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.

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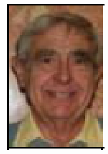

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2007 Meetings

1/26/07	**1Tb/sqi Recording on Patterned Media** Dr. Hans Richter, Seagate
2/16/07	**Spin Transfer Torque RAM Technology** Dr. Yiming Huai, Grandis
3/20/07	**Magnetic Nanoparticles** Prof. Sara Majetich, Carnegie Mellon Univ.
4/17/07	**Probing Ultrafast Magnetics with X-rays** Prof. Joachim Stohr, Stanford Synchrotron Lab
5/ 22/07	**Hybrid HDD's** Dr. Debasis Baral, Samsung Information Systems
6/ 12/07	**New Long Data Block Format Standard** Dr. Martin Hassner, Hitachi Global Storage
9/ 18/07	**State of the Art Ferrite Materials** Prof. V. Harris, Northeastern Univ.
10/19/07	**Imaging Magnetic Surfaces with Atomic Resolution** Dr. Mathias Bode, Univ. of Hamburg
11/21/07	**High Magnetic Anisotropy Nano-Composites and Applications** Prof. Takao Suzuki, Toyota Technological Institute

TUESDAY, JANUARY 16, 2007

Aspects of Recording on Patterned Media at Densities of 1Tb/in2 and Beyond

Hans Jürgen Richter
Recording Physics Group, Seagate Technology

Authors: H. J. Richter, A.Y. Dobin, O. Heinonen, K.Z. Gao, R.J.M. v. d. Veerdonk, R.T. Lynch, J. Xue, D. Weller, P. Asselin, M.F. Erden, and R.M. Brockie

Over the years, the recording density in magnetic recording technology has been continuously increased. To date, the highest recording density that has been publicly announced is Seagate's demonstration of 421 Gbit/in2 using perpendicular recording. One of the limitations to conventional perpendicular recording is the onset of superparamagnetism. The bits are defined by statistical means, that is, one has to define the bits with as many grains as possible. This requires a reduction of the grain size, which is eventually limited by the onset of superparamagnetic effects. It is generally agreed that this limits perpendicular recording to densities of 500 and 1000 Gb/in2. One of the leading candidates to increase areal density even further is recording on patterned media. Here one bit equals one grain and therefore, in light of the superparamagnetic effects, the areal density can be increased significantly. In the talk, a comprehensive analysis of the areal density potential of patterned media recording will be presented. The noise sources of patterned media, such as dot size fluctuations and dot spacing fluctuations are discussed and compared with recording on conventional media. The talk addresses general changes in a recording system that have to be made to achieve a successful recording system using patterned media. An aspect of particular importance is the requirement of synchronized writing. A statistical analysis shows that the recording performance is dominated by written-in errors rather than traditional signal-to-noise considerations. Written-in errors are caused by statistical fluctuations of the magnetic properties and the locations of the individual dots. The analysis shows that recording systems with a very low bit aspect ratio perform very poorly. The highest areal densities are obtained with a combination of a pole head, a soft magnetic underlayer and a storage medium of the composite type. Areal density scenarios of up to 5Tb/in2 are analyzed.

Hans Jürgen Richter received his degree in Electrical Engineering and his PhD (1989) from the Rheinisch-Westfälisch-Technische Hochschule Aachen in Germany. From 1989- 1995 he worked at BASF AG in Germany at the central research labs on magnetic, magnetooptical and optical data storage. Since 1995 he worked for Seagate Technology, where he has been leading the Recording Physics group. Dr. Richter is currently a Technologist at Seagate Technology. At Seagate, he has been working on both theoretical and experimental aspects of magnetic recording. He has been involved with longitudinal recording, anti-ferromagnetically coupled media, perpendicular recording and most recently with studies on bit patterned media. Dr. Richter has been active on the Editorial Board of the Transactions on Magnetics of the IEEE since 1996 and led the Technical Committee of the IEEE Magnetic Society from 1999-2004. He has published about 80 papers in peer-reviewed journals and 5 articles in textbooks and Encyclopedias. He currently holds 19 patents with another 14 pending and 1 trade secret. In 2005, he was consulting professor at Stanford University, CA.

TUESDAY, FEBRUARY 20, 2007

Spin-Transfer Torque RAM (STT-RAM) Technology

Dr. Yiming Huai
Grandis, Inc., Milpitas, CA 95035, USA

Spin-transfer torque writing technology, combined with the newly-observed high tunneling magnetoresistance (>300%) in MgO magnetic tunnel junctions (MTJs, provides an exciting path to realize Gbit-scale STT-RAM (Spin-Transfer Torque Random Access Memory) with low power consumption, fast operation speed (few ns), and excellent scalability to future semiconductor technology nodes. I will first describe the physics and mechanisms underlying spin-transfer torque switching (STS) and our experimental results showing spin-transfer switching in MgO MTJ bitcells. The techniques involved in reducing the critical STS current and achieving consistent switching in the nanosecond regime will be presented and discussed, along with recent experimental data. The key advantages of spin-transfer torque writing technology and the technical issues in commercializing STT-RAM will be highlighted. Finally, the potential applications of STT-RAM in mobile devices, digital consumer electronics and automotive products will be outlined. The excellent intrinsic attributes of STT-RAM are attractive for replacing not only existing nonvolatile memory products, but also Random Access Memory (RAM), such as SRAM and DRAM, in wireless and embedded applications.

Yiming Huai is Co-Founder, Chief Technology Officer and Vice-President of Engineering at Grandis, Inc., the pioneer in Spin-Transfer Torque RAM (STT-RAM) technology (www.grandisinc.com). Prior to Grandis, he held various positions, most recently as Senior Thin-Film Director at Read-Rite Corporation, where he led the development and manufacturing of industry-leading spin-valve recording heads for hard disk drives from 1996 to 2002. He previously worked as a Staff Scientist at the Lawrence Livermore National Laboratory (LLNL) on ultra-high density magnetic sensors and as a Post- Doctoral Fellow at the National Research Council in Ottawa, Canada. He received M.S. and Ph.D. degrees, both in Physics, from the University of Montreal in Canada.

Dr Huai has over 20 years' experience in thin-film materials, processing and devices. He has published over 90 papers in scientific journals, holds 32 patents and has more than 40 patents pending. He has given more than 15 invited talks on STT-RAM technology over the last three years and has served as Conference Chairman /Organizer for major international magnetics conferences and workshops. In 1996, he received the prestigious R&D 100 Award with his peers for his outstanding work on Ultra-High Density Magnetic Sensors.

TUESDAY, MARCH 20, 2007

MAGNETIC NANOPARTICLES: SELF-ASSEMBLY AND NANOSCALE BEHAVIOR

Prof. Sara A. Majetich
2007 IEEE Magnetics Society Distinguished Lecturer
Carnegie Mellon University

The magnetic behavior of a monodomain nanoparticle was first described by Stoner and Wohlfarth nearly sixty years ago, yet this simple system is frequently invoked in discussions of high-density magnetic recording media, magnetic refrigeration materials, and a host of biomagnetic applications. Here we will examine two crosscutting themes of current research on magnetic nanoparticles: self-assembly and nanoscale magnetic behavior. Different types of superstructure can be self-assembled from the same type of particles. In organic solvents, two-dimensional arrays with long-range order can be formed using Langmuir layer techniques. These monolayers are also used as nanomasks for crystallographically oriented thin films, which provide an alternative approach to preparing nanoparticle arrays for data storage media. Faceted threedimensional single “grain” nanoparticle crystals are formed by colloidal crystallization methods. Magnetic field gradients can also be used to guide self-assembly. For example, gold-coated iron oxide particles can be used to image self assembly dynamics in aqueous media, in response to patterned magnetic elements, using plasmon scattering and dark field optical microscopy to track single particles. The ability to make magnetic nanostructures creates a need for new tools that enable us to visualize their magnetization patterns. Small angle neutron scattering provides average magnetic correlation lengths within three-dimensional assemblies, where correlations of hundreds on nanometers may be present at low temperature. Electron holography shows real-space magnetization patterns of magnetic monolayers, where vortices and transverse domain walls are present as low energy excitations. Scanning probe techniques have the potential for single-particle-per-bit magnetic information storage.

Sara Majetich received her A.B. degree in chemistry at Princeton University, and a Masters Degree in Physical Chemistry at Columbia University. Her Ph.D. was in Solid State Physics from the University of Georgia, and following that she did postdoctoral work at Cornell University. She has been a faculty member in the Physics Department at Carnegie Mellon University since 1990 and is now a full professor there. Her awards include the Ashkin Award for excellence in teaching, the Carnegie Mellon University Undergraduate Advising Award, and a National Young Investigator Award from the National Science Foundation. She has three patents and over 100 publications. Her research interests focus on magnetic nanoparticles and nanocomposites and their applications

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TUESDAY, APRIL 17, 2007

PROBING THE ULTRAFAST MAGNETIC NANOWORLD WITH X-RAYS

Joachim Stöhr, Stanford Synchrotron Radiation Laboratory

The detailed understanding of advanced magnetic materials and phenomena requires new experimental techniques that are capable of probing materials on nanometer length scales and sub-nanosecond time scales. I will show that this can be uniquely accomplished by use of synchrotron x-rays that are tunable, polarized and pulsed. As examples, I will discuss the use of x-rays to probe interfacial phenomena such as exchange bias and their use for time-resolved imaging of spincurrent induced switching of magnetic nanostructures important in magnetic memory applications. I will also discuss how in the near future x-ray lasers will enable studies of the ultrafast magnetic nanoworld by means of femtosecond snapshots. These studies are expected to reveal fundamental limits of the magnetic switching speed.

Joachim Stöhr received his Ph.D. in Physics from the Technical University of Munich. After postdoctoral work at Lawrence Berkeley National Laboratory he worked as a staff scientist at the Stanford Synchrotron Radiation Laboratory (SSRL) and at EXXON Corporate Research Laboratory. He then spent nearly fifteen years at the IBM Almaden Research Center, where he conducted x-ray research in the areas of surface science and magnetic materials and managed various research departments. In January of 2000, he joined the faculty of Stanford University as Professor and was appointed Deputy Director of SSRL. In 2005 he became the forth Director of SSRL and an Associate Director of the Stanford Linear Accelerator Center (SLAC).

Prof. Stöhr's research has focused on the development of novel investigative techniques based on soft x-ray synchrotron radiation for exploring the structure, electronic and magnetic properties of surfaces and thin films. He played a major role in developing the surface extended x-ray absorption fine structure (SEXAFS) technique as a tool for exploring surface structures, especially atoms bonded to surfaces. He also developed the near edge x-ray absorption fine structure (NEXAFS) technique for the study of simple and complex molecules bonded to surfaces and for the study of thin polymer films. The technique is described in his book "NEXAFS Spectroscopy" (Springer, 1992). NEXAFS is widely used today, often in combination with x-ray microscopes, for the study of organic systems like polymers and biological cells. Over the last 15 years he has concentrated on the use of polarized soft x-rays to study magnetic materials and phenomena, especially thin films, interfaces and nanoscale structures. He has pioneered x-ray magnetic spectro-microscopy which allows the direct observation of nanoscale antiferromagnetic and ferromagnetic domain structures with elemental and chemical state specificity. Motivated by the technological drive of "smaller and faster", he has also pioneered time-resolved x-ray microscopy techniques with picosecond time resolution. These studies and more generally the whole field of magnetism form the topic of his second book, "Magnetism – From Fundamentals to Nanoscale Dynamics" (Springer, 2006), which he co-authored with Hans Christoph Siegmann. Besides his two books, Dr. Stöhr is the author of more than 250 scientific publications and several patents. He has served on many national and international advisory committees, most notably, the Basic Energy Sciences Advisory Committee (BESAC) of the U.S. Department of Energy.

More information can be found on his website http://wwwssrl.slac.stanford.edu/stohr.

Tuesday, May 22, 2007

Synergistic Integration of NV Flash and Hard Disk Drive – Creation of Hybrid HDD (HHDD)

Debasis Baral
Samsung Information Systems America, HDD Labs

Recently Samsung has introduced Hybrid Hard Disk Drives (HHDD) in the market. These drives have integrated non volatile flash memories with rotating disk drives and have shown better user experience with Microsoft's latest OS -Vista. In this presentation, we will explain basic principle of integration and operation of HHDD and discuss advantages and disadvantages of using flash memories along with large capacity hard drives. Finally we will review competing disk drives – SSD (Solid State Drive), HDD (Hard Disk Drive) and HHDD (Hybrid Hard Disk Drive) and their roles in user applications.

Debasis received his B.Sc and M.Sc degree in Physics from Presidency College, Calcutta and Delhi University respectively. Subsequently he joined Materials Science department of Northwestern University, Illinois and received Ph. D degree for his work on mechanical, magnetic and thermoelectric properties of compositionally modulated (multi-layer) thin metallic films. Debasis came to the valley in 1983 and worked for last 24 years at Memorex, Maxtor, Conner Peripherals, Western Digital and Samsung Information Systems America. Currently he is Vice President of SISA – HDD labs and oversees development of high capacity 3.5" drives and drive integration technologies for all form factor drives. He has published several papers and patents related to disk drive technology.

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TUESDAY, JUNE 12, 2007

Long Data Sectors, Capacity Growth and Data Integrity in HDD's

Dr. Martin Hassner, Hitachi Global Storage Technologies

The continued HDD Capacity Growth, at the current 512-Byte fixed Sector Format, is incompatible with the Storage User requirement of simultaneously improving the Data Integrity. The consequence of these incompatible requirements is a bottleneck that seems to limit the HDD Industry Capacity Growth. Long Data Sector coding solutions, that resolve this bottleneck, will be discussed.

Martin Hasner received a B.Sc and M.Sc at the Technion, Israel, and a Ph.D in 1980 at UCLA, all in Electrical Engineering. In 1980 he joined the IBM Research Division and has since worked on Coding and Signal Processing Applications for Magnetic Recording. Since 2002, when the IBM Storage Division and Research part were acquired by HITACHI, he has been with Hitachi GST Research.

Applications of his UCLA Ph.D. -Thesis on Modulation Codes, specifically the (1,7)-Code application, have been widely used throughout the industry during the 80's. The paper describing his Ph. D Thesis work was also awarded the Best Paper Award by the IEEE Transactions on Information Theory in 1986. In 1990 he introduced the first Key Equation Solver Reed Solomon-Decoder implementation in a Hard Disk Controller in IBM Storage Products. He has received several IBM Outstanding Innovation Awards and was an IBM Master Inventor. He holds 50 US Patents.

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TUESDAY, OCTOBER 16, 2007

IMAGING MAGNETIC SURFACES WITH ATOMIC RESOLUTION

Dr. Matthias Bode
IEEE 2007 Magnetic Society Distinguished Lecturer

Fueled by the ever increasing data density in magnetic storage technology and the need for a better understanding of the physical properties of magnetic nanostructures, there exists a strong demand for high resolution, magnetically sensitive microscopy techniques. The technique with the highest available resolution is spin-polarized scanning tunneling microscopy (SP-STM) which combines the atomic resolution capability of conventional STMs with spin sensitivity by making use of the tunneling magneto-resistance effect between a magnetic tip and a magnetic sample surface. Beyond the investigation of ferromagnetic surfaces, thin films, and epitaxial nanostructures with unforeseen precision, it also allows the achievement of a long-standing dream: the real space imaging of atomic spins in antiferromagnetic surfaces.

The lecture addresses a wide variety of phenomena in surface magnetism which in most cases could not be imaged directly before the advent of SP-STM. After starting with a brief introduction of the basics of the contrast mechanism, recent major achievements will be presented, like the direct observation of the atomic spin structure of domain walls in antiferromagnets and the visualization of thermally driven switching events in superparamagnetic particles consisting of a few hundreds atoms only. To conclude the lecture, recently observed complex spin structures containing 15 or more atoms will be presented.

Matthias Bode received the diplom degree in physics from the Free University of Berlin, Germany, in 1993, and the Ph.D. degree in physics from the University of Hamburg, Germany, in 1996. Based on his works on spin-polarized scanning tunneling microscopy he received the habilitation in experimental physics from the University of Hamburg in 2003.

Since 1996 he is a Research Staff Member at the Institute of Applied Physics at the University of Hamburg. In 2007, he joined the Argonne National Laboratory, and is leading the Electronic and Magnetic Materials & Devices Group.

In the past 10 years Dr. Bode developed spin-polarized scanning tunneling microscopy, a magnetic imaging technique with a resolution down to the atomic limit. His research explores correlations between structural, electronic, and magnetic properties of epitaxial nanostructures with a special interest in frustrated antiferromagnetic surfaces, superparamagnetism, and new magnetic phenomena.

Dr. Bode has published more than 80 peer-reviewed papers, three review articles, and three book chapters. In 2003 he was awarded the Philip-Morris Award for research.

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WED, NOV 21, 2007

High Magnetic Anisotropy Materials
- From Bulk through Multilayers to Nano-scaled Particles -

Prof. Takao Suzuki, Toyota Technological Institute

Magnetic anisotropy is one of the basic properties of magnetic substances. In particular, magneto-crystalline anisotropy is thought to be intrinsic for bulk materials, but the theoretical understanding is not satisfactory, as is often demonstrated. In multilayers and nanoparticles where surface or interfacial magnetic anisotropy plays a key role, magnetic behavior is significantly influenced by extrinsic or induced magnetic anisotropy. Among many alloy systems, ordered alloys are known to exhibit high magnetic anisotropy; in particular the L10 ordered phase is of great interest because of applications in bit-patterned magnetic data storage.

Nanocomposite particles with a high magnetic anisotropy phase, together with other magnetic anisotropies, are the subject of intensive research since they offer potential for various applications such as hybrid data storage, sensors, and bio-devices.

This tutorial lecture addresses the magnetism and structure of thin films and nanocomposite particles with a high magnetic anisotropy ordered phase. An in-depth review of magnetic anisotropy in representative materials is given. Recent developments in high magnetic anisotropy of novel materials, multilayers, and nanocomposites will be presented. Emphasis is placed on quasi-L12 structured alloy films with very high magnetic anisotropy and on FePt/FeRh nanocomposites of the first-order transition type, in conjunction with possible applications.

Takao Suzuki received the B.S. and M.S. from Waseda University, Tokyo, in 1962 and 1964, respectively, and the Ph.D. from California Institute of Technology in 1969. He was a postdoctoral fellow at Max-Planck Institute in Stuttgart from 1969 through 1972, and was an associate professor at Tohoku University from 1972 through 1988, where his research interests included magnetic multilayers with high magnetic anisotropy for magneto-optical recording, and magnetic recording applications.

From 1988 through 1995 he worked as a research staff member at IBM Almaden Research Center in San Jose, California, and was involved with high density magneto-optical and magnetic recording materials developments. In 1995 he joined Toyota Technological Institute in Nagoya, Japan, as a principal professor. Dr. Suzuki is now a vice president and a principal professor of the Institute, and also director of the Academic Frontier Center sponsored by the Japanese Ministry of Education, Science, Sports and Culture. His current research interests include the magnetic anisotropy and structure of ordered alloy thin films and nanoparticles, and high density perpendicular magnetic recording media applications. He has published more than 260 scientific papers, has written four books, and has 17 patents.

Professor Suzuki is Fellow of the IEEE. He has been active in many Intermag and Magnetism and Magnetic Materials conferences, including serving as program co-chair of MMM in 1995, and as treasurer co-chair of Intermag in 2005. He has served as a member of the Administrative Committee of the IEEE Magnetics Society for several terms. He is on the Editorial Board of IEEE TRANSACTIONS ON MAGNETICS and is an advisory editor of the Journal of Magnetism and Magnetic Materials.

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