# IEEE Magnetics Society
## Santa Clara Valley Chapter

The objective of the Santa Clara Valley Chapter of the IEEE Magnetics Society is to sponsor local seminars and publicize conferences, workshops and other information of interest to the Society's local members and technical people in the area of applied magnetics.

**Web Site: http://www.ewh.ieee.org/r6/scv/mag/**

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Georg Lauhoff
Samsung Information Systems America
Tel: (408) 544-5884
Email: georglauhoff@georglauhoff.com

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Joost Mortelmans
HGST (ret.)
Tel: (650) 941-8035
Email: mortelma@gmail.com

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Tel: (650) 494-0268
Email: UriCohen111@yahoo.com

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Tel: (408) 472-3769
Email: dbrsap@aol.com

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Tel: (408) 997-1826
Email: r.hoyt@ieee.org

## 2008 Meetings

| | |
|---|---|
| 1/29/08 | **The Spin is on Electronics**<br>Stuart Parkin, IBM Almaden Research Center |
| 2/12/08 | **Patterned nanomagnetic bits and devices**<br>Bruce D. Terris, Hitachi Global Storage Technologies |
| 3/18/08 | **Home digital storage hierarchy and consumer storage demand**<br>Thomas M. Coughlin, Coughlin Associates |
| 4/15/08 | **Magnetism and polarized soft X-rays**<br>**Towards fundamental magnetic length and time scales**<br>Peter Fischer, Lawrence Berkeley Nat. Laboratory |
| 5/27/08 | **Spintronic biochips for biomolecular recognition**<br>P.P.Freitas, INESC MN, Lisbon, Portugal and Physics Department, Instituto Superior Tecnico, Lisbon, Portugal |
| 6/10/08 | **Integrated On-Chip Inductors Using Magnetic Materials**<br>Don Gardner, Intel Corporation |
| 9/9/08 | **A BRIEF HISTORY OF AMPEX – 1944 to 1962**<br>John M. Leslie and Jay McKnight |
| 10/14/08 | **Turbulent Transitions and Frustrated States: Some Issues in Reversal**<br>Robert Stamps, University of Western Australia |
| 11/11/08 | **Current Magnetic Recording Media Performance and Future Challenges**<br>Tom Yamashita, VP Engineering, Western Digital Media Operations |

# 2008 Meetings Abstracts

# January 29, 2008

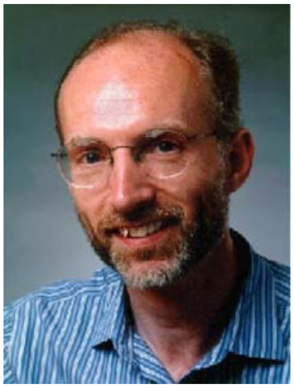
## THE SPIN ON ELECTRONICS!


## Stuart Parkin, IBM Almaden Research Center

(2008 IEEE Magnetic Society Distinguished Lecturer)


Today, nearly all microelectronic devices are based on storing or flowing the electron's charge. The electron also possesses a quantum mechanical property termed "spin", that gives rise to magnetism. Electrical current is comprised of "spin-up" and "spin-down" electrons, which behave as largely independent spin currents. The flow of these spin currents can be controlled in thin-film structures composed of atomically thin layers of conducting magnetic materials separated by non-magnetic conducting or insulating layers. The resistance of such devices, so-called spin-valves and magnetic tunneling junctions, respectively, can be varied by controlling the relative magnetic orientation of the magnetic layers, giving rise to magnetoresistance tailored for different applications. Recent advances in generating, manipulating and detecting spin-polarized electrons and electrical current make possible new classes of spin based sensor, memory and logic devices, generally referred to as the field of spintronics. In particular, the spin-valve is a key component of all magnetic hard-disk drives manufactured today and enabled their nearly 1,000-fold increase in capacity over the past eight years1. The magnetic tunnel junction allows for a novel, high performance random access solid state memory which maintains its memory in the absence of electrical power. The respective strengths of these two major classes of digital data storage devices, namely the very low cost of disk drives and the high performance and reliability of solid state memories, may be combined in the future into a single spintronic memory-storage technology, the magnetic Racetrack. The Racetrack is a novel three dimensional technology which uses nanosecond long pulses of spin polarized current to move a series of magnetic domain walls along magnetic nanowires2.


1. Stuart Parkin et al., Magnetically engineered spintronic sensors and memory. Proc. IEEE 91, 661-680 (2003).
2. S. S. P. Parkin, US Patent # 6,834,005, 6,898,132, 6,920,062, 7,031,178, and 7,236,386 (2004-2007).

**Stuart Parkin** is an IBM Fellow and Manager of the Magnetoelectronics group at the IBM Almaden Research Center, San Jose, California and a consulting professor in the Department of Applied Physics at Stanford University. He is also director of the IBM–Stanford Spintronic Science and Applications Center, which was formed in 2004. He received his BA and PhD degrees from the University of Cambridge and joined IBM as a postdoctoral fellow in 1982, becoming a permanent member of the staff the following year. In 1999 he was named an IBM Fellow, IBM's highest technical honor. Parkin's research interests have included organic superconductors, high-temperature superconductors, and, for almost the past two decades, magnetic thin film structures and spintronic materials and devices for advanced sensor, memory, and logic application. He is a Fellow of the Royal Society, the American Physical Society, the Institute of Physics (London), the Institute of Electrical and Electronics Engineers, and the American Association for the Advancement of Science. Parkin is the recipient of numerous honors, including a Humboldt Research Award (2004), the 1999-2000 American Institute of Physics Prize for Industrial Applications of Physics, the European Physical Society's Hewlett- Packard Europhysics Prize (1997), the American Physical Society's International New Materials Prize (1994), the MRS Outstanding Young Investigator Award (1991) and the Charles Vernon Boys Prize from the Institute of Physics, London (1991). In 2001, he was named R&D Magazine's first Innovator of the Year and in October 2007 was awarded the Economist Magazine's "No Boundaries" 2007 Award for Innovation. In 2007 Parkin was named a Distinguished Visiting Professor at the National University of Singapore, a Visiting Chair Professor at the National Taiwan University, and an Honorary Visiting Professor at University College London, The United Kingdom. Parkin has been awarded Honorary Doctorates by the University of Aachen, Germany and the Eindhoven University of Technology, The Netherlands. Parkin has authored ~350 papers and has ~63 issued patents.


***Contact:*** Parkin can be reached at IBM Almaden Research Center, 650 Harry Road, San Jose, CA 95120-6099, USA; tel. 408-927-2390 and e-mail:sparkin@almaden.ibm.com.

# Tuesday, February 12, 2008

## PATTERNED NANOMAGNETIC BITS AND DEVICES


### Bruce D. Terris, Hitachi Global Storage Technologies

**(2008 IEEE Magnetic Society Distinguished Lecturer)**



As conventional magnetic recording technology extends to ever higher areal density, it is possible the often predicted, and constantly increasing, density limit will be reached. This limit will likely be in the range of 750 – 1000 Gb/in2. The use of nanofabrication to create patterned magnetic elements, or patterned media, is one of the proposed approaches with the promise of delaying the onset of superparamagnetism and thus enabling higher areal density. I will discuss many of the challenges that must be overcome for patterned media to be successful, including fundamental physics and material science issues, new fabrication technologies, nm-scale manufacturing tolerances, and low cost budgets.

One of these challenges is to controllably reverse one magnetic element, or bit, without affecting the neighboring elements. A narrow anisotropy distribution will be required, yet data suggest that as the element size shrinks, the distribution widens. This distribution arises from a number of sources, including shape and size distributions, edge effects, variations in the full film anisotropy and magnetostatic fields from neighboring elements. As will be discussed, understanding and controlling the switching properties of magnetic nanostructures is critical not only for patterned media, but for device applications such as MRAM cells and spintronic devices and, for current induced as well as field induced reversal.


Bruce D. Terris received the B.S. degree in applied physics from Columbia University and the M.S. and Ph. D. degrees in physics from the University of Illinois at Urbana-Champaign. After receiving his doctorate, he was a post-doctoral fellow for two years at Argonne National Laboratory. In 1985, he joined IBM as a Research Staff Member at the Almaden Research Center, San Jose, CA, and subsequently joined Hitachi GST when it was founded in 2003 and where he is currently the manager of Nanostructures group. His research interests have included thin film superconductivity and magnetism, contact electrification of insulators, and new types of scanning probe microscopes (STM, AFM, near-field optical, etc.). His current research is on nanoscale patterning of magnetic structures, thermally assisted magnetic recording, novel approaches to high density data storage and spin torque devices. He has co-authored over 90 refereed publications and been issued more than 20 US patents. He has recently served as program co-chair for Intermag 2006 and program chair for the Nanoscale Science and Technology Division of AVS for 2005. He currently serves on the Administrative Committees of the IEEE Magnetic Society and the MMM conference and will serve as US program chair for Intermag 2008 and US Conference Chair for Intermag 2011 (Taipei). He is a Fellow of the APS and AVS, and is a member of IEEE.


*Contact:* Dr. Bruce D. Terris, Hitachi Global Storage Technologies, San Jose Research Center, 3403 Yerba Buena Road, San Jose, CA 95135, USA; telephone +1 408 717 5262; Fax:+1 408 717 9065; e-mail: Bruce.Terris@ieee.org

# March 18, 2008

# HOME DIGITAL STORAGE HIERARCHY AND CONSUMER STORAGE DEMAND


## Thomas M. Coughlin, Coughlin Associates



This presentation discusses different mobile and static usage models for digital storage in consumer devices. These models define storage hierarchies that are useful for analyzing the proper digital storage technology for a consumer electronics application. Important characteristics of consumer storage devices are shown and guidelines are given for how digital storage should be designed in consumer devices. Demand for higher resolution content and for capturing ever greater details of the life of family members will drive increases in commercial as well as personal content storage demand. Sharing of content within a home or over the Internet creates much greater demand for storage since a shared file can be multiplied many times through network sharing


Dr. Coughlin is the Founder and President of Coughlin Associates. Tom has over 30 years of experience in the data storage industry as a working engineer and high level technical manager. In addition to regular technical and management consulting projects he is the publisher of reports on digital storage in consumer electronics as as content creation and distribution. He is the author of the recently published Digital Storage in Consumer Electronics: The Essential Guide from Newnes (a division of Elsevier). Tom has many published reports and articles on digital storage and its applications. He has 6 patents on magnetic recording and related technologies. Tom is the founder and organizer of the annual Storage Visions Conference, a partner to the International CES. Tom is a senior member and was 2007 chairman of the Santa Clara Valley IEEE Section and San Francisco Bay Area Council and was chairman of the Santa Clara Valley IEEE Consumer Electronics Society in 2006 and past chairman of the SCV IEEE Magnetics Society more than once.

Tom is a member of the IEEE CE Society Adcom. He is also a member of APS, AVS, IDEMA, SNIA, AAAS, TCG and SMPTE. Tom received a B.S. in Physics and an M.S.E.E. from the University of Minnesota (Minneapolis) and a PhD in Electrical Engineering from Shinshu University in Nagano, Japan.


*Contact:* Thomas M. Coughlin URL: www.tomcoughlin.com Email: tom@tomcoughlin.com
Phone: 408-871-8808

# April 15, 2008

## MAGNETISM AND POLARIZED SOFT X-RAYS - TOWARDS FUNDAMENTAL MAGNETIC LENGTH AND TIME SCALES

**Peter Fischer**
Center for X-ray Optics, Lawrence Berkeley National Laboratory

The challenge to modern magnetic microscopies is provide both spatial resolution in the nanometer regime, a time resolution on a ps to fs scale and elemental specificity which allows to study novel multicomponent and multifunctional magnetic nanostructures and their ultrafast spin dynamics which is of both fundamental and technological interest.

Magnetic soft X-ray microscopy combines X-ray magnetic circular dichroism (X-MCD) as element specific magnetic contrast mechanism with high spatial and temporal resolution. Fresnel zone plates used as X-ray optical elements provide a spatial resolution down to currently <15nm [1] which approaches fundamental magnetic length scales such as the grain size [2] and magnetic exchange lengths. Images can be recorded in external magnetic fields giving access to study magnetization reversal phenomena on the nanoscale. Utilizing the inherent time structure of current synchrotron sources fast magnetization dynamics with 70ps time resolution, imited by the lengths of the electron bunches, can be performed with a stroboscopic pump-probe scheme [3].

I will give an overview of the current status of high resolution magnetic soft X-ray microscopy. The data presented were obtained with the full-field soft X-ray microscope XM-1 at the Advanced Light Source in Berkeley CA. Selected examples on magnetic multilayers and nanostructured systems where both classical Oersted fields as well as spin torque phenomena are used to manipulate the magnetisation [4] demonstrate the potential of this novel diagnostic tool.

Future perspectives of magnetic soft X-ray microscopy aiming for <10nm spatial and fs time resolution will be discussed.

[1] W. Chao, et al., Nature 435, 1210, (2005); D.-H. Kim, et al., J. Appl. Phys. 99, 08H303, (2006)

[2] M.-Y. Im et al, Advanced Materials (2007) in print

[3] P. Fischer, et al., JMMM 310(2) pt 3 (2007) 2689

[4] G. Meier et al., Phys. Rev. Lett. 98, 187202 (2007)

**Peter Fischer**

Peter Fischer studied physics at the Technical University of Munich and received his PhD from the Technical University of Munich/Germany in 1993, followed by the habilitation thesis from the Universiy of Wuerzburg/Germany in 2000. After being a scientific group leader at the Max-Planck-Insitute for Metal Research in Stuttgart/Gemrany, he joined the Center for X-ray Optics at Lawrence Berkeley National Laboratory in 2004 where he is staff scientist within the Materials Science Division.

He is in charge of the scientific program and the user support at the high resolution soft X-ray microscope beamline at the Advanced Light Source, a world leading instrument serving a wide community in X-ray optics, nanomagnetism research, materials science and biology. His research interest are dedicated to use polarized X-rays to study magnetism at short length and time scales based on X-ray dichroism effects and he pioneered soft X–ray microscopy for magnetic imaging. His recent focus is on spin dynamics in nanoscale magnetic systems.

He has (co-)authored more than 90 refereed publications and he is serving the synchrotron community as a member of the proposal panels at the Swiss Light Source and the ALS and as a member of the international program committee for X-ray microscopy conferences. He is chair of the 7th International Symposium on Metallic Multilayers (MML2010) to be held in 2010 in Berkeley. He is a member of the MagSociety of IEEE and APS.

Contact:
Dr. Peter Fischer, Center for X-ray Optics, Materials Science Division, Lawrence Berkeley National Laboratory, MS 2-400, 1 Cyclotron Road, Berkeley, CA 94720 U.S.A, phone: +1 510 486 7052, fax: +1 510 486 4550, email: PJFischer@lbl.gov, http://www.cxro.lbl.gov/

# May 27, 2008

## SPINTRONIC BIOCHIPS FOR BIOMOLECULAR RECOGNITION

P.P.FREITAS,
INESC MN and Phys. Dept, Inst. Superior Tecnico, Lisabon, Portugal

Integrated spintronic biochip platforms are being developed for portable, point-of-care diagnostic applications. The platforms consist of a microfluidic unit where the bioassay takes place, an arraying and detector chip consisting of target arraying current lines and integrated magnetoresistive sensors, and electronic control and readout boards. Probe biomolecules are immobilized by microspotting over sensor sites, and target biomolecules, labeled with magnetic nanoparticles are arrayed over the probe sites ( magnetically assisted hybridization). After proper washing, hybridized targets are recognized by the fringe fields created by the magnetic beads, detected by the incorporated magnetoresistive sensors. Detecting geometries will be reviewed, using either out-of-plane or in-plane bead excitation, and dc or ac detection/excitation. Detection limits using spin valve and tunnel junction sensors will be presented, depending ultimately on platform electronic noise, and sensor noise characteristics. Applications to gene expression chips ( Cystic Fibrosis gene mutation detection) and imuno assay chips ( anti-body-antigen recognition, e-Coli, Salmonella detection) will be presented. Spintronic biochip are also being integrated into multi -module lab-on-chip platforms including i) biomolecule extraction from biological fluids ( magnetophoresis ), ii) PCR modules ( if required), and iii) the biomolecular recognition module. Alternative spintronic biochip geometries will also be presented ( lateral flow biosensors), where a magnetoresistive reader scans the surface of a porous strip, where labeled target biomolecules bind to immobilized probes. Finally, a brief review of other biomedical applications of magnetoresistive sensors will be given, from hybrid sensors targeted at biomedical imaging, to magnetic tweezers/sensors for DNA translocation monitoring.

Paulo Freitas is a Full Professor of Physics at the Instituto Superior Tecnico (IST) in Lisbon, and the Director of INESC Microsystems and Nanotechnologies. Current research topics include MRAMS, read heads for ultra high density recording, magnetoresistive biochips, and sensors for biomedical applications. He has been involved in research in the area of magnetoresistive materials and devices since he received his Ph.D in Solid State Physics from Carnegie Mellon University in 1986. His PhD thesis was on the subject of anisotropic magnetoresistance of ferromagnetic thin films and alloys. He then joined IBM Research at Yorktown Heights as a post doctoral fellow working on high-TC superconductivity and transport properties of ferromagnetic thin films. In 1988 he joined INESC in Lisbon, where he started the Solid State Technology Group.

In 1989 he became Professor of Physics at the Instituto Superior Tecnico in Lisbon. From 1992 to 1996, he was responsible for the start up and operation of INESC´s ASIC back-end of the line microfabrication facility. From 1996 till now, his research areas expanded to magnetoresistive read elements for magnetic data storage, magnetoresistive sensors, MRAMS, and biomedical applications including magnetoresistive biochips. He became director of INESC Microsystems and Nanotechnologies in 2001, and Full Professor of Physics at IST in 2002. Over this period, he co-authored over 200 technical papers and several chapter books. Professional activities include membership in IEEE, participation in several Publication/Program/Advisory Committees of MMM and Intermag Conferences.

Contact: Paulo Freitas, Physics Department, Instituto Superior Tecnico, Lisbon, Portugal. e-mail:pfreitas@inesc-mn.pt

# June 10, 2008

## Integrated On-Chip Inductors Using Magnetic Material

Don Gardner, Intel Corporation

On-chip inductors with magnetic material are integrated into both advanced 130 nm and 90 nm CMOS processes. The inductors use copper metallization and amorphous CoZrTa magnetic material. Increases in inductance of up to 28× were obtained, significantly greater than prior values for on-chip inductors. With such improvements, the effects of eddy currents, skin effect, and proximity effect become clearly visible at higher frequencies. The CoZrTa was chosen for its good combination of high permeability, good high-temperature stability (>250°C), high saturation magnetization, low magnetostriction, high resistivity, minimal hysteretic loss, and compatibility with silicon technology. The CoZrTa alloy can operate at frequencies up to 9.8 GHz, but tradeoffs exists between frequency, inductance, and quality factor. The effects of increasing the magnetic film thickness on the permeability spectra were measured and modeled. The inductors use magnetic vias and elongated structures to take advantage of the uniaxial magnetic anisotropy. Techniques are presented to extract and examine the effects of magnetic vias on the inductor structures. The inductors with thick copper and thicker magnetic films have inductance densities of up to 1.3 mH/mm2, resistances as low as 0.04 W, and quality factors of 8 at 50 MHz.

Dr. Gardner has been with Intel Corporation since 1991 and is currently a principal engineer in Intel Research and a visiting scientist at Stanford University. Don received his PhD in Electrical Engineering from Stanford University. He has had appointments as a visiting research scientist at Hitachi Research Labs in Japan and as an instructor at Stanford University. He is the inventor or co-inventor of 56 patents including for inductors using high-frequency magnetic materials, Al-Ti layered metal for interconnections, reflow of copper metal, and embedded ground planes. Don has published and/or presented over 200 electrical engineering, materials science and computer science papers. He has received 3 Best Paper and Poster awards at international conferences and his paper on inductors was judged the best at the IEEE IITC conference. He enjoys bringing new life to old technologies by blending them with different technologies or recent science and new materials. His current interests include magnetic materials for high-frequency inductors, nanostructure design and devices, silicon-based optoelectronic devices, and new process technology.

Contact: d.s.gardner@intel.com

# September 9, 2008

## A BRIEF HISTORY OF MAGNETIC TAPE RECORDING AT AMPEX – 1944 to 1962 by John M. Leslie and Jay McKnight

This talk covers the History of Magnetic tape recording at Ampex Corporation from its inception in 1944 to 1962. It includes highlights of: (1) what led a small motor manufacturer to become a major producer of magnetic tape recorders and an industry leader for decades; (2) development of the Ampex 200A; (3) the Model 300, which became the backbone of both the audio and data recording industries; (4) the Model 350 which became the workhorse of many radio and recording studios; (5) multi-channel recorders for widescreen theater productions; and (6) development of the Ampex VR-1000 videotape recorder that revolutionized the television broadcast industry. The paper also includes comments on the equalization characteristics used in Ampex's audio and data recorders. It closes with a look back at events that slowed the momentum of the "glory years" of Ampex.

BIOGRAPHY – John M. Leslie
Born 1921, in Springfield, MO.
BSEE ('49, Berkeley)
MSME ('63, Stanford)
EME ('65, Stanford)

Contact: johnmleslie@msn.com

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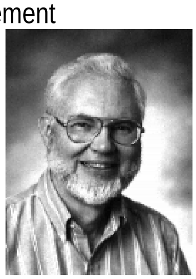
|---|---|---|
| Military | 1942 - 46 | U.S. Navy |
| Ampex Corp. | 1948 - 62 | Rising from Subcontractor to Vice President and General Manager |
| Stanford Univ. | 1963 - 65 | Associate Professor (acting) in Mechanical Engineering |
| Hewlett Packard | 1966 - 69 | Manager of Engineering |
| Pemtek Corp. | 1970 - 76 | Part owner and Vice President of Engineering |
| United Scientific Corp | '76 - 81 | Senior Vice President of Engineering, President of Analytical Instruments |
| Tracor Xray | 1981 - 84 | Vice President and General Manager |
| Retirement | | wonderful time with our 5 children, their spouses, 13 grandchildren |



Biography John G. (JAY) McKnight
Born 1931 in Seattle, Washington
BS in Elec. Eng. from Stanford University in 1952

Contact: jaymck@flash.net

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|---|---|---|
| Ampex Corp | 1952 - 72 | served in the magnetic recording research group, stereo tape and professional audio division |
| Magnetic Reference Lab. | | Co-founder (1973), president since 1975. |

Mr. McKnight has published over 60 papers on the theory and practice of magnetic recording, and audio engineering (see bibliography at http://home.flash.net/%7Emrltapes/jmbibsub.pdf ). In 1973/74 he was a member of Judge Sirica's "Advisory Panel on White House Tapes"("The Watergate Tapes"). Mr. McKnight has been very actively serving the Audio Engineering Society (AES): He is Fellow, President (1978/79), Honorary Member (1979), member of the AES Journal Review Board (1960 – '07), Governor 4 times, Standards Committee Chairman (1971 - 74), Publications Policy Committee Chairman (1977/78), Historical Committee Chairman (1999 - '06), and now Chair Emeritus of that Committee. He has been a member of several standards committees on audio engineering and magnetic recording. He received the AES's Publication Award (1982), AES Award (1971), Board of Governors Award (1990) and the AES Distinguished Service Medal Award (10/2008) for extraordinary service to the Society and contributions to the advancement of knowledge in magnetic recording over a period of more than 50 years. He is IEEE senior member, IEEE Magnetics Society member, "IRE (IEEE) Professional Group on Audio" member (1953 - 70).

# October 14, 2008

## Turbulent Transitions and Frustrated States: Some Issues in Reversal

Dr. R Stamps, University of Western Australia

A trend over the last few decades in many areas of science and technology has been to modify and control material properties through careful choice of dimensions. A key feature of such endeavors is to create useful physical properties governed by surfaces and interfaces. Important length scales in magnetic metals are spin diffusion, which ranges from angstroms to nanometers, and exchange lengths, which can be on the order of several nanometers. Advanced techniques now allow us to create structures on these length scales in three dimensions. This is a remarkable achievement because it often represents true atomic level engineering, and is based on years of detailed study of thin films and multi-layers. A rich wealth of fascinating phenomena has emerged from studies of these types of constrained geometry structures within the contexts of high speed magnetization reversal and magnetic domain stability. This lecture will provide an introduction to essential concepts, illustrate examples of new physics, and present some challenging, unanswered questions. Topics will include examples of frustration in exchange bias systems and analogies to spin glasses; control of nonlinear processes in patterned magnetic structures and parametric processes incurred during high speed reversal; pinned and viscous domain wall motion in ultra-thin films and nanowires; and electronic and spin wave transport through domain walls. These examples will illustrate reversal processes and domain stability issues relevant for a wide variety of magnetic device applications, including concepts being explored for novel spin logic schemes.

Robert Stamps received BS and MS degrees from the University of Colorado, and a PhD in Physics from Colorado State University. He has taught at the University of Colorado, Ohio State University, and has been with the University of Western Australia since 1997 where he is now Associate Professor in Physics. Dr Stamps has held a Humbolt Junior Fellowship at RWTH Aachen, CNRS Professorial Fellowships (Strasbourg and Orsay), CNR Fellowship (Florence), a University of Paris VII Visiting Professorship, and received a Faculty Excellence in Teaching award in 2001. His work on exchange bias and magnetization dynamics featured in his tenure as the 2004 Wohlfarth Lecturer. Professor Stamps has published over 140 papers on a range of topics in magnetism, including linear and nonlinear dynamics of magnetic and ferroelectric nanostructures, frustrated spin systems and spin glasses, inelastic light scattering and ferromagnetic resonance, spin electronics and domain wall dynamics in constrained geometries and random systems. He is a member of the IOP, Australian AIP, and IEEE Magnetics Society, chair of the 2007 MML Symposium, and currently serves on the advisory editorial board of the Journal of Magnetism and Magnetic Materials.

Contact: Robert Stamps, School of Physics M013, Univ of Western Australia, 35 Stirling Highway, Crawley WA 6018;

Tel: (+61) 8 6488 3794, Fax: (+61) 8 6488 1014, e-mail:stamps@physics.uwa.edu.au
http://www.physics.uwa.edu.au/about/research/condensed

# November 11, 2008

## Current Magnetic Recording Media Performance and Future Challenges

Tom Yamashita, VP Engineering, Western Digital Media Operations

Thin film magnetic recording media made a large scale transition to PMR technology starting in 2006 at around 130-180 Gb/in$^2$ areal density. This transition has been remarkably fast and effective. Just recently, we have announced a start of volume production of 400 Gb/in$^2$ mobile HDD product. This allows 500 GB capacity in 2 platters for a notebook HDD. The key enabler to this transition was the use of "granular oxide" media. The general characteristics of PMR media design and their performance from the beginning in 2006 to the current state will be described. It is expected that current PMR design will carry us thru at least to the next generation at between 500-600 Gb/in$^2$. At 800 Gb/in$^2$ and beyond however, it is generally agreed that more radical changes in media design will be required. These include discrete track recording (DTR) and also potentially a change to higher Ku magnetic materials which are quite fundamentally different from today's granular oxide media. These two new technologies make the next step in areal density increase one of the most daunting transitions ever undertaken by the media industry, perhaps rivaling the change from oxide to thin film media which occurred over 20 years ago. These challenges faced by the media technologist will be discussed to highlight some of the important considerations that have to be kept in mind, in order to make the new technologies a reality in a product.

Tom Yamashita is currently the VP of Engineering for Western Digital Media Operation. He was formerly the Chief Technical Officer of Komag Inc., and came to WD thru the acquisition of Komag by WD in September 2007. Current role at WD remains the same as before, which is to lead the R&D for WD Media Operation. Tom Yamashita holds BS in Chemistry and MS in Materials Science from Stanford University. He joined Komag in 1984 as one of the first dozen employees for the company, and he has been involved in the development of numerous technologies associated with thin film media. He holds many patents on magnetic films, overcoats, and other key media processes. Tom Yamashita was born in Japan, and emigrated to US at age of 10, and has been living in the Bay Area ever since.