

# **GMAG NEWSLETTER**

Topical Group on Magnetism and its Applications  
No. 22, November 2005

A Focused Group within the American Physical Society.

**Dear GMAG members,**

After a brief review of GMAG activities: free student memberships, outreach support, fellowship and award nominations, etc., this newsletter focuses on GMAG-sponsored activities at the March 2006 APS meeting.

**Note:** March Meeting Abstract Submission Deadline is *Nov. 30, 2005*.

**Jack Bass, GMAG Chair**

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## **(1) Free Student Membership in GMAG.**

Students who are members of APS can join GMAG without paying additional dues (GMAG will pay student GMAG dues to APS). *To join, students need to send a note to membership chair, Jeff Childress ([Jeff.Childress@hitachigst.com](mailto:Jeff.Childress@hitachigst.com)) with their name, APS membership number, mailing address, and e-mail address (note that students can join APS free for one trial year and \$26 for each succeeding year).*

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**(2) GMAG Outreach Funding.** Since last year, GMAG has invited applications from its members to support outreach activities involving magnetism. Limited funds (up to \$2500 per project) are available to cover supplies and expenses associated with activities that aim to educate non-scientists about magnetism and its applications. Preference will be given to innovative activities that will be documented so that they can be reproduced elsewhere. The outcome of the activities will be disseminated to the GMAG membership through the Newsletter and to the broader magnetism community through the GMAG website. Interested GMAG members should prepare a 1-2 page summary of the proposed activity (including expected duration and outcome) along with a 1 page CV and a list of anticipated expenses. *These should be mailed as a single file in .pdf format to the GMAG Chair, Jack Bass, at [bass@pa.msu.edu](mailto:bass@pa.msu.edu).* The GMAG Executive Board will review proposals on an ongoing basis.

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## **(3) Nominations for APS Fellowship and Prizes/Awards.**

**The nominations deadlines for this year have passed, but it is not too soon to start thinking about next year.** GMAG nominates 2-3 people for APS Fellowship each year. The next nomination deadline is **April 1, 2006**. Information can be found at <http://www.aps.org/fellowship/>. **Nominations** for most APS prizes are due by **July 1, 2006**. See <http://www.aps.org/praw/>.

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## **(4) ‘Magnetism Images’ at the GMAG Web Site.**

The GMAG website has a section entitled ‘Magnetism Images, subdivided into six sections: (a) Magnetism, Fundamental Science; (b) Magnetism on Earth and in the Universe; (c) Magnetism in Industry; (d) Magnetism Education; (e) Magnetism-related Web Sites; and (f) Magnetism-related Books. Clicking on a section will bring up a list of figure captions, and clicking on a caption will bring up a figure. The intent is to make these figures available (with proper attribution) for private use and, perhaps, for magnetism-related brochures to be prepared by GMAG. *If you are interested in helping to organize and ‘fill’ this section, please contact Jack Bass ([bass@pa.msu.edu](mailto:bass@pa.msu.edu)).*

## **(5) GMAG Board Nominations.**

*Nominations for GMAG offices will be announced soon.* Nominations for Vice Chair (who becomes Chair-Elect, Chair, and Past Chair), and 2 new Members-at-Large for the Executive Committee will be announced soon. According to the GMAG bylaws, once these nominations are announced, the GMAG membership may recommend additional candidates to be included in the election. To be included, a candidate must be nominated by 5% of the GMAG membership as of Dec. 31, 2004. An e-mail message with details will be sent out by the GMAG secretary/treasurer.

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## **(6) Ask your colleagues to Join GMAG.**

**For only \$7 for APS Members (students free for first year) GMAG Membership confers these benefits:**

**The Quarterly GMAG newsletter.**

**Eligibility for GMAG graduate student awards and sponsorship.**

**Potential to increase the number of APS Fellows sponsored by GMAG.**

**Potential to increase the number of invited talks on Magnetism at the March Meeting.**

**Opportunity to help shape the voice and future of the Magnetism Community (your community) in the USA.**

**For more info. See the GMAG website: <http://www.aps.org/units/gmag/index.cfm>.**

**TO JOIN:** Go to the APS page for “Application to add units” (<http://www.aps.org/memb/unitapp.html>) and follow the instructions for adding a unit to your membership. Or call the APS at 301-209-3280 and tell a Membership Representative that you want to join topical group GMAG.

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## **(7) March Meeting 2006: Sorting Categories, Focus Sessions, Tutorials, Symposia:**

Contributed talks for both regular sessions and focus sessions must be submitted directly to APS at <http://abstracts.aps.org/> following their procedures. The March Meeting deadline for abstracts is *Nov. 30, 2005*. For focus sessions, please indicate the appropriate session.

### **SORTING CATEGORIES**

- 6.1 Cooperative Phenomena (incl. spin structures, spin waves, phase transitions).
- 6.2 Magnetic Domains & Magnetic field Phenomena: Dynamic & Static
- 6.3 Correlated Electrons (incl. heavy fermions, oxides).
- 6.4 Spin Dependent Transport: GMR, CMR, tunneling, spin injection, semiconductors.
- 6.5 Magnetic Recording Materials and Phenomena
- 6.6 Magnetic Anisotropy: hard & soft materials.
- 6.7 Artificially Structured or Self-Assembled Magnetic Materials (incl. multilayers & dots).
- 6.8 Low Dimensional magnetism (incl. molecules, chains, surfaces).
- 6.9 Frustrated or Disordered Magnetic Materials.
- 6.10 New Techniques and Applications.

### *Focus Sessions*

- 6.11.1 Theory and Simulation of Magnetism and Spin Dependent Properties
- 6.11.2 Nanostructured Magnetic Materials
- 6.11.3 Complex Multifunctional Oxides
- 6.11.4 Spin Transport and Magnetization Dynamics in Metal-Based Systems
- 6.11.5 Spin-Dependent Phenomena in Semiconductors
- 6.11.6 Nanoscale Magnetic Materials for Information Recording and Storage.

### 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 semiconductors, 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 Nanostructured Magnetic Materials (DMP/GMAG)

This session focuses on magnetic materials and phenomena at the nanometer-scale. Magnetic nanostructures include films, multilayers, nanocomposites, hybrid structures, wedges, nanowires, magnetic point contacts, nanoparticles, nanoparticle arrays, and patterned films. This session will cover both experimental and theoretical advances in low dimensional magnetism, proximity effects, interlayer magnetic coupling, exchange spring, exchange bias, magnetic quantum confinement, magnetic anisotropy, effects of structural disorder, hysteresis modeling, and other magnetic phenomena. Of special interest is 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 other unusual physical phenomena present in these systems.

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### 6.11.3 Complex Multifunctional Oxides (DMP/GMAG)

The broad range of functionalities associated with solid oxides results in large part from the complexity of their electronic structures, and the close competition they exhibit between multiple magnetic and electronic phases. These factors can lead to large responses to external stimuli and the occurrence of striking phenomena such as colossal magnetoresistance and giant magnetoelectric or magnetocalorimetric effects. This symposium will explore recent advances in the fundamental physics and potential technological applications of such complex and multifunctional oxide materials. Sessions will focus both on phenomena of current interest, such as colossal magnetoresistance, multiferroic behavior, magnetoelectronic phase separation, and orbital and charge ordering, as well as specific materials classes that are receiving increased attention, including manganites, cobalt oxides (perovskites and the sodium cobaltates), and ruthenates. The interplay between bulk and thin film synthesis, characterization of structural, electronic and physical properties, and theory and simulation, will be emphasized.

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

This session will focus on experimental and theoretical investigations that elucidate and/or utilize the transport and transfer of spin in metal-based magnetic systems. 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), tunneling spectroscopy of spin states, spin filtering and related effects. Also of particular interest are studies of the interplay between non-equilibrium carriers and magnetization dynamics in point contacts, magnetic pillar structures and magnetic nanowires. Additional topics include, but are not limited to, interfacial spin transport, spin injection and detection, spin relaxation time, damping mechanisms in ferromagnets, spin-current-driven domain wall dynamics, and studies in ferromagnetic - normal metal and ferromagnetic - superconductor systems. Studies that emphasize spin phenomena in semiconductor systems will be covered in a separate focus session.

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

Recent advances in understanding the physics of spin-dependent phenomena in semiconductors have come from the mutual influence of research on fundamental optical and transport properties, materials physics, and devices. This focused session solicits abstracts that explore a fundamental understanding of spin-dependent processes in magnetic and non-magnetic structures incorporating semiconductors. Topics include 1) spin dynamics and transport in nonmagnetic semiconductors, including spin transport in mesoscopic systems, electrical or optical spin injection, manipulation, and detection, optical and electronic control of spin coherence, and hyperfine effects; 2) growth, characterization, electrical, optical and magnetic properties, and control of magnetic properties in ferromagnetic semiconductors and hybrid ferromagnet-semiconductor structures and devices; and 3) developments in related fields, such as organic semiconductors and quantum computing, that relate to spin-dependent phenomena in semiconductors.

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#### 6.11.6 Nanoscale Magnetic Materials for Information Recording and Storage (GMAG/FIAP)

This session focuses on nanoscale magnetic materials for information recording and storage applications, one of the most advanced and rapidly developing fields of magnetism today. Recent technological advances have brought this field to a point where fundamental physical properties such as stability (super-paramagnetic effect) and speed (intrinsic and extrinsic damping) have reached crucial significance, and materials fabrication technologies have become most challenging. Simultaneously, novel technologies like perpendicular recording, patterned media and thermally assisted recording are emerging in this field.

The session covers materials intended to advance storage applications, their magnetic properties and characterization techniques, including magnetic reversal for high-speed switching, and theoretical descriptions and modeling of materials and processes. Novel recording materials of interest include: thin and ultrathin films, multilayers, nanoparticles, cluster-assembled nanocomposites and other nano-assemblies, as well as lithographically defined nanostructures. Applied and technological topics include conventional and emerging information-storage applications.

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## **Magnetism-Related Tutorials**

### **1. *Spintronics: What's New.*** Organizer: Mark Johnson, Naval Research Laboratory, Wash. DC 20375

“Spintronics” is the emerging field of basic and applied research supporting electronic device structures that utilize electronic spin for new and unique functionality. Applications for conventional digital electronics include low power, ultrahigh density nonvolatile magnetoresistive random access memory (MRAM). Prototype MRAM chips with several Mbit capacity have been made by numerous industrial labs, including IBM and Freescale (Motorola). These chips have demonstrated several performance advantages over silicon technology: true nonvolatility; excellent durability; read, write and access times of order nsec; and read and write operating energies of order 100 pJoule. Commercially competitive MRAM with capacities one or two orders of magnitude larger are being developed. Key issues of basic research involve rapid, low power magnetization reversal dynamics and the physics of device operation and scaling at nanometer dimensions. Research on unconventional information processing applications such as quantum computing is also very active. The field of Biotechnology offers important new directions and opportunities.

**2. *Molecular Magnets.*** Organizer: Andrew Kent, New York University, New York, NY 10003  
Research on molecule-based-nanomagnets has progressed rapidly in recent years in materials known as single molecule magnets (SMMs), which exhibit a host of remarkable quantum phenomena. SMMs represent a molecular or 'bottom-up' approach to nanomagnetism, with advantages that include chemical control of molecular structure, spin, magnetic anisotropy as well as intra- and intermolecular magnetic interactions. They display properties of much larger ferromagnetic particles prepared by conventional lithographic methods but in a manner that enables fundamental physics studies. For example, quantum tunneling of the magnetization (QTM) has been clearly demonstrated and studied in these materials. This tutorial will provide background toward understanding recent developments in this area, which includes advances in materials, experiment and theory.

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## **GMAG Sponsored Symposia**

- 1. High TMR MgO tunneling and spin momentum transfer materials, physics, and devices**
- 2. New Results in Geometrically Frustrated Magnets**
- 3. Quantum Spin Dynamics in Molecular Nanomagnets**

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## **Magnetism conferences and workshops: for updates, see GMAG website**

<http://www.aps.org/units/gmag/index.cfm>.

Materials Research Society (MRS) 2005 Fall Meeting (Boston, Mass., Nov. 28-Dec. 2, 2005)  
([www.mrs.org](http://www.mrs.org)).

Seventh Latin American Workshop on Magnetism, Magnetic Materials and their Applications (Renata, Chile, Dec. 11-15, 2005) (<http://www.law3m.cl/Law3m/index.htm>).

Intermag 2006 (San Diego, CA, May 8-12, 2006). <http://www.intermagconference.com/intermag2006/>

6<sup>th</sup> International Conference on the Scientific and Clinical Applications of Magnetic Carriers (Krems, Austria—Vienna region, May 17-20, 2006) <http://www.magneticmicrosphere.com>

19<sup>th</sup> International Colloquium on Magnetic Films and Surfaces (ICMFS 2006) (Sendai, Japan, Aug. 15-18, 2006).  
<http://icmfs2006.apph.tohoku.ac.jp/>

10<sup>th</sup> Joint MMM/Intermag Conference (Baltimore, Maryland, January 7-11, 2007 )

## **The GMAG Executive Committee**

**Chair:** Jack Bass ([bass@pa.msu.edu](mailto:bass@pa.msu.edu))

**Chair-Elect:** Jim Rhyne ([rhyne@lanl.gov](mailto:rhyne@lanl.gov))--Program Committee Chair.

**Vice-Chair:** Daniel Reich ([reich@jhu.edu](mailto:reich@jhu.edu))--Fellowship Committee Chair.

**Past Chair:** Peter Schiffer ([schiffer@phys.psu.edu](mailto:schiffer@phys.psu.edu))

**Secretary-Treasurer:** Caroline Ross ([caross@mit.edu](mailto:caross@mit.edu))

**Executive Committee Members-at-Large (term ends March xxxx of the year shown):**

Jeff Childress ([jeff.childress@hgst.com](mailto:jeff.childress@hgst.com)) (2007)—Membership Chair,

Andrew Kent ([andy.kent@nyu.edu](mailto:andy.kent@nyu.edu)) (2007)—Nominating Committee Chair,

Chris Leighton ([leighton@tc.umn.edu](mailto:leighton@tc.umn.edu)) (2008),

Laura Lewis ([lhlewis@bnl.gov](mailto:lhlewis@bnl.gov)) (2006),

Sara Majetich ([sm70@andrew.cmu.edu](mailto:sm70@andrew.cmu.edu)) (2008),

Mark Stiles ([mark.stiles@nist.gov](mailto:mark.stiles@nist.gov)) (2006)