



# CMRR Report

Center for Magnetic Recording Research

## Research Highlight

### *Patterned Media*

*Based on Soft/Hard  
Composite*

*Nanowire Array  
of Ni/CoPt*

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Winter 2006

## PROFESSORS JIN AND BERTRAM RECEIVE AWARDS

**Sungho Jin**, the Iwama Professor of Materials Science at UCSD and a CMRR Faculty member, was named by Nanotech Briefs as one of the winners of the **Nano 50 Awards** in 2005. The award, presented during the Nano Engineering Conference in Boston in November 2005, honors 50 top nanotech technologists and innovators in the US, with the Innovator category awards recognizing an individual as a leader or pioneer for advancing the state of the art in nanotechnology.



Sungho Jin

Professor Jin is a member of the National Academy of Engineering, a Fellow of the American Physical Society and a Fellow of The Metal, Minerals and Materials Society (TMS). He received his Ph.D. from UC Berkeley in 1974, and after many years as a researcher at Bell Labs, in Murray Hill, New Jersey, he joined the UCSD faculty in 2002. He is currently serving as the Director of the UCSD wide Materials Science & Engineering Program.

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## CMRR WELCOMES NEW SPONSORS

**Fujitsu**, one of the five largest manufacturers of storage devices, joined the Center in October 2005. Recently, Fujitsu announced 2.5-inch hard drives with a record-breaking 200GB capacity, using perpendicular recording. They also reported developments in magnetic tunnel junctions and synthetic ferrimagnetic media. Iida Atsuo will serve as the sponsor representative.

**STMicroelectronics** became a CMRR sponsor in January 2006. STMicroelectronics is the world's third largest independent semiconductor company and a global leader in developing and delivering semiconductors. Their data storage ICs include state of the art System-on-Chip technology, a broad range of preamplifiers, advanced Read/Write channel technology, and digital motor control ICs. They produce ultra compact and low consumption ICs for mobile storage products. Rick Barndt, a CMRR Ph.D. graduate from Professor Jack Wolf's group, will serve as the sponsor representative.

CMRR is pleased to welcome our newest sponsors, **Fujitsu** and **STMicroelectronics, Incorporated**.

## 2006 SHELDON SCHULTZ PRIZE FOR EXCELLENCE

*The Schultz Prize is intended to recognize CMRR graduate students who have distinguished themselves through the creativity of their research and the impact of their publications*

The Sheldon Schultz Prize for Excellence in Graduate Student Research was established in 2003 to recognize CMRR graduate students who have distinguished themselves through the creativity of their research and the impact of their publications.

The Prize is named in honor of former CMRR Director, Sheldon Schultz, who skillfully guided the Center from November 1990 through August 2000. The first Schultz Prizes were awarded at the 20<sup>th</sup> Anniversary Celebration dinner May 6, 2003.

The selection of the recipient is based upon the recommendation of a committee consisting of CMRR faculty members, with input from selected experts in information storage technology. CMRR's goal is to endow the Prize so it can be awarded annually and in perpetuity.

Those interested in making a donation of any amount to the Schultz Prize will help move us closer to the endowment target of \$50,000. Checks should be made payable to "UC San Diego Foundation" with a notation on the check or a brief cover letter designating the contribution for the "Schultz Prize." Donations are 100% tax-deductible, and an official acknowledgement of contributions will be provided.

All correspondence pertaining to the Prize can be directed to:

Professor Paul H. Siegel, Director  
Center for Magnetic Recording Research  
University of California, San Diego  
9500 Gilman Drive, 0401  
La Jolla, CA 92093-0401

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H. Neal Bertram

Professor Emeritus **Neal Bertram** has been named the recipient of the 2006 Achievement Award of the IEEE Magnetics Society. This award recognizes exemplary technical achievement and distinguished service to the magnetics community. It consists of a certificate and an honorarium which will be presented at the Plenary and Awards session of the next Intermag Conference in San Diego on Tuesday May 9, 2006. As an Achievement Award recipient, Professor Bertram automatically becomes a life member of the Achievement Awards Committee.

Congratulations Neal on receiving this much deserved award.

## FROM THE DIRECTOR

Things are happening at CMRR. Good things.

The Center has recruited two new sponsors, **Fujitsu** and **STMicroelectronics**. We are delighted to enter this new technical partnership with Fujitsu, and plans are underway to host a visiting scientist from their Advanced Magnetic Recording Laboratory during the next academic year. We are equally pleased to renew our previously close relationship with STMicroelectronics, where a number of CMRR graduates are leading a strong team working on read/write channel development.

The Patterned Media Initiative, introduced in our Summer 2005 newsletter, is moving ahead vigorously. Several sponsor companies have already committed additional funding, and progress is being made in areas including media fabrication, magnetic modeling, patterned sample measurements, media planarization, air-bearing simulation, servo pattern design, and evaluation of signal modulation and coding techniques. The project involves not only CMRR faculty and research staff, but also several affiliated faculty who

lend their unique expertise to the investigation of this promising – and challenging – technology.

If you wish to learn about some of the fascinating approaches to patterned media fabrication being investigated at CMRR by Professor Jin and his group, I encourage you to read the Research Highlight article. Elsewhere in this issue, you'll find evidence of the continued excellence and vitality of our research and educational programs: professional recognition for CMRR faculty and research staff members, research grants awarded, and CMRR students bringing their skills to the data storage industry.

Exciting things are indeed happening at CMRR, and we are pleased to share the thrill of scientific and technological discovery with our partners in industry, government, and academia. I hope you enjoy reading the newsletter.



## SHANNON MEMORIAL LECTURE



Richard E. Blahut

To commemorate the achievements of Claude Elwood Shannon an endowed lectureship was established by CMRR at the University of California, San Diego. Each year an outstanding information theorist is selected by a committee to present the Shannon Memorial Lecture on or about Shannon's birthday (April 30th).

This year's Shannon Memorial Lecture was presented by **Professor Richard E. Blahut** on April 21st. The lecture, entitled "Demodulation Meets Signal Processing: Two-Dimensional Information Theory"\* examined algorithms for demodulation and signal processing such as the Viterbi algorithm and the Wiener filter which are highly valued by those who use them. Motivated by problems of two-dimensional recording, Professor Blahut considered these problems in a unified way. The Richardson-Lucy algorithm was described as an information-theoretic algorithm suitable for both demodulation and signal processing, and often superior to both the Viterbi algorithm and the Wiener filter.

Richard E. Blahut received his B.S. degree in electrical engineering in 1960 from the Massachusetts Institute of Technology, Cambridge, MA, the M.S. degree in physics in 1964 from the Stevens Institute of Technology, Hoboken, New Jersey, and the Ph.D. degree in electrical engineering in 1972 from Cornell University, Ithaca, New York.

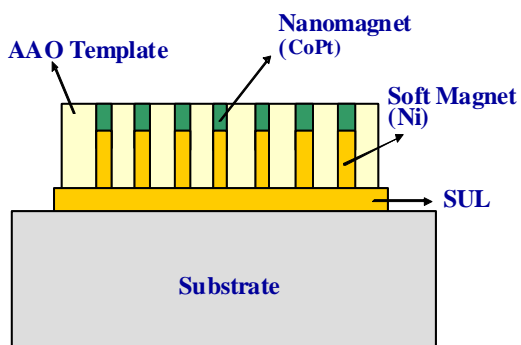
\*Based in part on the thesis of Zhijun Zhao

**RESEARCH HIGHLIGHT**

**Patterned Media Based on Soft/Hard Composite Nanowire Array of Ni/CoPt**  
by A. I. Gapin, X. R. Ye, J. F. Aubuchon, L. H. Chen, and S. Jin

**Introduction**

One of the critical issues in utilizing the L1<sub>0</sub> phase magnets for patterned media is the difficulty of magnetic switching of the high coercivity material with industrially viable magnetic fields available in the write heads. For fabrication of patterned media with desirable high density of  $\sim 1$  terabit/in<sup>2</sup> or higher, one of the possible approaches is to use a template with vertically aligned nanopores such as the anodized aluminum oxide, and fill the nanopores with high coercivity material.<sup>1</sup> For easier switching, a composite nanowire geometry consisting of soft magnetic nanowire lower part and hard magnetic L1<sub>0</sub> nanowire upper part, as illustrated in Fig. 1, has been prepared by electrodeposition into anodized aluminum oxide (AAO) nanopores with  $\sim 20$ - $30$  nm diameter,  $\sim 100$  nm tall. The nanopores were filled with  $\sim 80$  nm long soft magnet (Ni) followed by  $\sim 20$  nm tall hard magnet (CoPt). The microstructure and magnetic properties were investigated.



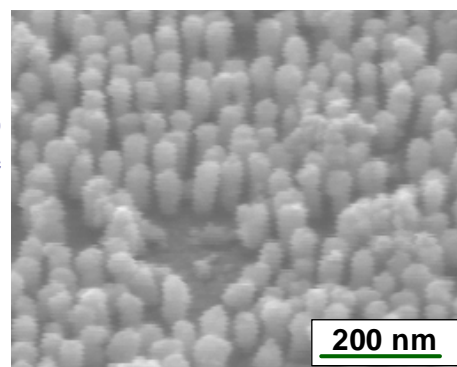
**Fig. 1. Schematics of the composite nanowires inside the AAO template.**

**Experimental**

The AAO templates with nanopore array were prepared by sputter deposition of  $\sim 500$  nm of Al on top of Au-metallized Si substrates. Anodization was carried out in 0.3 M oxalic acid at a constant DC potential of 20V using a platinum cathode. The first segment of the two-step nanowire structure was deposited using DC electrodeposition and a nickel based electrolyte solution containing 0.065 M boric acid and 0.045 M nickel sulfate hexahydrate. The CoPt nanowires were deposited via DC electrodeposition bath composition consisting of 0.01 M cobalt sulfate, 0.01 M diamminedinitroplatinum, 0.085 M sodium acetate, 0.052 M triethanolamine and 0.094 M sodium carbonate with a pH adjusted to 6.3 with sulfuric acid.<sup>1</sup> The as-deposited nanowires within the AAO pores were then annealed at 700°C for 1 hour for conversion to L1<sub>0</sub> phase. The microstructure was characterized using scanning electron microscopy (SEM) and energy dispersive X-ray analysis (EDX). Magnetic properties were measured with an alternating gradient magnetometer (AGM) with 14 KOe maximum applied field.

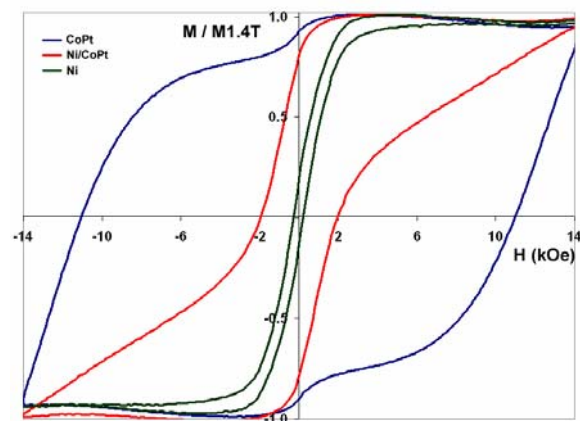
**Results and Discussion**

Shown in Fig. 2 is an SEM image of the Ni/CoPt composite nanowire array after removing the AAO matrix by etching. The composite nanowires consist of  $\sim 80$  nm long Ni wires (as confirmed by



**Fig. 2. SEM micrograph for Ni/CoPt composite nanowire array.**

SEM of samples with electrodeposited with Ni nanowires only) on top of which ~20 nm tall CoPt wires are deposited. The diameter of the nanowires is ~25-30 nm. To see the influence of the two-step composite structure, separate samples with Ni and CoPt nanowires of the same height were prepared and annealed using the identical conditions. M-H hysteresis loops along the perpendicular direction are presented in Fig. 3 which shows the comparative data for the Ni nanowire only (100 nm tall), CoPt nanowire only (100 nm tall), and Ni/CoPt composite nanowires (80 nmNi + 20 nm CoPt) after the  $L1_0$  conversion annealing.



**Fig. 3 – Comparative MH loops.**

The Ni nanowires exhibit relatively soft magnetic coercivity of 242 Oe, while the CoPt nanowires show a very high coercivity of at least 10.97 KOe. The two-step Ni/CoPt nanowires exhibit an intermediate coercivity of ~1.96 KOe. While the two-step nanowire structure, composition, and magnetic properties have not yet been optimized, the data seems to indicate a trend that the presence of the soft magnetic bottom reduces the coercivity of the CoPt nanowires placed on top. This decrease may be caused by exchange interactions or by the longer Ni nanowires serving as magnetic-field-concentrating poles which would increase the effective applied field on the CoPt portion of the composite nanowire in contact. The significant decrease in the coercivity would make it much easier for magnetic data writing. Another possible explanation for the drastic drop in coercivity for the Ni/CoPt composite nanowires is the interdiffusion during annealing between the Ni and CoPt segments resulting in the formation of a ternary  $L1_0$  alloy of Co-Pt-Ni. The results for further optimization and analysis of materials and processes, as well as implications for potential patterned media applications, will be discussed.

1. A. I. Gapin, X. R. Ye, J. F. Aubuchon, L. H. Chen, Y. J. Tang, and S. Jin, *J. of Appl. Phys.* In press, (2006).

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Dr. Blahut is the Henry Magnuski Professor and Head of the Department of Electrical and Computer Engineering at the University of Illinois and a Research Professor of the Coordinated Science Laboratory. His teaching and research are in the areas of communications, signal processing, imaging systems, coding theory, and optical recording. A major project of the past decade is his authorship of a series of advanced textbooks on the mathematical aspects of theoretical informatics including information theory, communications theory, surveillance theory, error-control codes, and signal processing.

In 1980, he was named a Fellow of the IBM Corporation, in 1990 he was named a member of the National Academy of Engineering, and in 1991 a Fellow of the Institute of Electrical and Electronics Engineers. He is a member of the IEEE, the American Association for the Advancement of Science, and a member of SIAM. He is the recipient of the 1998 IEEE Alexander Graham Bell Medal, and the 2005 Shannon Award from the IEEE Information Theory Society. He is a recipient of the IEEE Information Theory Group 1974 Paper Award.

## INVITED TALKS AND RECENT PAPERS

### Professor Emeritus Ami E. Berkowitz

Hong, J.I., Sankar, S., Berkowitz, A..E., Egelhoff Jr., W.F., "On the Perpendicular Anisotropy of Co/Pd Multilayers," *Journal of Magnetism and Magnetic Materials*, Vol. 285, pp. 359-366, 2005.

### Professor Emeritus H. Neal Bertram

Gao, Kai-Zhong, Fernandez-de-Castro, J., Bertram, H. Neal, "Micromagnetic Study of the Switching Fields in Polycrystalline Magnetic Thin-Film Media," *IEEE Transactions on Magnetics*, Vol. 41, no. 11, pp. 4236-4241, 2005.

### Professor Sungho Jin

"Nanoscale Control of Structures for Nano-Bio Applications," 12th International Conference on Composites/Nano Engineering (ICCE-12), August 1-6, 2005, Tenerife, Spain (Keynote Lecture).

"Control of Carbon Nanotube Geometry for Advanced Technical Applications," MRS (Materials Research Society) Fall Meeting, Boston, November 2005 (Invited talk).

"Control of Nanomaterials Geometry for Advanced Technical Applications," 2006 TMS Annual Meeting, San Antonio, CA, March 12-16, 2006.(Invited talk).

"Effect of Endocytosed Magnetic Nano Particles on Cell Behavior," 2006 TMS Annual Meeting, San Antonio, CA, March 12-16, 2006.(Invited talk).

### Professor Paul H. Siegel

Junsheng Han, Patrick Lee, Paul H. Siegel, "On the Probability of Undetected Error for Over-Extended Reed-Solomon Codes," *IEEE Information Theory Workshop*, Punta del Este, Uruguay, March 2006. (Invited talk).

Paul H. Siegel, "Information-Theoretic Limits of Two-Dimensional Optical Recording Channels," *Optical Data Storage Topical Meeting 2006* (Montreal, April 23-26, 2006).

Panu Chaichanavong, H. Neal Bertram, and Paul H. Siegel, "Design Parameter Optimization for Perpendicular Magnetic Recording Systems," *Intermag 2006* (San Diego, May 8-12, 2006) (Invited Talk).

### Professor Frank E. Talke

Duwensee, M., Knigge, B., Baumgart, P., Talke, F. "Voltage Pulsing for Localized Clearance Measurement," *IEEE Transactions on Magnetics*, V.41, no. 12, pp. 4454-4456, 2005.

### Professor Jack K. Wolf

"On Coding for 2-D Storage Systems," *IEEE Information Theory Workshop Punta del Este*, Uruguay, March 2006 (Invited talk).

"Source Coding for Correlated Sources and LDPC Codes," seminar speaker at Universidad de la Republica, Montevideo, Uruguay, March 2006 (Invited Talk).

"Efficient Encoding of Updated Information," *WICAT Workshop on Cooperative Communications Polytechnic University* (Brooklyn, NY), October 2005 (Invited Talk).

## CMRR RESEARCH REVIEW HIGHLIGHTS

The **Fall 2005 Research Review and Advisory Council Meeting** was held on October 26-27, 2005. Over fifty representatives from CMRR Industrial Sponsor companies and other invited guests participated in the meeting, including several who participated via teleconference.

In addition to the sessions devoted to technical presentations of CMRR research results, the Review featured a special presentation by Dr. Kevin Curtis of InPhase Technologies entitled, "Holographic Data Storage: An Introduction to the Media and Systems Breakthroughs at Bell Labs and InPhase Technologies."

CMRR Sponsor company employees may access the abstracts and viewgraphs of all Research Review presentations on the CMRR website in the Sponsor Resources section at <http://cmrr.ucsd.edu/sponsors/subpgset.htm>. Contact Jan Neumann with any questions regarding Sponsor Resources at [jneumann@ucsd.edu](mailto:jneumann@ucsd.edu).

**The Spring 2006 Research Review and Advisory Council Meeting** will be held on May 4-5, 2006. For further information on the Spring Review, please contact Betty Manoulian at 858-534-6707 or [bmanoulian@ucsd.edu](mailto:bmanoulian@ucsd.edu).

## GRADUATE STUDENTS & RESEARCHERS NEAR COMPLETION

Student	Level	Advisor	Dept	Research	Completion
Joseph Aubuchon	Ph.D.	Jin	MAE	Electric field guided synthesis of carbon nanotubes for potential e-beam nanolithography and metrology applications	June 2006
Sharon Aviran	Ph.D.	Siegel/Wolf	ECE	One-dimensional and two-dimensional constrained codes, iterative decoding and detection	Spring 2006
Chiara Daraio	Ph.D.	Jin	MAE	Effect of structural configurations on electronic & phonon wave properties	June 2006
Ismail Demirkan	Ph.D.	Wolf	ECE	Constrained codes for perpendicular recording; channel characterization, coding, and detection for two-dimensional recording	Spring 2006

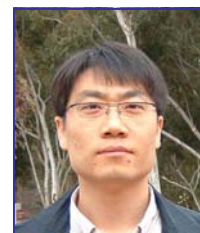
## GRADUATE DEGREES AWARDED



**Ryan Taylor**, a member of Professor Frank Talke's group, received his Ph.D. in August 2005. His dissertation was entitled "Experimental, Analytical, and Numerical Investigations of High Frequency in-plane Transverse Vibrations of Axially Moving Magnetic Tape." His research involved the investigation of transverse in-plane dynamics of magnetic tape. Ryan is currently employed in Servo Control Design at Quantum Corporation in Costa Mesa., CA.

## POSTDOCTORAL SCHOLAR

**Dae-Hoon Hong** has joined Professor Jin's lab as a Postdoctoral Scholar. He is currently working on two research topics. One is perpendicular magnetic recording media and the other is patterned media. He received his B.S. degree at Hanyang University, Korea, in 1998 and his M.Sc. and Ph.D. degrees at the Korea Advanced Institute of Science and Technology (KAIST) in 2000 and 2005, respectively. During his Ph.D. course, he participated in an internship project on perpendicular recording media at Maxmedia in San Jose, CA. For his Ph.D. thesis he studied a new structured soft magnetic underlayer (SUL) to reduce noise from SUL and proved the origin of grain isolation in CoCrPt-SiO<sub>2</sub> perpendicular magnetic recording media through the investigation of Ru underlayer condition and growth behavior of CoCrPt-SiO<sub>2</sub> recording layer. He has written several papers on the above subjects and obtained a US patent. He continued his research on magnetic tunnel junction (MTJ) at Korea Institute of Science and Technology (KIST) in 2005 as a postdoctoral scholar. He enjoys photography, traveling, and playing badminton, soccer, and tennis.

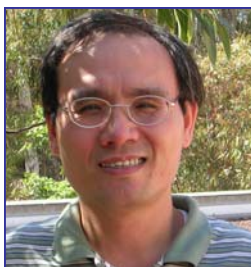


**Brian (Seunghan) Oh**, is a Postdoctoral Scholar in Professor Sungho Jin's laboratory. He received his B.A., M.S., and Ph.D. degrees from Yonsei University, Seoul, Korea, in 1996, 1998, and 2002, respectively. His research interests include (1) the development of nano-patterned recording media composed of self organized magnetic array (SOMA) and (2) the effect of magnetic nanoparticle on cancer treatment by hyperthermia technique.

**Gilberto Rodriguez** is a Postdoctoral Scholar in Ami Berkowitz's group. He is currently working on a novel design for a magnetic motor with over one hundred poles and uncompensated spins of nanoparticles of MnO. In June 2005 he was granted a Ph.D. from the University of California, Riverside under Dr. Raymond Orbach. His thesis was entitled, "Initial Conditions and Long Time Dynamics for A Complex System: Hierarchical Properties of the Spin Glass Decay." Gilberto received his undergraduate degree in Physics at UC Irvine, in 1998.



## NEW RESEARCHER



**Dr. Li-Han (Leon) Chen** is currently an Associate Research Scientist in Professor Sungho Jin's group. He received his Ph.D. in materials science & engineering from the National Cheng-Kung University, Taiwan. His thesis research focused on the influence of magnetic energy on the phase stability of binary Fe- and Co- alloys. He became a postdoctoral member of technical staff at AT&T Bell Labs in 1991, where he worked on magneto-transport properties of nano-structured alloys and multilayer films. In 1993, he joined I-Shou University, Taiwan. In 2002 he moved to the University of California, San Diego. He is one of the co-inventors of colossal magnetoresistance (CMR) effect. He also works on the soft magnetic materials for ultra-high frequency applications. His current research focuses on the magnetic nanostructures for the development of novel magnetic storage technologies, synthesis and characterization of carbon nanotubes, and MEMS triode devices. He has co-authored more than 85 papers and 6 patents.



## VISITORS

**Professor Izhak Etsion** spent four months of his sabbatical from the Technion, Israel, in Professor Frank Talke's Lab as a visiting scholar. In addition to giving lectures on contact mechanics and texturing, he worked closely with Aravind Murthy on the effect of slider surface texture, and with Bart Raeymaekers on the analysis and measurement of friction of magnetic tape. Professor Etsion's time in the lab past quickly, and members of the Talke lab hopes he returns this summer.



**Ulrich Hausmann** joined Professor Talke's lab as a visiting scientist in the fall of 2005. His research project was on the "Tribology of Textured Sliders." He is currently a graduate student in medical engineering at the Technische Universität München, Germany. His dissertation explores a new concept for wound closure with flexible endoscopes. Outside of the lab, Ulrich enjoyed weekend trips to San Francisco to visit his wife.

**Sangshin Park** is a visiting scholar from Yeungnam University, Korea, working primarily in the research group of Professor Frank E. Talke. He completed his B.S., M.S. and Ph.D. degrees from Seoul National University in 1989, 1991, and 1995 respectively. His major fields are tribology and mechatronics and he is especially focused on air bearing analysis and experiment. His work will focus on air slider bearing design and creating the computer programming code. Sangshin came here with his wife and two daughters. When not at CMRR, Sangshin loves to play golf in beautiful San Diego and also enjoys traveling around the United States.



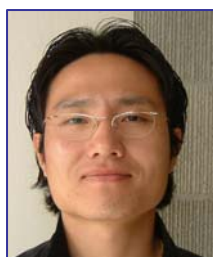
**Mathias Pfabe** is a visiting student in Professor Frank Talke's lab. He is from the University of Rostock, located in northern Germany on the Baltic Sea. His research project is "Modal Analysis of 1-inch Drives." Mathias was born in 1982 near the city of Dresden. After he passed his final examinations in high school, he studied engineering at the University of Rostock. Since he received his pre-diploma in 2004, he has specialized in technical dynamics and propulsion systems. In September 2005 he received a scholarship from the German Academic Exchange Service (DAAD) to study at UCSD for nine months. In his spare time, Mathias enjoys sailing and surfing.

**Thorsten Schulz** is a visiting student from Germany in Professor Frank Talke's lab for the academic year 2005-2006. He is an electrical engineering student from the University of Rostock. His major research interests are embedded systems and computer architecture. He has worked on an Open GL Visualization of Lateral Tape movement and has assisted in different computer related problems. When not in the lab, he enjoys many outdoor activities, such as, surfing, wind skating, and bicycle riding.



## NEW GRADUATE STUDENTS

**Joseph Aubuchon** is a Materials Science and Engineering Ph.D. student in Professor Sungho Jin's lab. Prior to coming to UCSD he received his B.S. in 2002 at UC Berkeley in Materials Science and Engineering. Much of his work has involved the use of carbon nanotubes for technical device applications. He has also worked on several other projects including new types of nano-patterned magnetic recording media. Joseph's dissertation is on "Control of Carbon Nanotube Growth Directions by Direct Current Plasma Enhanced Chemical Vapor Deposition." He plans to defend his dissertation this spring. As for interests outside of academics, Joseph is a runner and has competed for UCSD at the NCAA level during his first two years here before his eligibility expired.



**Chulmin (Edward) Choi** from Seoul, South Korea, is a new graduate student of Professor Sungho Jin's research group. His research interest is perpendicular recording media & future recording media. Before coming to UCSD, Chulmin (Edward) received his Master's degree in materials science & engineering from Korea University. After he graduated from the master's course, he worked at Samsung Advanced Institute of Technology (SAIT). For the years 2005-2007, he has been supported by a fellowship from the Korea Science and Engineering Foundation Grant, which is funded by the Korean government. Outside of school, Chulmin enjoys watching sports on TV and cooking.

**Mohammad Hossein Taghavi** is a graduate student in Professor Paul Siegel's group. He received his B.Sc. in Electrical Engineering from Sharif University of Technology, Tehran, Iran, in 2003, and joined UCSD as a graduate student. During the first year of his research at UCSD, he worked jointly with Professors Paul Siegel and George Papen on capacity analysis of nonlinear fiber optics, and received his M.Sc. in June 2005. His current area of interest is performance analysis and decoding algorithms for low-density parity-check codes with applications to data storage and communications. Outside of school he enjoys volleyball, soccer, and camping.



## LEAVING CMRR

**Yun Jun Tang** a postdoctoral student in Ami Berkowitz's group for four years has recently accepted a position with CMRR sponsor company, **Western Digital**. At CMRR he was a major investigator on a number of projects and publications. These included: heat capacity and magnetization of CoO/SiO<sub>2</sub> multilayers to determine blocking temperatures and ordering temperatures as functions of CoO thickness; ferromagnetic shape memory effects in Ni-Mn-Ga spark-eroded particles; spark-eroded Co-Fe particles for power frequency applications; exchange-spring permanent magnet properties of Nd<sub>2</sub>(FeCo)<sub>14</sub>B/ $\alpha$ -Fe particles produced by spark-erosion; magnetocaloric effect in Ni-Mn-Ga spark-eroded particles; issues involved in establishing exchange-bias below T<sub>N</sub> in ferromagnetic/antiferromagnetic exchange couples.

**Kishore Sreenivasan** was a postdoctoral student in Ami Berkowitz's group for a year. He worked on the preparation and magnetic behavior of CoO nanoparticles. He is presently a postdoctoral student at the University of Nebraska working with Prof. Diandra Lesley-Pelecky on magnetic nanoparticles.

## RECENT GIFTS, GRANTS, and AWARDS

**Professor Emeritus Ami Berkowitz** was granted a research contract from **BAE systems** under the DOD/DARPA Program to support his research work on “Development of Novel Permanent Magnetic Structure.”

**Professor Emeritus H. Neal Bertram** and Professor Paul H. Siegel received funding from **INSIC** for his work on “Design Parameter Optimization for Perpendicular Recording Channels.”

**Dr. Gordon Hughes** has received support for CMRR’s intelligent storage work from a \$500,000 Sloan Foundation grant to the

UCSD Information Storage Industry Center.

**Dr. Gordon Hughes** received an IEEE Service Award for his six years of service on the IEEE Reynold B. Johnson Information Storage Field Award Committee.

**Professor Paul Siegel’s** research work on “Enhanced Tensor-Product Parity Coding Architecture” was funded under the **INSIC/EHDR** Program.

**Dr. Frederick Spada** received continued funding from **INSIC/Tape** Program on his research work “Contribution of Electrochemical Processes to Increased

Head-Media Spacing in Tape Drives.”

**Professor Frank Talke** received funding under the **INSIC/EHDR** Program to support his research work on “Air Bearing Simulation of Discrete Track and Bit Patterned Media Using a New Mapping Approach with Finite Element Analysis.”

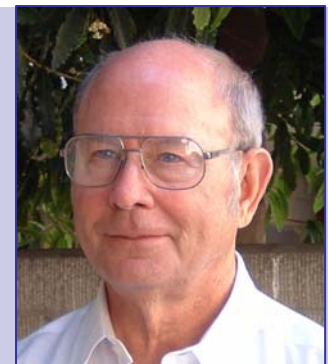
**Professor Frank E. Talke** received an honorary doctorate degree (Dr.-Ing. E.h.) from the Technical University of Muenchen, Germany, on July 8, 2005.

## GORDON HUGHES RETIRES

**G**ordon Hughes retired as Associate Director of CMRR on October 1, 2005. He joined CMRR in 1997 as Associate Director after a distinguished career at Seagate Technology where he helped establish sputtered thin film metallic recording media as today’s commercial standard. Previously, he worked at Xerox PARC on digital magnetic recording on oxide and thin film plated discs, as well as on recording heads, and channels.

During his career he has published many technical papers on recording physics and recording channels, has several patents, and was a Distinguished Lecturer for the Magnetics Society of the IEEE in 1989 and 1998. In 2001, he was named Fellow of the IEEE for “Contributions to magnetic recording physics and for pioneering work in thin film disk media.”

Fortunately for CMRR, he remains active as a part time UCSD Project Scientist. His research interests remain in patterned media recording theory and an intelligent storage systems, with current projects in secure storage and secure user data erasure. He is currently working with Gilberto Rodriguez, a post-doctoral scholar in the Berkowitz group, on a many-pole stepper motor design project. His free time is spent skiing and flying.



Gordon F. Hughes

**R**ichard Land began working at the CMRR as an assistant to Iris Villanueva , Dr. Ami Berkowitz and Professor Frank Talke in September of 2005. He is currently finishing his business degree and plans on returning to the University of San Diego in the fall of 2007. Richard brings with him a strong background in Theater Arts. He studied at the Academy of Performing Arts under scholarship for 4 years, at the same time performing for numerous production companies in town. Richard can be seen this summer in Starlight Theater's summer production of Hot Mikado.



Richard Land

Director:  
Paul H. Siegel

Newsletter Editor:  
Jan Neumann

Photography:  
Ray Descoteaux  
Betty Manoulian

Contributors  
Gordon Hughes:  
Sungho Jin  
Betty Manoulian  
Jan Neumann  
Paul Siegel  
Iris Villanueva

Welcome Richard!

<http://cmrr.ucsd.edu>

**CMRR**

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