, and vacancy-ordered perovskites are particularly encouraged.

8.1.2: Dopants and Defects in Semiconductors

Organizers:

Paul Koenraad (Eindhoven University of Technology) p.m.koenraad@tue.nl,
Joel Varley (Lawrence Livermore National laboratory) varley2@llnl.gov

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, the development of semiconducting oxides for transparent conducting displays, and the promise of next-generation sensors and computing based on individual defects like the NV center in diamond. 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. Abstracts on experimental and theoretical investigations are solicited in areas of interest that include: 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 including NV centers, SiC, group-III nitrides, two-dimensional materials including phosphorus and BN, oxide semiconductors, and the emerging organic-inorganic hybrid perovskite (e.g., MAPbI3) solar cell materials are of interest. Likewise welcomed are abstracts on specific materials challenges involving defects, e.g., in processing, characterization, property determination, including imaging and various new nanoscale probes.

9.1.1: Fe-based Superconductors

Organizers:

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Chris Homes (Brookhaven National Laboratory) homes@bnl.gov
Chris Stock (University of Edinburgh) cstock@ed.ac.uk

Substantial experimental and theoretical progress has been made toward understanding the unusual normal and superconducting-state properties of the iron-based superconductors (IBS). However, many challenges and controversies remain, driven by discoveries of new or improved materials whose properties differ radically from those of the previous generation. Among the current challenges in the IBS: understanding the intricate interplay between spin and orbital degrees of freedom, and their consequences for the elastic, normal, and superconducting-state properties; the role of quantum criticality; the nature of the parent phase, and the role of interactions and electronic structure in defining such a phase; the normal and superconducting-state properties of materials with only hole or electron-pockets, in particular FeSe thin films grown over various types of substrates; mechanisms for nematicity without long-range magnetic order, or magnetism without nematic order; new materials based on intercalation, and in particular, recent efforts on FeSe-based systems. This Focus Topic will cover the latest experimental and theoretical issues pertaining to both normal and superconducting properties of IBS, covering both pnictide and chalcogenide materials. By better understanding how the different crystalline, magnetic and electronic structures in the distinct families of IBS relate to each other and to other unconventional superconducting and heavy fermion materials, such as the cuprates and the intermetallic 115's; the goal is to enhance the potential for discovering new superconducting systems with higher Tc's.

9.1.2 Topological Superconductivity

Organizers:

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Chris Palmstrom (UC Santa Barbara) cpalmstrom@ece.ucsb.edu

Topological quantum matter emerges from local degrees of freedom and is characterized by non-local topological properties, often related to symmetries. An important class of such materials are topological superconductors which can emerge for instance from conventional s-wave superconductors in the presence of spin-orbit interactions and magnetic fields, spin textures, topological insulators, or from other mechanisms which can give rise to an effective p-wave pairing. These systems can also support topological quantum states at interfaces obeying non-Abelian braid statistics such as Majorana fermions and parafermions that have attracted a lot of attention due to their potential use for topological quantum computing. This Focus Topic explores the experimental and theoretical advances in topological superconductivity and topological bound states emerging in a large variety of superconducting heterostructures involving semiconducting nanowires, topological insulators, atomic chains, Shiba states, graphene, transition metal dichalcogenides, junctions with ferromagnets, integer and fractional quantum Hall states, quantum spin Hall materials, coupled wire constructions, Floquet systems, odd-frequency superconductors, etc. The Focus Topic also solicits classification of these states as well as applications of such topological quantum states to quantum information processing.

12.1.1: 2D Materials: Synthesis, Defects, Structure and Properties

Organizers:
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The interest in two dimensional (2D) materials is rapidly spreading across all scientific and engineering disciplines due to their exceptional chemical, mechanical, optical and electrical properties, which not only provide a platform to investigate fundamental physical phenomena but also promise solutions to the most relevant technological challenges. 2D materials find their immediate application in field effect transistors, gas sensors, bio-detectors, mechanical resonators, optical modulators and energy harvesting devices with superior performances that have already been demonstrated in prototype devices. However, the true impact will only be made if the initial breakthroughs are transformed into commercial technologies. A major challenge towards the commercialization of 2D materials is the large area, scalable and controllable growth of highly crystalline layers in a cost effective way. So far the best quality samples of 2D materials have been obtained through micromechanical exfoliation of naturally occurring single crystals. Chemical vapor deposition (CVD) is the most widely used bottom-up technique to grow large area 2D-materials. Several top-down approaches have also been adopted based on bulk liquid phase chemical and electrochemical exfoliation. The 2D focus topic will cover:

- Experimental, theoretical, and computational studies illuminating various aspects of the growth process including, e. g., layer number and stacking geometry control, the formation of topological and structural defects, grain size and grain boundary control, and the effect of substrate chemistry, crystallography and strain
- Methods of doping
- Templated or bottom-up growth or top-down synthesis of nanostructures and integration with other materials
- Characterization and modeling of the structural, mechanical, electronic, and optical properties of the synthesized 2D materials

12.1.2: 2D Materials: Semiconductors *[Same as 8.1.7]*

Organizers:
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Research exploring 2D semiconductors and their heterostructures are rapidly expanding to include a wide variety of layered material systems with diverse properties, including strong many body interactions, strong spin-orbit coupling effects, spin- and valley-dependent physics, and topological physics etc. This Focus Topic will cover experimental and theoretical/computational work related to 2D semiconductors and their heterostructures, including large bandgap materials such as many chalcogenides (e.g., MoS2, WSe2, GaSe ReSe, etc.), phosphorene and h-BN, small bandgap materials with possible topological effects (such as silicene, germanene, stanene, and Bi2Se3 etc.), and magnetic semiconductors (e.g. CrGeTe3, Mn:MoS2, etc.). Important areas related to monolayers, few-layers and heterostructures include quantum transport properties, mobility engineering, spin- and valley-dependent phenomena, 2D exciton physics, defect engineering on optical and electronic properties, understanding the role of the dielectric environment, many-body effects, magnetic properties, and thermal and mechanical properties.

12.1.3: Devices from 2D Materials: Function, Fabrication and Characterization

Organizers:
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With the rapid progress in the research on 2D materials, including graphene and other layered material systems, a wide variety of properties and functionalities have emerged that have broad scientific and technological significance. The rational design of devices consisting of 2D materials calls for improved understanding of their intrinsic and extrinsic properties that are critical to the device functionality, as well as their integration with other device components. The development of these 2D materials based devices also requires solutions to problems associated with material functionalization, structural fabrication, and device characterization. This Focus Topic will cover experimental and theoretical/computational work related to devices based on the growing array of 2D materials that exhibit a wide variety of behaviors – such as metallic, semiconducting, insulating, magnetic, superconducting, and various strongly correlated electronic phenomena. These 2D materials include (but are not limited to) graphene, transition-metal chalcogenides (e.g., MoS2, WSe2, NbSe2, TaS2, FeSe etc.), silicene, germanane, stannanane, phosphorene, topological insulators (e.g., Bi2Se3, Bi2Te3, etc.), layered oxides (e.g., BSCCO), and large band gap materials such as h-BN. We invite contributions on topics including: (i) the functionalization, fabrication, measurements, and modeling of devices based on the unique properties of 2D materials in the single- or multi-layered forms as well as their heterostructures; (ii) proof-of-principle studies focusing on the electronic, magnetic, optical, mechanical, thermal, and chemical behaviors of 2D materials relevant for device applications; and (iii) interfacial, environmental, and system-based properties and behaviors inherent to the application of 2D materials in future devices.

12.1.4: 2D Materials: Metals, Superconductors, and Correlated Materials

Organizers:
Abhay Pasupathy (Columbia U) apn2108@columbia.edu
Cory Dean (Columbia U) cory.dean@gmail.com
Ben Hunt (Carnegie Mellon) bmhunt@andrew.cmu.edu

After the discovery of graphene and other two-dimensional (2D) semiconductors and semimetals, research exploring 2D materials is rapidly expanding to include a wide variety of layered material systems with diversely different properties. There is enormous interest in building functional structures and devices based on these novel 2D materials, some possibly integrated with graphene or 2D semiconductors. This symposium will cover experimental and theoretical/computational work related to 2D materials that are metallic, superconductors, or have other correlated electronic phases such as charge or spin density waves, Mott insulators, etc. Examples of these 2D materials include various types of layered chalcogenides (eg. NbSe2, TaS2, FeSe) and oxides (eg. BSCCO, V2O5). Particular focus will be on the electronic, thermal, magnetic, and optical properties and functions of few-layers and monolayers of these materials and their heterostructures. Material synthesis (in either bulk or nanostructure form), device fabrication and integration are also included, as well as applications exploiting unique properties of these materials.

12.1.5: Carbon Nanotubes and Related Materials: Synthesis, Properties, and Applications

Organizers:
Chongwu Zhou (Univ of Southern California) chongwuz@usc.edu
George Tulevski (IBM) gstulevs@us.ibm.com

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

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

12.1.6: Van der Waals Bonding in Advanced Materials

Organizers:
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Leeor Kronik (Weizmann Institute) leeor.kronik@weizmann.ac.il

Whether binding organic components together, facilitating physisorption or modifying molecular chemisorption processes, van der Waals interactions are vital to structure, stability and function. They are ubiquitous in organic, inorganic, polymeric, and biological systems and play a fundamental role in defining underlying physical and chemical properties. There is no disputing the existence of van der Waals forces, yet our fundamental grasp of their impact on materials properties is still poor. While these forces are typically weaker than the internal (covalent) bonds that hold a molecule together, they still span a few orders of magnitude and thus present a unique challenge to both theory and experiment. This focus session aims to bring together theorists and experimentalists from a wide range of disciplines to discuss the key challenges and recent progress in the synthesis, characterization, and design of van der Waals bonded complexes and materials. The goal is to share new insights into how non-covalent interactions result in novel physical phenomena in these materials.

12.1.7: Computational Materials Discovery.

Organizers:
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Gus Hart (BYU) gus.hart@gmail.com

Advances in algorithms, computational power, and the ability to predictively model physical phenomena are spurring the computational discovery and design of novel materials, allowing for virtual materials synthesis and characterization before their realization in the laboratory. This focus topic will cover studies at the frontier of computational materials discovery and design, ranging from quantum-level prediction to macro-scale property optimization. Topics of interest include, but are not limited to: Computational materials design and discovery, high-throughput computation and automatized data analysis, computational materials databases, materials informatics, data mining, machine learning, global structure and property optimizations, algorithms for searching the structure/composition space, first principles property prediction, methods for uncertainty quantification, improved accuracy or efficiency, and computational modeling of materials synthesis. Of particular interest are contributions that apply novel data/computation-intensive approaches to materials design, that feature a strong connection to experiment, and those that translate physical insights gained from computation into advanced materials by design. The application focus broadly covers electronic materials, ranging from low-power electronics (Mottronics), energy conversion and storage materials (thermoelectrics, batteries, fuel cells, photocatalysts, photovoltaics), to novel materials for non-linear optics and data processing (spintronics).

13.1.1: Nanostructures and Metamaterials

Organizers:
Jacob Khurgin (Johns Hopkins University) jakek@jhu.edu
Andrea Alù (University of Texas, Austin) alu@mail.utexas.edu

Recent experimental, theoretical and computational advances have enabled the design and realization of nanostructured materials with novel, complex and often unusual electromagnetic properties unattainable in natural materials. Such nanostructures and metamaterials provide unique opportunities to manipulate electromagnetic radiation over a broad range of frequencies, from the ultraviolet and visible to terahertz and microwave. This focus topic will highlight recent progress in the physical understanding, design, fabrication, and applications of these man-made materials. Topics of interest include, but are not limited to: nanophotonics, plasmonics, near field and quantum optics, opto-fluidics, energy harvesting, and the emerging interface of condensed matter and materials physics with the biological and neuro sciences.

13.1.3: Electron, Exciton, and Phonon Transport in Nanostructures

Organizers:
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Jonathan A. Malen (Carnegie Mellon University) jonmalen@andrew.cmu.edu

Understanding and controlling how heat, charge, and energy flow at the nanoscale is critical for realizing the potential of nanomaterials in next generation device technologies. Of particular challenge, and opportunity, is understanding how elementary excitations such as phonons, electrons, holes, excitons, and plasmons interact with each other and are influenced by interfaces, confinement, and quantum effects in nanostructures. This is particularly true for heterogeneous nanoscale materials and interfaces with varying degrees of electronic and phononic couplings, and distinct thermal and electrical impedances. Structural components used in hybrid nanostructures can be made of semiconductors, metals, molecules, liquids, etc.

Contributions are solicited in areas that reflect recent advances in experimental measurement, theory, and modeling of transport mechanisms in nanoscale materials and interfaces. Specific topics of interest include, but are not limited to:

- Electron-phonon coupling and heat generation by hot charge carriers
- Dynamics of energy and charge flow in nanostructured hybrid materials
- Ultrafast dynamics of charge carriers, excitons and phonons in nanostructures and across nanoscale interfaces
- Charge, heat, and exciton transport through metal-semiconductor interfaces
- Non-equilibrium heat transport and phonon-bottlenecks effects
- Nanostructuring and reduced dimensionality for tailoring heat and charge transport
- Energy transfer in hybrid nanomaterials including dots, wires, plates, polymers, etc
- Excitonic nanomaterials with light-harvesting and lighting properties utilizing both solid-state and molecular components
- Plasmonic nano- and meta-structures for light harvesting and concentration
- Hybrid structures with interacting exciton and plasmon resonances
- Hybrid nanomaterials for photo-catalytic applications utilizing excitons and plasmons

13.1.4: Complex Oxide Interfaces and Heterostructures

Organizers:
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The intricate interactions between the electronic and structural degrees of freedom make complex oxides one of the most exciting fields of research. When these oxides are prepared in the form of thin films and heterostructures, they exhibit additional properties that cannot be realized in the constituent materials alone. These novel properties arise as a result of interfacial charge transfer, exchange coupling, orbital reconstructions, proximity effects, dimensionality and modifications to local atomic coordination. Emergent electronic and magnetic states at oxide interfaces raise exciting prospects for discovery of new fundamental physics and technological applications. This Focus Topic is dedicated to the progress in the knowledge, methodologies and tools in the field of complex oxide thin films, heterostructures, superlattices, and nanostructures, also with respect to the competition/coexistence with a rich variety of other physical properties. Synthesis, characterization, theory, and novel device physics are emphasized. Specific areas of interest include, but are not limited to, growth of oxide thin films and heterostructures, formation of two-dimension electron gases, control of their magnetic properties and ordering, interfacial superconductivity, magnetotransport, strong spin-orbit coupling effects, magnetoelectric phenomena, coupling of atomic and magnetic structures, and recent developments in theoretical prediction and materials-by-design approaches. Advances in techniques to probe and image electronic, structural and magnetic states at heterostructure interfaces, including but not limited to scanning probes, optical, electron, neutron, and synchrotron-based techniques are also emphasized. Note that overlap exists with other DMP and GMAG focus sessions. As a rule of thumb, if complex oxides and their heterostructures are the core of the investigation, then the talk is appropriate for this focus topic.

13.1.5: Thermoelectric Materials and Novel Thermoelectric Phenomena [Same as 21.1.1]

Organizers:

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Thermoelectrics for solid-state power conversion and refrigeration applications continues to be of great interest as new materials and transport phenomena are being discovered. The physics of materials and the associated charge carrier, spin, photon, and phonon transport is of particular interest. This focus topic addresses the latest developments in state of the art materials and novel phenomena, including theory, synthesis, characterization, processing, mechanical, thermal, and electrical properties. These sessions will also highlight the latest application advances in waste heat recovery, high efficiency refrigeration, and how the field can lead to new advances in fundamental condensed-matter physics. Experimental, theoretical, and application and device-related contributions are solicited.

14.1.2: Surface Science of Organic Molecular Solids, Films, and Nanostructures

Organizers:

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Organic molecular solids are a challenging materials class since numerous "weak" interactions, all of comparable strength, control structures and functional properties. The promise of high performance optoelectronics, designer sensors, electrode work function control, and bioelectronic devices make the payoff for addressing this challenge high. Moreover, there is great scientific value in addressing complex systems with hierarchical interactions and a strong tension between localized and delocalized phenomenon such as found in organic molecular solids. This Focus Topic will bring together Surface Scientists to report and discuss new experimental and theoretical/computational results aimed at the basic physics underpinning this material class. Research of interest includes the structure, properties, and applications of organic adsorbates, monolayer assemblies, thin films, crystals and nanostructures.

DMP Co-Sponsored Focus Topics led by other APS Units *(submit invited talk nominations through primary sponsoring Unit)*

01.1.9: Organic Electronics and Photonics (DPOLY/DMP)

03.1.6: Nonperiodic order in colloids, alloys, and fabricated structures (GSNP, GSOFT, DMP)

08.1.8: Organic electronics and photonics (DPOLY/DMP)

10.1.1: Magnetic Nanostructures: materials and phenomena (GMAG/DMP)

10.1.2: Emergent properties of bulk complex oxides (GMAG/DMP/DCOMP)

10.1.3: Magnetic oxide thin films and heterostructures (GMAG/DMP/DCOMP)

10.1.4: Spin transport and magnetization dynamics in metals-based systems (GMAG/DMP/FIAP)

10.1.5: Spin dependent phenomena in semiconductors (GMAG/DMP/FIAP/DCOMP)

10.1.6: Frustrated magnetism (GMAG/DMP)

10.1.7: Spin-orbit mediated chiral spin textures (GMAG/DMP)

10.1.8: Low-dimensional and molecular magnetism (GMAG/DMP)

12.1.8: First-Principles Modeling of Excited-State Phenomena in Materials (DCOMP/DMP)

16.1.3: Theory and Simulation of Fiber-Based Materials (DCOMP/DMP/DPOLY)

16.1.4: Computational Physics at the Petascale and Beyond (DCOMP/DMP/DCMP/DCP/DBIO)

16.1.7: Materials in Extremes: Bridging Simulation and Experiment (DCOMP/DMP/GSCCM)