



## From The President

By Takao Suzuki, President of the Magnetics Society

Happy New Year!

First of all, I would like to thank all the members of the Magnetics Society for their support and cooperation for our activities over this past year. Special thanks are due to the officers, AdCom members, committee chairs, and all the committee members.



Secondly, I would like to welcome the newly elected AdCom members (term 2012-2014): Russell Cowburn, Laura Heyderman, Atsufumi Hirohata, Albrecht Jander, David Jiles, Kai Liu, John Snyder, and Leonard Spinu. In addition, Pallavi Dhagat is taking the AdCom position of Thomas Thompson who has been confirmed as finance chair. Also, Mingzhou Wu

*continued on page 4*

## INSIDE THIS ISSUE...

From The President	1
5th IEEE Magnetics Society Summer School	1
2012 Achievement Award	2
New IEEE Fellows	3
Technical Committee Members	5
New Senior Members	8
2012 Distinguished Lecturers	9
Chapter News	13
IEEE Fellow Nominations	15
AdCom Election Results	15
Conference Calendar	16
About The Newsletter	16

## The 5th IEEE Magnetics Society Summer School

By Albrecht Jander, Education Committee Chair

The 5th IEEE Magnetics Society Summer School will be held on the campus of SRM University, Chennai, India during **July 22-27, 2012**. The school is designed for graduate students studying magnetism. It will consist of lectures by international experts and will include poster presentations by participating graduate students. The program will cover both fundamentals and advanced topics in magnetism.

Financial support will be awarded to approximately 100 students. Awardees will be provided with free room and board and will be reimbursed for most of the cost of economy round trip airfares or equivalent ground transportations. A limited number of additional students may be accepted with reduced or

no financial support. The Summer School is open to current MS or PhD students who are members of the IEEE Magnetics Society (at the time of attendance) and have not attended previous summer schools. The application requires a recommendation from a faculty member. Preference will be given to students who have a recommendation from a current member of IEEE Magnetics Society.

For more information, please visit:

<http://summerschool.iecemagnetics.org/>

Application deadline: **March 1, 2012**.

Award announcement date: **March 20, 2012**.

# John Slonczewski Receives 2012 Achievement Award

By Bruce Gurney, Honors and Awards Committee Chair

The IEEE Magnetics Society honors one of its outstanding members each year for his or her lifetime professional achievement. This is the highest award of the Magnetics Society and is given for scientific, technical achievements and service to the Society. The award is presented at the INTERMAG conference each year, and consists of a diploma with citation and a cash prize.

Dr. John Slonczewski receives the 2012 Achievement Award for "for contributions to magnetic devices and storage, including prediction of the spin transfer torque effect in magnetic thin films, theory of magnetotransport and interpretation of magnetic reversal."

Dr. John Slonczewski is a recognized world leader in developing fundamental understanding of magnetic phenomena and applying that understanding to magnetic devices. He is well known for pioneering the current induced spin transfer torque effect, predicting both persistent oscillations and enhanced magnetic reversal phenomena, both of which are intensively studied today in numerous research groups and companies. He has contributed to theories of tunnel magnetoconductance, interlayer coupling, domain walls and bubbles.

Dr. Slonczewski earned his BS in Physics at Worcester Polytechnic Institute in 1950 and PhD in Physics at Rutgers University in 1955, where he derived the band structure of graphite. He then joined IBM as a Research Staff Member in what, by 1960, became the IBM Research Center in Yorktown Heights, NY. He retired from IBM Yorktown in 2002, having also spent three years at the IBM Zurich Research Laboratory. He has been a guest scientist at many research institutions and universities.

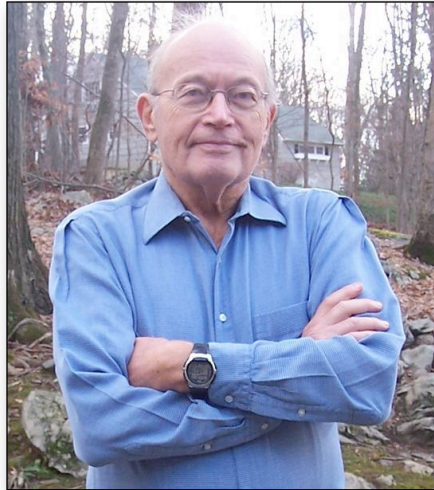
During the period 1955-62, Dr. Slonczewski investigated quantum theories of magnetic anisotropy and magnetostriction. In the 1970s he turned to physics of magnetic vortices, Bloch lines, Bloch points, and magnetic bubbles, and co-invented the high-density bubble-lattice-file memory which was demonstrated in 1979. He also proposed applications of the

magnetoresistance of a magnetic tunnel junction (MTJ). Since 1987, he has concentrated on the physics of magnetic multilayers, including interlayer exchange coupling and magnetoresistance, and predicted current-driven spin transfer torque. In 1989, he introduced the use of spin-polarized currents to establish the close connections between these three effects in MTJs. In the 1990s he studied these effects in all-metallic multilayers. He predicted steady precession of a free single-domain nanometer-scaled magnet having a negative uniaxial magnetic anisotropy coefficient, ushering in a new field of spin-torque RF oscillators. If this coefficient is positive, he found that the precession may lead to a moment switch, making possible writing in high-density magnetic memory. Devices using both of these phenomena are investigated throughout the world today.

More recently, following the experimental discovery of spin-transfer switching in MTJs, Dr. Slonczewski published a general theory of non-collinear magneto-conductance and spin-transfer torque for them. Also, he now predicts that spin-transfer torque originating from magnons flowing through a ferrite conducting Joule-effect-generated heat will make more effective use of an electric drive current. He has published 110 scientific articles and holds 24 patents.

Dr. Slonczewski's previous recognitions include the 2006 IUPAP Magnetism and Néel Medal Award and 1977 IBM Research Outstanding Achievement Award. He is a Fellow of the American Physical Society and Life Member of the IEEE.

*Dr. Slonczewski joins a distinguished list of past recipients: Fred Luborsky 1981, Herb Storm 1982, Harold Lord 1984, Joe Suozzi 1985, Fritz Friedlaender 1986, Andrew Bobeck 1987, Floyd Humphrey 1988, Paul Biringier 1989, Daniel Gordon 1990, Emerson Pugh 1991, Yoshifumi Sakurai 1992, William Doyle 1993, Richard Barker 1994, Mark Kryder 1995, Koosuke Harada 1996, Gordon Slemon 1997, Stan Charap 1998, Dave Thompson 1999, Denis Mee 2000, Fred Hagedorn 2001, Sun-ichi Iwasaki 2002, Carl Patton 2003, Yutaka Sugita 2004, Robert Fontana 2005, Neal Bertram 2006, John C. Mallinson 2007, Jack H. Judy 2008, Roger Wood 2009, and Isaak Mayergoyz 2010, Jian-Gang (Jimmy) Zhu 2011.*



# New IEEE Fellows

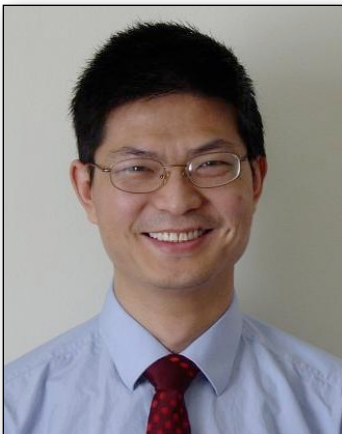
By Bruce Gurney, Honors and Awards Committee Chair

Seven members of the Magnetics Society have been elevated to IEEE Fellow for 2012:

- **David Davidson:** for contributions to computational electromagnetics (Stellenbosch University, South Africa);
- **Eric Fullerton:** for contributions to the synthesis and characterization of magnetic exchange coupled films, superlattices and recording media (University of California, San Diego, USA)
- **Donald Gardner:** for contributions to integrated circuit interconnects and integrated inductor technology (Intel Corporation, USA)
- **Reinhard Lerch:** for contributions to ultrasonic transducer technology and computer modeling of sensors and actuators (University Erlangen-Nuremberg, Germany)
- **Chunting (Chris) Mi:** for contributions to hybrid electric vehicle modeling and power control (University of Michigan-Dearborn, USA)
- **Andrei Slavin:** for contributions to magnetic excitations and magnetization dynamics induced by spin transfer (Oakland University, USA)
- **Thomas Weiland:** for development of the finite integration technique and impact of the associated software on electromagnetic engineering (Technische Universität Darmstadt, Germany)



**Above ( to r): David Davidson, Eric Fullerton, Donald Gardener and Reinhard Lerch.  
Below (l to r): Chunting (Chris) Mi, Andrei Slavin and Thomas Weliland.**



# From The President *continued from page 1*

has been confirmed as chair of the education committee, succeeding Albrecht Jander.

Third, I would sincerely like to thank those AdCom members who served the term from 2009 through 2011 for their constant dedication and commitment for the Magnetics Society. They are Richard Dee, Josef Fidler, Usha Varshney, Vince Harris, Sara Majetich, Kevin O'Grady, Laura Heyderman and John Snyder. Thank you for your wonderful service!

I am pleased to announce our new lecturers for the Distinguished Lecturer program: George C. Hadjipanayis (Subject: Science and Technology of Modern Permanent Magnet Materials), Shinji Yuasa (Magnetoresistance and Spin-Transfer Torque in Magnetic Tunnel Junctions), Gerrit E. W. Bauer (Spin Caloritronics) and Masahiro Yamaguchi (Soft Magnetic Thin Film Application at Radio Frequencies). Congratulations, and we all are looking forward to having your exciting lectures at many places around the world!

I am very pleased to inform everyone that Kannan Krishnan at the University of Washington, who is now an AdCom member, has received the 2012 IEEE Donald G. Fink Prize for his review article "Biomedical Nanomagnetism: A Spin Through Possibilities in Imaging, Diagnostics and Therapy," IEEE Transactions on Magnetics, Vol. 46, No. 7, July 2010, pp. 2523-2558." The IEEE Fink Prize identifies the "best of the best" papers in surveys, reviews or tutorials, which often are the province of our Magazines. You may find more information at [http://www.ieee.org/documents/2012\\_medal%20and%20recog%20recipients\\_citationslist.pdf](http://www.ieee.org/documents/2012_medal%20and%20recog%20recipients_citationslist.pdf). Congratulations, Kannan, for this prestigious prize!

As we end 2011, let us look ahead to upcoming activities in 2012. We will have the Intermag in Vancouver in May, and TMRC in Silicon Valley (details to be determined) and other sponsored meetings. Continuing, we will have the Summer School in India and also the Distinguished Lecturer Program which already is on the way. Indeed, it looks like another very exciting year for our Magnetics Society.

Regarding future conferences, I would like to add a few things. At the last AdCom meeting during the MMM conference in Scottsdale, Arizona, we decided to hold the Intermag 2015 in the Asia-Pacific region, following the Intermag in Dresden, Germany 2014. The site is to be determined. This decision was made mainly because there is significant growth in interest in

magnetism, magnetic materials and related fields in the region, and it is in the best interest for our Magnetics Society to meet this demand. The site will be finalized during the Intermag in Vancouver in May. Additionally, the International Conference on Magnetism (ICM) 2018 has been decided to be in North America, and details are under discussion.

Currently, our Magnetics Society has the Sister Society Agreement (SSA) with the Magnetics Societies of Taiwan, Korea and Japan. The spirit of this agreement is to enhance mutual collaboration between the Magnetics Society and respective counterparts through reciprocal and complementary activities. There is a 10% discount in the membership fee for both Societies' members. I am happy to inform you that the SSA with the Spain Magnetism Club (Club Español de Magnetismo) was signed by the president of the Spain Magnetism Club and me in November 2011. This is the first SSA in Europe and I eagerly look forward to collaborating with them. In addition, I am hoping to establish similar SSAs with other countries as well.

2011 was an unforgettable year for me (and I am sure that many of you feel the same way!). We had disastrous and violent natural disasters around the world, including the big earthquake and tsunami in Japan, which caused nuclear radiation contamination; and in Thailand, there was very heavy flooding in October and November. Here in Alabama, we had violent tornados which took the lives of more than three hundred people and destroyed hundreds of buildings and homes. As we close this chapter in 2011, I sincerely wish that the coming New Year will be one of the most prosperous and happy years of all for you.

Best wishes for a brilliant New Year in 2012!

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## Get in touch...

We're always interested to hear from Newsletter readers... what you like, what you don't like - what you'd like to see more of in the Newsletter. Just letting us know that you're a reader would be great too!

Drop the Editor a line at: [g.p.hatch@ieee.org](mailto:g.p.hatch@ieee.org)

# IEEE Magnetics Society Technical Committee

By Kaizhong Gao, Technical Committee Chair

The following is a full list of the current IEEE Magnetics Society Technical Committee members and their fields of interest. The Technical Committee will help to identify new and define existing field of interest, initiate, support and organize workshops and conferences, and answer technical questions for Society members.

To better serve the Society, we have listed each members field of expertise and a link to their websites, if available. If you have any questions, feel free to contact each individual person or you can contact current Technical Committee chair, Kaizhong Gao, via [kaizhong.gao@seagate.com](mailto:kaizhong.gao@seagate.com). Note that Committee membership will change over time, and such changes will be noted in future editions of the Newsletter, as well as the Web site.

**Adekunle O. Adeyeye** is Associate Professor in the ECE Department at National University of Singapore. His research interests include: ferromagnetic and exchange-biased nanostructures, spin-dependent transport in nanostructures, nanofabrication techniques for magnetic materials and devices and multiferroic nanostructures. Web site: [www.ece.nus.edu.sg/stfpage/eleaao/Adekunle\\_Adeyeye/Home.html](http://www.ece.nus.edu.sg/stfpage/eleaao/Adekunle_Adeyeye/Home.html)

**Amr A. Adly** is Professor in the Electrical Power & Machines Department at Cairo University in Egypt. His research interests include: field computation in complex media, hysteresis modeling, magnetostriction, magnetic measurement instrumentation, magnetic recording, magnetic force scanning tunneling microscopy, electromagnetic actuators, electric machines and transformers, superconductivity and magneto-hydro-dynamics. Web site: [www.eng.cu.edu.eg/staffweb/ShowInstructorData.aspx?id=1086](http://www.eng.cu.edu.eg/staffweb/ShowInstructorData.aspx?id=1086)

**Darío A. Arena** is Associate Physicist in the National Synchrotron Light Source Group at Brookhaven National Lab. His research interests includes: investigation of magnetic materials via synchrotron-based techniques, particularly x-ray magnetic circular dichroism (XMCD) and x-ray absorption spectroscopy (XAS), study of chemical and magnetic structure of multilayer films and arrays of nanomagnets using x-ray resonant magnetic scattering (XRMS), investigations of magnetization dynamics in complex materials (alloys, multi-

layers) using ultrafast time-resolved XMCD, development of new measurement methods, primarily synchrotron and accelerator-based.

**Hiroyuki Awano** is Professor at the Toyota Technological Institute, Japan. His research interests include: thermally assisted magnetic recording, magnetic super lattice, magneto-optical effect, magnetic materials, magnetic recording, optical recording; spintronics, magnetic solid-state memory, magnetic meta-material, spin optronics and spin-logic devices.

**Sharat Batra** is Technical Director at WD. His research interests include: heat-assisted recording for integrating efficient magnetic and near field optics design, writer designs for conventional perpendicular recording, recording system design for extending conventional perpendicular, MAMR and HAMR technology.

**Byoung C. Choi** is Associate Professor in the Department of Physics & Astronomy at the University of Victoria, Canada. His research interests include: non-equilibrium magnetization phenomena in magnetic materials, with particular emphasis on ultrafast magnetization probing using time-resolved magneto-optical Kerr effect. Web site: [web.uvic.ca/~bchoi/GroupMembers.htm](http://web.uvic.ca/~bchoi/GroupMembers.htm)

**Alina M. Deac** is a Researcher at Julich. Her research interests include: spin-torque phenomena such as STT-MRAM, ST-driven oscillators, CPP-GMR and perpendicular anisotropy materials.

**Haifeng Ding** is Professor of Physics in the Department of Physics at Nanjing University. His research interests include: magnetic nanostructure, spin-polarized scanning tunneling microscopy and molecular beam epitaxy. Web site: [physics.nju.edu.cn/php/dinghaifeng.htm](http://physics.nju.edu.cn/php/dinghaifeng.htm)

**Jürgen Fassbender** is Division Head at Forschungszentrum Dresden-Rossendorf. His research interests include: ultrathin magnetic films, magnets in confined dimensions, coupling phenomena, induced anisotropy; magnetization dynamics, ion-irradiation-induced effects, spin-torque phenomena such as

*continued on page 6*

# Society Technical Committee *continued from page 5*

STT-MRAM, ST-driven oscillators and device nanofabrication techniques, especially those applicable to magnetic devices.

**Peter Fischer** is Staff Scientist and PI at LBNL. His research interests include ultrafast spin dynamics, magnetism on the nanoscale, magnetic X-ray microscopy and X-ray spectroscopy. Web site: [www.lbl.gov/msd/investigators/investigators\\_all/fischer\\_investigator.html](http://www.lbl.gov/msd/investigators/investigators_all/fischer_investigator.html)

**Kaizhong Gao** is Principal Engineer and Manager at Seagate Technology, Media and Head R&D. He is also the current Magnetism Society Technical Committee Chair. His research interests include: magnetic recording, energy-assisted magnetic-recording technology, information-storage technology, magnetization dynamics, micromagnetics, materials simulation, recording physics and spintronics applications.

**Maria Elena Gómez** is Full Professor and Leader of the Thin Film Research Group, in the Department of Physics at the Universidad del Valle, Cali, Colombia. Research interests include: magnetic thin films and heterostructures of oxide materials, effects in magnetic superlattices, GMR in the Fe-Cr system, exchange bias in ferromagnet-antiferromagnet system based in manganites and magnetoelectric effect in oxide heterostructures.

**Romel D. Gomez** is Professor in the Department of Electrical and Computer Engineering at the University of Maryland, College Park. His research interests include: experimental condensed matter physics, spin-dependent transport, surface science, fundamental characterization of surface magnetism, NDE using scanned-probe microscopes, nanomagnetism and biomolecular detection. Web site: [www.ece.umd.edu/~rdgomez/](http://www.ece.umd.edu/~rdgomez/)

**Oliver Gutfleisch** is Group Leader at IFW Dresden, Germany. His research interests include magnetic materials for energy applications, magnetocaloric materials, magnetic refrigeration, ferromagnetic shape-memory alloys, magnetorheologic fluids and solids and magnetic MEMS. Web site: [www.ifw-dresden.de/institutes/imw/sections/21/members/gutfleisch](http://www.ifw-dresden.de/institutes/imw/sections/21/members/gutfleisch)

**Ryusuke Hasegawa** is Vice-President of R&D at Metglas, Inc, USA. His research interests include: magnetism in amorphous and nanocrystalline materials, power electronics, energy-efficient magnetic devices and charged-particle accelerators.

**Atsufumi Hirohata** is Lecturer at the University of York, UK. His research interests include: spin injection and detection in ferromagnet/semiconductor hybrid structures, spin modulation in lateral spin-valve devices and growth and characterisation of half-metallic Heusler alloy ferromagnets. Web site: [www.elec.york.ac.uk/staff/ah566.html](http://www.elec.york.ac.uk/staff/ah566.html)

**Ganping Ju** is Research Engineering Director at Seagate Technology. His research interests include: exploratory high-density media for heat-assisted magnetic recording, advanced perpendicular recording, high-anisotropy media, ultrafast spin/magnetization dynamics in ferromagnetic thin films, recording subsystem and novel magnetic materials, advanced magnetic and thermal characterization of recording media and time-resolved Kerr microscopy.

**Jordan A. Katine** is Research Staff Member at HGST and is a past Technical Committee Chair (2009-2010). His research interests include: magnetic recording, particularly nanoscale elements in recording heads such as CPP-GMR sensors, plasmonic antennas for thermally-assisted magnetic recording, spin torque phenomena such as STT-MRAM, ST-driven oscillators and device nanofabrication techniques, especially those applicable to magnetic devices.

**Olga L. Kazakova** is Principal Research Scientist at the National Physical Laboratory, UK. Her research interests include: nanomagnetism and ultra-small magnetic sensors (e.g. for biomedical applications), magnetism in novel materials (e.g. diluted magnetic semiconductors and oxides and transport in low-dimensional carbon-based materials. Web site: [www.npl.co.uk/quantum-phenomena/quantum/people/olga-kazakova](http://www.npl.co.uk/quantum-phenomena/quantum/people/olga-kazakova)

**Hyun Cheol Koo** is Principal Research Scientist at the Korea Institute of Science and Technology (KIST). His research interests include spin transport, spin-FET, gate-controlled spin modulation, spin-logic devices using spin diffusion and

*continued on page 7*

# Society Technical Committee *continued from page 6*

accumulation and spin-torque memory. Web site: [irda.kist.re.kr/faculty/khc.asp](http://irda.kist.re.kr/faculty/khc.asp)

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**Casey W. Miller** is Assistant Professor of Physics at the University of South Florida. His research interests include: spintronics, magnetic tunnel junctions, spin filtering, spin-polarization measurements, spin Seebeck effect, exchange bias and magnetocaloric effect. Web site: [shell.cas.usf.edu/millerlab/index.html](http://shell.cas.usf.edu/millerlab/index.html)

**Paulo D. Morais** is Professor of Physics at the University of Brasilia, Brazil. His research interests include: nanosized magnetic-particle-based materials, and preparation and characterization for industrial and biomedical applications.

**Markus Muenzenberg** is Research Group Head at the Institute for Low Temperature Physics, at the University Göttingen, Germany. His research interests include: spin dynamics, ultrafast time-resolved spectroscopy, spin-torque devices and spin transport, aiming to study ps-resolved spin transport in nanoscale magnetic devices. Web site: [www.uni-goettingen.de/de/99100.html](http://www.uni-goettingen.de/de/99100.html)

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**Rudolf Schaefer** is Head of the Magnetic Microstructures Department at IFW Dresden, Germany. His research interests include: exploration of magnetic microstructure and magnetization processes in all kinds of magnetic materials, mainly based on regular and stroboscopic Kerr microscopy, understanding the anatomy and physics of magnetic domains as well as their dynamic behavior. Web site: [www.ifw-dresden.de/institutes/imw/sections/24/members/schaefer](http://www.ifw-dresden.de/institutes/imw/sections/24/members/schaefer)

**Toshiyuki Shima** is Professor at Gakuin University, Japan. His research interests include: magnetization process and thermal stability in hard magnetic films/dot arrays with perpendicular anisotropy such as L10 ordered Fe-Pt, Nd-Fe-B,

*continued on page 8*

# Society Technical Committee *continued from page 7*

Sm-Co alloy films. Web site: [www.nanonet.go.jp/english/mailmag/2006/072b.html](http://www.nanonet.go.jp/english/mailmag/2006/072b.html)

**Alexandru Stancu** is Professor and Director at the Excellence Research Center CARPATH, Romania. His research interests include: modeling and computational magnetism, general hysteresis theory, Preisach-type models, magnetic characterization methods (FMR, TS, FORC/SORC, deltaM), toggle MRAM, nanomagnetism, interactions in nanostructured magnetic materials, hysteresis in multiferroics, molecular magnetism, spin-transition materials, hysteresis in molecular magnets – quantum effects. Web site: [stoner.phys.uaic.ro/amon/staff1/alexandru\\_stancu.html](http://stoner.phys.uaic.ro/amon/staff1/alexandru_stancu.html)

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**Toshiyuki Ueno** is Professor at the University of Kanazawa, Japan. His research interests include: giant magnetostrictive materials (GMR), magnetic-force control using composite magnetostrictive/piezoelectric materials, microactuators using iron-gallium alloys (Galfenol). Web site: [kurt.kanazawa-u.ac.jp/souran\\_ku/info\\_e.php?teacher\\_id=683](http://kurt.kanazawa-u.ac.jp/souran_ku/info_e.php?teacher_id=683)

**Paolo Vavassori** is currently Researcher and Aggregate Professor at the Physics Department of the University of Ferrara, Italy and Co-Group Leader of the Nanomagnetism Group at CIC nanoGUNE. His research interests include: magneto-optics, magnetization reversal and soft spin waves modes in nano-structures, sub-ps thermomechanical and magnetic dynamics of arrays of nanomagnets and magneto-transport properties of nano-structures. Web site: [www.nanogune.eu/en/research/nanomagnetism/people/paolo-vavassori/](http://www.nanogune.eu/en/research/nanomagnetism/people/paolo-vavassori/)

**Pieter B. Visscher** is Professor of Physics at the University of Alabama. His research interests include the theory and simulation of magnetization dynamics and applications to magnetic recording, calculations of spontaneous switching rates (stability) in novel magnetic media (e.g. graded anisotropy, read-induced errors in spin torque MRAM) and statistical (Fokker-Planck) theories of spin-torque switching. Web site: [bama.ua.edu/~visscher/](http://bama.ua.edu/~visscher/)

**John Q. Xiao** is Professor in the Department of Physics and Astronomy at the University of Delaware. He is also Director of the Center for Spintronics and Biodetection. His research interests include: spintronics, focus on the synthesis of magnetic tunnel junctions, structure-property relationship, and the spin dynamics in spintronic devices, development of soft magnetic materials, particularly with high frequency properties and metamaterials of designed dielectric permittivity and permeability for microwave and optical applications. Web site: [www.physics.udel.edu/~csb](http://www.physics.udel.edu/~csb)

## New Senior Members

Senior Member is the highest grade for which IEEE members can apply. The following members of the IEEE Magnetics Society were recently elevated to the grade of Senior Member.

Oct 2011: Laura Heyderman and Kai Liu.

Nov 2011: Yung-Kang Chin, Thomas Lingel and Steve Zhao.

For further information, visit the IEEE Web site at:

[http://www.ieee.org/membership\\_services/membership/grade\\_elevation.html](http://www.ieee.org/membership_services/membership/grade_elevation.html)



## 2012 Distinguished Lecturers

The IEEE Magnetics Society selected four Distinguished Lecturers (DLs) for 2012. They are:

- ▶ Shinji Yuasa (AIST, Japan);
- ▶ George C. Hadjipanayis (University of Delaware, USA);

- ▶ Gerrit E. W. Bauer (TU Delft, The Netherlands);
- ▶ Masahiro Yamaguchi (Tohoku University, Japan).

Each DL makes his own schedule, so contact them early, via the email addresses below.

IEEE Magnetics Society 2012 Distinguished Lecturer

### Magnetoresistance and Spin-Transfer Torque in Magnetic Tunnel Junctions

Shinji Yuasa - National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan

A magnetic tunnel junction (MTJ) consisting of a thin insulating layer (a tunnel barrier) sandwiched between two ferromagnetic electrodes exhibits the tunnel magnetoresistance (TMR) effect due to spin-dependent electron tunneling. Since the discovery of room-temperature TMR in the mid-1990s, MTJs with an amorphous aluminum oxide (Al-O) tunnel barrier have been studied extensively. Such MTJs exhibit a magnetoresistance (MR) ratio of several tens of percent at room temperature (RT) and have been applied to magnetoresistive random access memory (MRAM) and the read heads of hard disk drives. MTJs with MR ratios substantially higher than 100%, however, are desired for next-generation spintronic devices. In 2001, first-principle theories predicted that the MR ratios of epitaxial Fe/MgO/Fe MTJs

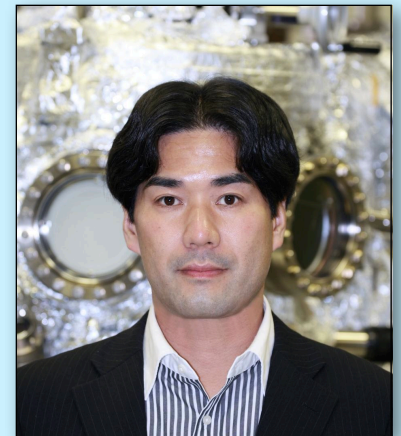
with a crystalline MgO(001) barrier would be over 1000% due to the coherent tunneling of specific Bloch states. In 2004, MR ratios of about 200% were obtained for MgO-based MTJs [1]. MTJs with a CoFeB/MgO/CoFeB structure were developed for practical application and found to have MR ratios of above 200% and other practical properties.

This lecture focuses on the physics of magnetoresistance and spin-transfer torque in MTJs and the application of MTJs to various spintronic devices such as magnetic sensors, spin-transfer-torque MRAM (STT-RAM or spin-RAM) with perpendicular magnetization, and novel spin-torque oscillators. In addition, new types of MTJs such as spin-filter junctions with a ferromagnetic tunnel barrier will be discussed.

**Shinji Yuasa** received the Ph.D. degree in physics from Keio University in 1996. After receiving his doctorate, he served as a Staff Scientist at the Electrotechnical Laboratory, Tsukuba, Japan, where he worked on spin-dependent transport in metallic magnetic multilayers. Since 2001, he has been a Staff Scientist at the National Institute of Advanced Industrial Science and Technology (AIST), working on the physics and device applications of MTJs. Since 2010, he has been a Director of the Spintronics Research Center at AIST. He has published more than 100 peer-reviewed papers and has given more than 80 invited talks at international conferences. For his achievement of the giant TMR effect in MgO-based MTJs, Dr. Yuasa has been awarded or co-awarded 20 prizes, including the Asahi Award in 2007. He is now serving as a program co-chair

for the 2013 Joint MMM / InterMag Conference and is a member of the advisory committee for the MMM Conference and an editor of *Applied Physics Express*.

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## Science and Technology of Modern Permanent-Magnet Materials

George C. Hadjipanayis, Department of Physics and Astronomy,  
University of Delaware, Newark, Delaware, USA

Permanent magnets (PMs) are indispensable for the electric, electronic and automobile industries, information technologies, automatic control engineering and many other commercial and military applications. In most of these applications, an increase in the magnetic energy density of the PM, usually presented via the maximum energy product,  $BH_{max}$ , immediately increases the efficiency of the whole device and makes it smaller and lighter. Worldwide demand for high-performance PMs has increased substantially in the past few years, driven by hybrid and electric cars, wind turbines and other power generation systems.

A dramatic improvement in the performance of PMs was made during the 20th century, with  $BH_{max}$  increased by more than 100 times, as a result of major advances in solid state physics, materials science and metallurgy. However, new energy challenges in the world require devices with higher energy efficiency and minimum environmental impact. The potential

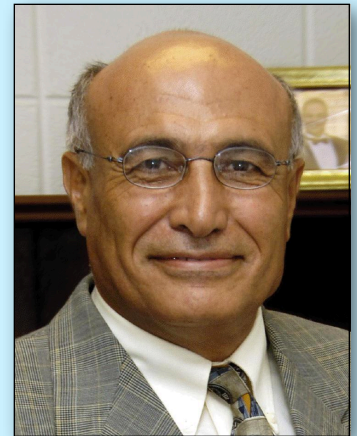
of 3d-4f compounds that revolutionized PM science and technology is nearly fully utilized, and the supply of 4f rare-earth elements is no longer assured.

This lecture will cover the major principles guiding the development of PMs, including the important role of microstructure on coercivity, and overview state-of-the-art theoretical and experimental research. Recent progress in the development of nanocomposite PMs, consisting of a fine (at the scale of magnetic exchange length) mixture of phases with high magnetization and large magnetic hardness will be discussed. Fabrication of such PMs is currently the most promising way to boost the, while simultaneously decreasing, at least partially, the reliance on the rare-earth elements. Current efforts in the development of high performance non-rare-earth magnets and their future prospects will also be discussed.

**George Hadjipanayis** received the B.Sc. degree in Physics from the University of Athens (1969), and the M.Sc. and Ph.D. degrees in Physics from the University of Manitoba (Canada), in 1974 and 1979, respectively.

Prof. Hadjipanayis was an assistant professor (1982-1985) and associate professor (1986-1988) in the Department of Physics at Kansas State University. In 1989 he joined the faculty of the University of Delaware as a full professor. In 1998, Prof. Hadjipanayis was a Humboldt Senior Fellow at the Max Planck institute (Stuttgart, Germany). In 1999, he assumed the position of Richard B. Murray Distinguished Professor of Physics and Astronomy and since 2003 has been the Chair of the Department of Physics and Astronomy at the University of Delaware. He has been recognized for seminal advances in scholarship with the Francis Alison Award (2005) and by elevation to Fellow of the American Physical Society (2001). Prof. Hadjipanayis' areas of interest span hard magnetic materials with a focus on high performance permanent magnets

and magnetic nanoparticles for storage media and biomedical applications. He has published more than 500 technical articles in peer-reviewed science and engineering journals, including book chapters, review articles, and invited technical feature articles on the topical areas of rare earth magnetism, nanotechnology, and permanent magnet materials, among others.



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## Spin Caloritronics

Gerrit Ernst-Wilhelm Bauer, Institute of Materials Research, Tohoku University, Japan  
and Kavli Institute of NanoScience, TU Delft, The Netherlands

The spin degree of freedom of the electron affects not only charge, but also heat and thermoelectric transport, leading to new effects in small structures that are studied in the field of spin caloritronics (from *calor*, the Latin word for heat).

This lecture addresses the basic physics of spin caloritronics. Starting with an introduction into thermoelectrics and Onsager's reciprocity relations, the generalization to include the spin dependence in the presence of metallic ferromagnets will be addressed. Using this foundation I will describe several recently discovered spin-dependent effects in metallic nanostructures and tunneling junctions as well as a multitude of spin-related thermal Hall effects in terms of a two spin-current model of non-interacting electrons.

Next, I will argue that different classes of spin caloritronic effects exist that can be explained only by the collective spin

dynamics in ferromagnets. The thermal spin transfer torque that allows excitation and switching of the magnetization in spin valves as well as the operation of nanoscale heat engines is complemented by thermal spin pumping. The latter generates the so-called spin Seebeck effect, which is generated by a heat current-induced non-equilibrium of magnons at a contact between an insulating or conducting ferromagnet and a normal metal. Under these conditions a net spin current is injected or extracted from the normal metal that can be detected by the inverse spin Hall effect.

Both classes can be formulated by scattering theory of transport in the adiabatic approximation for the magnetization dynamics and computed in terms of material-dependent electronic structures. Further topics to be addressed are the relation between electric, thermal and acoustic actuation, as well as the application potential of spin caloritronics.

**Gerrit Ernst-Wilhelm Bauer** received the Engineering degree in chemical technology in 1980 from Twente University, The Netherlands, and the Doctor degree in physics in 1984 from the Technical University Berlin, Germany, for research carried out at the Hahn-Meitner-Institute of Nuclear Research.

After a postdoc at the Institute for Solid State Physics of the University of Tokyo (1984–86), he became a member of the Scientific Staff of the Philips Research Laboratories (1986–92). He was appointed Professor of Physics at Delft University of Technology in 1992 and at Tohoku University in 2011. He coauthored more than 200 refereed scientific papers in the area of condensed matter physics, in the last two decades mainly in the field of magnetoelectronics/spintronics.

Prof. Bauer received the Wilhelm-Conrad-Röntgen Award from Würzburg University (2000), the Outstanding Referee Award by the American Physical Society (2008), and the Lars Onsager

Medal from the Norwegian University of Science and Technology (2009). He became Fellow of the American Physical Society in 2010 “for exposing the interaction between spin transport, magnetization dynamics, charge and heat transport, and mechanical motion.”



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## Soft Magnetic Thin Film Applications at Radio Frequencies

Masahiro Yamaguchi, Department of Electrical and Communication Engineering,  
Tohoku University, Sendai, Japan

Development of new passive component technologies will enable a “More-than-Moore” paradigm leading to innovative application-specific compact systems. Ferromagnetic thin film materials, having high permeability at (and above) radio frequencies, are candidate materials for use in inductive passive components that are available in the forms of vacuum-deposited and electro-deposited metallic alloys, chemically synthesized nano-particulate composites, and traditional oxides, among others. Using these materials, the development of CMOS-integrated inductors and integrated electromagnetic noise suppressors for radio-frequency-integrated circuits (RFIC) and point-of-load (POL) one-chip dc-dc converters in “3.9th Generation” mobile phones that use the Long Term Evolution standard, is attracting great interest from both academic and industrial communities.

This lecture begins with a review of new soft-magnetic thin-film applications at radio frequencies for future system-in-package (SiP) and system-on-chip (SoC) technologies. Proposed in the

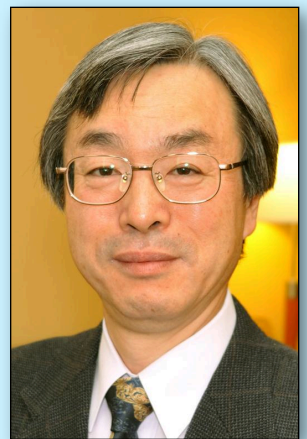
late 1970s, these thin-film soft-magnet applications have evolved from inductive read/write recording-head technology to the frontiers of gigahertz-frequency device applications. Discussions covered in this lecture include: 1) Development of international cross measurements of RF permeameters to evaluate RF permeability and related ferromagnetic resonance (FMR) profiles of magnetic films; 2) small signal, high permeable, low-loss applications to CMOS-integrated inductors; 3) small-signal lossy application to CMOS-integrated electromagnetic noise suppressor; 4) small-to-medium signal applications as new metal/ferromagnetic multi-stack “conductors” to suppress skin-effect-utilizing negative permeability beyond the FMR frequency; and, 5) large-current permeable application to POL type one-chip dc-dc converters.

The lecture will conclude with an outlook that provides a perspective on the future of on-chip RF magnetics.

**Masahiro Yamaguchi** received the B.S., M.S., and Ph.D. (Dr. Eng.) degrees in electrical and communication engineering from Tohoku University, Sendai, Japan, in 1979, 1981, and 1984, respectively.

He was an Associate Professor with the Research Institute of Electrical Communication, Tohoku University, from 1991 to 2003. In 1995, he was a visiting Associate Professor at the University of Wisconsin-Madison. Since 2003, he has been serving as Professor in the Department of Electrical and Communication Engineering, Tohoku University. He is also with the New Industry Creation Hatchery Center (NICHe), Tohoku University, since 2010. His research interest cover RF permeability and FMR measurements for magnetic thin films, RF magnetic field measurements for IC chips to analyze and counter electromagnetic interference, and application of soft magnetic materials for on-chip RF devices including thin film inductor, noise suppressor, and skin-effect free multilayer conductor for telecommunication and micro-power-conversion technologies.

Prof. Yamaguchi established and served as the general chair for the International Workshop on High Frequency Micromagnetic Devices and Materials (MMDM, 2002–2008). He has served as the IEEE Magnetics Society Japan-Sendai Chapter Chair (2007), co-editor-in-chief for the Magnetics Society of Japan (2007–2010), and board member of Japan Institute of Electronics Packaging (2008–2010). He is currently the chairman of the committees on On-Chip RF Magnetics of the Institute of Electrical Engineers of Japan (2011–2014).



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# Hong Kong Chapter News

By Philip Pong, Hong Kong Chapter Chair

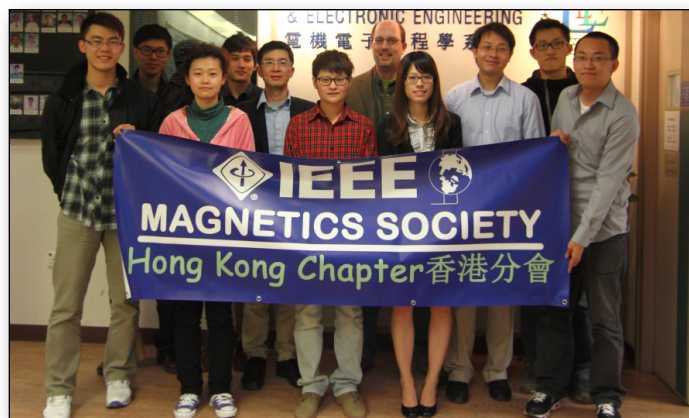
The Hong Kong Chapter organized the IEEE Magnetics Society Symposium on Magnetism and Magnetic Technologies with Student Workshop. This symposium was featured by the two keynote speeches given by Prof. Johan van Lierop from the University of Manitoba and Prof. Ko-Wei Lin from the National Chung Hsing University.

Prof. van Lierop talked on magnetic frustration in nanomagnetism while Prof. Lin gave a lecture on structural and magnetic characterization of magnetic thin films. This symposium also contained a student workshop composed of nine presentations by the graduate students from the National Chung Hsing University of Taiwan, City University of Hong Kong, and the University of Hong Kong. The students presented their research works covering a wide spectrum:

resistive switching in ferromagnetic materials, ion-beam bombarded materials, FePt nanoparticles, MTJ biosensors, flux concentrator design, smart grid, and so on.

Prof. van Lierop and Prof. Lin provided feedback and guidance on the research and presentation skill of each student presentation. After the symposium, the students had an excursion to the downtown area of Hong Kong.

The Hong Kong Chapter formed the Student Group which comprises both graduate and undergraduate students working on magnetism in Hong Kong. The Student Group assisted the organization of this Symposium and also led the excursion. They also volunteer as the web master for the website of the Hong Kong Chapter.



# France Chapter News

By Bernard Diény, France Chapter Chair

The French Chapter of the IEEE Magnetic Society was heavily involved in the organization of the 14th Louis Néel Colloquia on "Magnetic Thin Films and Nanostructures", which has been organized every 18 months in France for the past 20 years. Approximately 200 researchers attended, mainly from France and from European countries working in the field of nanomagnetism and spintronics. The colloquia attract both young and senior researchers and the presentations are mainly given by young PhD students and post-doctoral researchers. For PhD students, these colloquia are often the first opportunity for presenting their work in front of the nanomagnetism community.

Each meeting is organized in a different place by one of the major laboratories represented in the scientific committee. This year, for the first time, the 14th meeting took place in Brest; organized by the Laboratoire de Magnétisme de Bretagne (Brest University). During two and half days from the 21st to the 24th of September 2011, the attendees were present in an exceptional location at the Oceanpolis ocean discovery park Oceanopolis, situated in the Brest marina.

As in previous editions, the aim of the organizing and scientific committees has been to attract most of the young French researchers in magnetism thanks to a great scientific program and low registration fees.

There were 40 oral contributions (given mainly by PhD students) in 5 oral sessions devoted to "Spin Dynamics", "Nanostructures", "Spintronics", "theory" and "Applications: sensors, biology, medicine...". More than 100 posters were presented in three poster sessions. Six prizes were awarded to the best posters. On the first day, a special session was dedicated in homage to our colleague Catherine Dufour.

During the second day in the afternoon, a free time period allowed the attendees to go either on a cruise in Brest harbor, or a journey west of Brittany to discover the lighthouse and the ancient abbey of St Matthieu. Incidentally, it was at Brest harbor that where Louis Néel elaborated a simple method to protect ships against magnetic mines, based on the demagnetization of ships using huge coils in the harbor.

The quality of the scientific program combined with the convivial atmosphere and enough free time for discussions, contributed to the creation of new ideas and to strengthening of relationships within the French magnetism community members.

The colloquium has been financially supported by various local, private and institutional organizations, and the French chapter of the IEEE Magnetic Society.



# Meet The IEEE Fellow Nomination Subcommittee

By John Moreland, IEEE Fellow Nomination Subcommittee Chair

IEEE Fellow is a distinction reserved for select IEEE members whose extraordinary accomplishments in any of the IEEE fields of interest are deemed fitting of this prestigious grade elevation. The Magnetics Society has established the Fellows Nomination Subcommittee as part of the Awards Committee to help with the nomination process.

IEEE Fellow nominees are classified into the following four categories:

- Application Engineer/Practitioner
- Educator
- Research Engineer/Scientist
- Technical Leader

At the time the nomination is submitted, a nominee must:

- have accomplishments that have contributed importantly to the advancement or application of engineering, science and technology, bringing the realization of significant value to society;
- hold IEEE Senior Member or IEEE Life Senior Member grade;
- have been a member in good standing in any grade for a period of five years or more preceding 1 January of the year of elevation.

Other important information:

- All forms (nomination, reference, and endorsement by the Society) must be received no later than 1 March.
- Submitting a nomination early gives references and endorsers more time to complete their form.
- At least five references are required - a reference must be an IEEE Fellow or IEEE Life Fellow in good standing

The goals of the subcommittee are to help promote eligible regular members to IEEE Senior Member grade, identify and encourage highly qualified Senior Members to put together Fellow nomination packages, and generally help with promotions and nominations, including submitting Senior Fellow nominations, writing letters of reference, and finding others to write letters. Please feel free to contact the committee for help in these matters.

The Fellows Nomination Subcommittee:

John Moreland (Chair)	moreland@boulder.nist.gov
Shan Wang	sxwang@stanford.edu
Jinliang He	hejl@tsinghua.edu.cn
John Snyder	snyderje@cardiff.ac.uk
Horia Chiriac	hchiriac@phys-iasi.ro

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## AdCom Election Results

By Randall Victora, Nominations Committee Chair

Each year, the Magnetics Society holds an election for 8 three-year terms on AdCom. This year, the nominations committee consisted of Bernard Dieny, Claudia Felser, Hiroaki Muraoka, Liu Bo, Ron Goldfarb, Dmitri Litvinov, Jan-Ulrich Thiele, Takao Suzuki (ex-officio) and Randall Victora (chair).

Nominations were solicited from all members of the Magnetics Society. The election extended from September 19 – October 26. 532 ballots representing 18.4% of society members were received.

The elected members for 2012-2014 are:

- Russell Cowburn
- Laura Heyderman (2nd term)
- Atsufumi Hirohata
- Albrecht Jander
- David Jiles
- Kai Liu
- John Snyder (2nd term)
- Leonard Spinu

## Conference Calendar

May 7-11, 2012 International Magnetism Conference INTERMAG 2012  
Vancouver, BC, Canada  
Web site: [www.intermagconference.com/2012/](http://www.intermagconference.com/2012/)

May 20-23, 2012 International Memory Workshop IMW2012  
Milan, Italy  
Web site: [ewh.ieee.org/soc/eds/imw/](http://ewh.ieee.org/soc/eds/imw/)

May 22-26, 2012 9th International Conference on the Scientific and Clinical Applications of Magnetic Carriers  
Minneapolis, MN, USA  
Web site: [www.magneticmicrosphere.com](http://www.magneticmicrosphere.com)

Sep 2-5, 2012 22nd Workshop on Rare-Earth Permanent Magnets And Their Applications  
Nagasaki, Japan  
Web site: [intrax.jp/REPM2012/](http://intrax.jp/REPM2012/)

Sep 9-14, 2012 Joint European Magnetic Symposia 2012  
Parma, Italy  
Web site: [www.jems2012.it](http://www.jems2012.it)

Nov 14-19, 2012 International Conference on Megagauss Magnetic Field Generation  
Maui, HI, USA  
Web site: [www.megagauss.org](http://www.megagauss.org)

Nov 3-8, 2013 57th Conference on Magnetism & Magnetic Materials MMM 2011  
Denver, CO, USA  
Web site: [www.magnetism.org](http://www.magnetism.org)

To list your conference in the Newsletter Conference Calendar, please contact the Editor

## About The Newsletter

The purpose of the IEEE Magnetics Society Newsletter is to publicize activities, conferences, workshops and other information of interest to the Society's members and other technical people in the general area of applied magnetism. Manuscripts are solicited from Magnetics Society members, conference organizers, Society Officers & other volunteers, local chapters, and other individuals with relevant material.

The Newsletter is published in January, April, July and October electronically on the Magnetics Society webpage at [www.ieeemagnetics.org](http://www.ieeemagnetics.org). Submission deadlines are January 1, April 1, July 1, and October 1 respectively.

Please send articles, letters & other contributions to the Newsletter Editor:

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