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JODIE CHRISTNER, EDITOR

# TECHNICAL COMMITTEE UPDATE: MAGNETISM AND BIOLOGY

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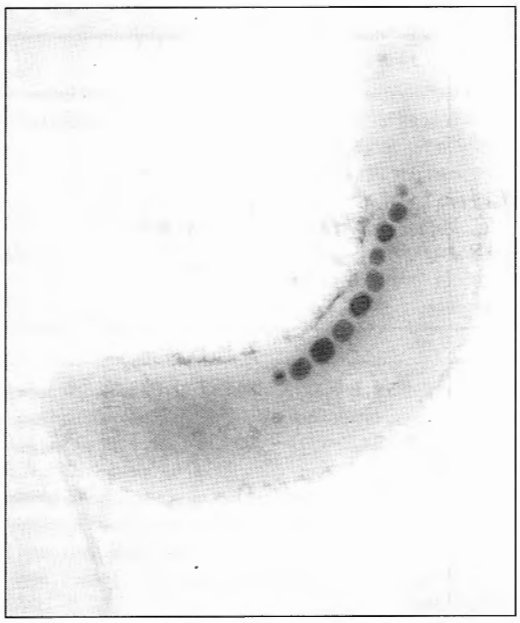
Evidence has continued to accumulate over the last several years that a wide variety of organisms are sensitive to earth-strength magnetic fields. These include bacteria, insects, marine invertebrates, fish, birds, amphibians and mammals. At the same time, the inventory of organisms that biomineralize magnetic particles has grown (1,2) and now includes humans (3).



*Magnetotactic bacterium with chain of magnetile particles that constitute a biomagnetic compass. Similar particles occur in many organisms, including humans.*

The connection between magnetic particles and magnetic sensitivity is well established for magnetotactic bacteria, which can orient and migrate along geomagnetic field lines (4). Cells have a permanent magnetic dipole moment that causes them to be oriented in the geomagnetic field as they swim. The cellular magnetic dipole is based on a clever arrangement of single-magnetic domain particles of magnetite ($Fe_3S_4$) (5). The magnetic orientation is passive in the sense that the cells are oriented by the torque exerted by the field on their magnetic dipole. In more complex organisms, there must be a magnetic field direction or intensity transducing organ coupled to the central nervous system. The question is, is the magnetic field sensitivity in complex organisms based on some kind of transducing organ that involves magnetic particles?

That this connection is not necessary is demonstrated in sharks and rays, which have an electric field sensing organ, the ampullae of Lorenzini. Motion and heading in the geometric field can be detected by induction (6).

The earlier evidence on magnetic sensitivity of organisms came from inferences based on observation of natural behavior, or from disruption of natural behavior due to changed magnetic circumstances. For example, Martin and Lindauer (7) inferred magnetic sensitivity in honeybees from careful observations of their honeycomb dance angles, and Keeton (8) demonstrated magnetic sensitivity in homing pigeons by disorienting them by attaching small bar magnets to their heads.

More recent demonstrations of magnetic sensitivity involve training organisms to detect magnetic fields, and by direct electrophysiological measurements. Examples of the former are the training of honeybees to detect a magnet under a dish of sugar water by Bitterman and coworkers (9), and the training of salamanders to orient in magnetic fields by Phillips and coworkers (10). Examples of the latter are measurements of electrical responses to magnetic stimuli in various parts of the visual system of birds by Semm and Beason (11), and in various neurons in sea slugs by Lohmann, Willows and Pinter (12).

There have been various reports of human sensitivity to geomagnetic fields (13), however they have not been replicated and remain controversial. Recently, Kirschvink and coworkers (3) have reported finding magnetite in human brain tissue. Remanent magnetic material in human brain was detected with a SQUID rock magnetometer in a specially shielded room. Then magnetic particles were extracted from brain and electron diffraction was used to identify

**TECHNICAL COMMITTEE UPDATE** *(Continued on page 2)*

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the particles as magnetite. The particles had a bimodal distribution in terms of morphology. One group had a well defined cubo-octahedral morphology, while the other group had a more spherical morphology. The cubo-octahedra were in the single magnetic domain size range and resembled the magnetite particles produced by some magnetotactic bacteria, and particles extracted from salmon (1,2). The magnetite appeared to be distributed throughout the brain, and the average concentration was quite low, about 5 nanograms of magnetite per gram of brain tissue. This compares with a total iron concentration of about 200 micrograms per gram of brain tissue. This mostly paramagnetic iron is associated with proteins, principally the iron-storage protein ferritin.

The big question concerns the functional significance of the brain magnetite. Does it have a metabolic or sensory function, or is it metabolic "junk"? Is there a magnetic receptor, or a relict magnetic receptor, in humans? The narrow size distribution and well-defined particle morphology suggests a functional role. But there is the other group of magnetite particles without a well defined morphology. Also, the remanent magnetization measurements only see particles that are large enough to be blocked at room temperature. It is possible that the collection technique is less efficient for smaller particles as well. Thus the size distribution might be wider than we think. However, the distribution is probably cut off on the high-particle-volume side, that is, there are no big (multidomain) chunks. Finally, if the magnetite is part of a mangetoreceptor, one would expect it to be localized in a specific region of the brain. So far, there is no evidence for this.

What does this have to do with power lines, video terminals, car telephones, hair dryers, and electric shavers? Maybe nothing, but Kirschvink (14) has suggested that the presence of brain magnetite could provide a mechanism by which d.c. and low frequency weak magnetic fields might interact with humans.

Stay oriented for further developments.

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## NEW MAGNETICS SOCIETY FELLOWS FOR 1993

Four members of the IEEE Magnetics Society were recently named Fellows for their work in magnetism. The new Fellows and the contributions leading to their awards are as follows.

**Dr. Hideo Fujiwara,** 2-24-9 Keyakidai, Moriya-Machi Kitasoma-Gun, Ibaraki 302-01 Japan. "For contributions to the research and development of heads and media for high-density recording." (Dr. Fujiwara is currently at the Center for Magnetic Information Technology, University of Alabama, Tuscaloosa, Alabama 35487-0708).

**Dr. Tatsuo Fujiwara,** 6-2-104, 1-21 Utsukushigaoka, Yokohama, Japan. "For contributions to high-density magnetic recording and theoretical analyses of the recording process."

**Prof. Takayoshi Nakata,** Dept. of Elec. Engrg., Okayama Univ. School of Engrg., Tsushima Okayama 700, Japan. "For contributions to the application of the finite element method to the analysis of nonlinear magnetic devices."

**Dr. Celia E. Yeack-Scranton,** IBM Almaden Research Center, 650 Harry Road, San Jose, CA 95120. "For the development and application of transducers that characterize the head-medium interface in magnetic recording."

In addition, a Magnetics Society member, **Dr. Wolfgang D. Lampe,** Swedish Trans. Research Inst. AB, Dept. STRI/H, P.O. Box 707, S-771 80, Ludvika, Sweden, was elected Fellow by another IEEE Society. His citation reads "For contributions to ac and dc insulation design of high-voltage transformers under polluted conditions."

**IEEE Magnetics Society Newsletter** is published quarterly by the Magnetics Society of The Institute of Electrical and Electronics Engineers, Inc. Headquarters of the IEEE is 345 East 47th Street, New York, NY 10017-2394. $1.00 per member per year (included in Society fee) for each member of the Magnetic Society. Printed in USA. Second-class postage paid at New York, NY and at additional mailing offices. **Postmaster:** Send address changes to IEEE Magnetics Society Newsletter, IEEE, 445 Hoes Lane, Piscataway, NJ 08854-4150.

The objective of the **IEEE Magnetics Society Newsletter** is to publicize activities, conferences, workshops and other information of interest to the Society membership and technical people in the general area of applied magnetics. Copy is solicited from the Magnetics Society membership, organizers of conferences, officers of the Society and local chapters and other individuals with relevant material. The Newsletter is published in January, April, July and October. Submission deadlines are December 1, March 1, June 1, and September 1, respectively.

Please send contributions to:

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# TECHNICAL COMMITTEE UPDATE: IMPROVED MATERIALS FOR MAGNETORESISTIVE HEADS

*By J. Kent Howard*

*J. Kent Howard*

A roadmap for 10Gb/in$^2$ media was published recently(1). Although the principal focus was on media requirements and fabrication schemes, several assumptions were made concerning the head technology required to achieve 10Gb/in$^2$ areal density. The current high-end products are recording at approximately 150-200 Mb/in$^2$ and both 1 Gb/in$^2$ and 2 Gb/in$^2$ technology demonstrations have been reported(2,3). Based on historical trends, products with an areal density of 1 Gb/in$^2$ should be introduced about the year 2000 and 10 Gb/in$^2$ about 2010(1). However, the introduction of the MR head should accelerate this trend with 1 Gb/in$^2$ product introduction in 1997 and 10 Gb/in$^2$ products available as early as 2005(1).

To record the high coercivity values (2500-4500 Oe) required for 10 Gb/in$^2$ media, the write head should be fabricated with a high moment material such as FeN, FeTa-N, or FeTa-C(1,4). It was also assumed that the MR read head would contain new sensor materials which exhibit the giant magnetoresistive effect(5) with about five times the anisotropic resistivity of permalloy(1).

The discovery of giant magnetoresistance (GMR) in Fe/Cr superlattices has produced interesting experimental and theoretical work. The original work showed $\Delta R/R$ values as high as 50% which was correlated to antiferromagnetic coupling of Fe films across Cr interlayers(5). It was suggested that spin-dependent scattering at the Fe/Cr interface was responsible for the magnetoresistance. However, the maximum $\Delta R/R$ value was observed at 4.5° Kelvin and 20 KOe fields were required to saturate the Fe/Cr superlattice. It was observed that a more general class of metallic multilayers (Fe, Co) separated by non-magnetic spacer layers (Cr, Ru, Au, Cu) also exhibit GMR but high saturation fields (~10KOe) are still required(6). The magnetic superlattices provide some interesting challenges for transport physics but the saturation fields are far in excess of the low field sensitivity (< 10 Oe) required for an MR read head.

Dieny and co-workers(7) have developed an alternative structure of soft magnetic multilayers which exhibit a spin-valve effect. The spin-valve structure consists of a complex multilayer film structure deposited on a Si substrate (eg. Si/50 Å Ta/60 Å NiFe/25 Å Cu/40 Å NiFe/50 Å FeMn/50 Å Ta). However, the multilayer magnetic structure exhibits a relative change in resistance of 4% at room temperature for a saturation field of only 15Oe. The spin-valve effect demonstrates that in-plane resistivity of soft ferromagnetic layers (NiFe) separated by a non-magnetic metallic Cu spacer depends on the relative angle between their magnetizations. When the magnetizations of the soft ferromagnetic layers are parallel the resistance is low but the resistance is high for antiparallel alignment of the magnetizations. The antiferromagnetic FeMn film is exchange coupled to the upper NiFe layer which constrains it's reversal at low field, thus only the bottom layer is free to rotate with the applied field. The spin-valve effect is attributed to the change in magnetization of the two soft magnetic layers from antiparallel alignment to parallel alignment and the resultant change in resistance. Other studies have reported different spin valve structures which exhibit $\Delta R/R = 8.7\%$ and saturation fields of 20 Oe(8). The spin-valve structures represent a very viable magnetic multilayer configuration to achieve an improved magnetoresistive sensor for 10 Gb/in$^2$ recording applications. However, the spin-valve technology involves the fabrication of complex multilayers with unknown materials reliability (electromigration, diffusion, corrosion).

Giant magnetoresistance has been recently reported in heterogeneous (non-multilayer) alloy systems such as Cu-Co, Co-Ag and NiFe-Ag(9,10). The Cu-Co alloy contains metallic elements that are immiscible at low temperature. However, annealing the metastable alloy causes the formation of ultra-fine Co precipitates in a Cu matrix. The magnetoresistance effect varies inversely with the diameter of the average particle diameter. Cu-19% Co alloys annealed at 484° C. exhibit $\Delta R/R$ values of 22% at 10° K. and about 5-6% at 300° K. The Co-rich precipitates were investigated with transmission electron microscopy. The 19% Co alloy annealed at 484° C. produced precipitates with an average diameter of 40 Å and an average spacing of about 80 Å (9a). The Co-Cu alloys require saturation fields of several thousand Oe and would not be useful in a low field MR sensor device. However, recent work on granular permalloy in a silver matrix has yielded $\Delta R/R$ values of 10% at room temperature with the width of the GMR peak ($\Delta R/R$ versus Field) about 400 Oe(10). Although the saturation field is lower than the reported value for Co-Cu and Co-Ag, it is not in the range that is useful for MR devices (10 Oe or less). The "granular" alloy is an attractive approach to achieve a GMR sensor with only a single film in contrast to the more complex spin-valve multilayers. The granular alloy annealed at 300-500° C to achieve the GMR effect should also be stable during device processing at lower temperature. A recent paper has evaluated the effect of particle size and shape, magnetocrystalline anisotropy and temperature on the performance and sensitivity of MR devices fabricated with heterogeneous alloys(11). The model predicts that it is unlikely that sputtered granular alloys can achieve both low field sensitivity (< 20 Oe) and useful values of $\Delta R/R$ for GMR sensor applications.

The spin-valve structure appears to be the only published configuration that achieves both low field sensitivity and $\Delta R/R$ values in 4-8% range. However, the complexity of spin-valve fabrication combined with device processing and materials sensitivity issues will probably spur additional work to find a new granular GMR alloy with low field sensitivity.

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## IEEE MAGNETICS SOCIETY ANNOUNCES TMRC STUDENT TRAVEL AWARDS

The Awards Committee of the Magnetics Society of the IEEE will sponsor several students working in magnetics to attend The Magnetic Recording Conference to be held September 13-15, 1993, in Minneapolis, Minnesota.

Nominations will be accepted up to June 11, 1993 from faculty advisors of the interested students. This deadline will be firm. The nominator must be a member of the Magnetics Society. The nomination should be made in a one or two page letter and must contain the following information:

1. the source and extent of current support for the student;
2. whether or not the student has submitted a paper which he/she will present;
3. whether or not the student has received a previous IEEE travel award;
4. itemized budget requirements.

If air travel is planned the budget should be based on the most economical air fares available. It is expected that some portion of the cost will be borne by the student and/or his/her institution. The awards will be announced June 15, 1993.

Nominations for students working in the United States and Canada should be sent to:

Professor Ronald Indeck
Department of Electrical Engineering
Washington University
St. Louis, MO 63130-4899
TEL: 314/935-4767,
FAX: 314/935-4842
rsi@wueel.wustl.edu

Nominations for students in all other countries should be sent to:

Dr. Subrata Dey
Storage Technology Corporation
2270 S. 88th Street MS 8110
Louisville, CO 80028
TEL: 303/673-6494
FAX: 303/673-6540
subrata-dey@stortek.com

## PARTICIPANTS SOUGHT FOR SURVEY ON POWER SUPPLY TRENDS

A frequency trend survey, covering AC-DC and DC-DC converters and electronic ballasts, has been generated by the ETTC Committee on Magnetic Materials for Switching Power Supplies. The survey is sponsored by the Power and Electronic Society of IEEE. The primary objective is to determine industry trends in frequency and power levels over the next five years. The secondary objective is to assess the impact of these trends on future magnetic core material and geometry needs, thus allowing the core industry to anticipate and enhance future power supply developments, rather than belatedly reacting to industry demands.

The survey will be mailed to interested power supply design engineers this May. Survey respondent confidentiality will be protected. A preliminary report will be presented at the next committee meeting at APEC '94 in Orlando. The immediate challenge is to obtain an adequate survey population! The current mailing list is only 120. Your participation in completing this two page survey is both welcome and needed.

If you are interested in receiving the survey please call (412/282-8282) or FAX (412/282-6955) George Ramig, Working Group Chair.

## PHILADELPHIA PERMANENT MAGNETS MEETING '93

*by Bryen E. Lorenz*

The annual, day long gathering of the Philadelphia Permanent Magnets Meeting (PPMM '93) was held on March 25 and hosted by SPS Technologies at their Jenkintown, Pennsylvania location. PPMM '93 was cosponsored by the Magnetics Chapter of the Philadelphia Section of the IEEE along with YBM Technologies, Pennsylvania University and Widener University.

The meeting featured four speakers: Steve Constantinitis from Arnold Engineering, Stanley Trout from MolyCorp, V. "Prem" Panchanathan from General Motors and Lin Li from the University of Pennsylvania. Their talks covered a host of topics ranging from a technical discussion of bonded magnets currently under development by Arnold Engineering to GM's innovative Magnaquench permanent magnet process to recent theoretical studies conducted at the University of Pennsylvania into the microstructure of rare earth sintered permanent magnets. To round out the meeting, a discussion of the cost and processing issues experienced by MolyCorp in extracting and refining rare earth metals, was presented.

Several dozen individuals attended the meeting representing a broad mix of suppliers, manufacturers and academics from the local area. This marks the second time that this event has been held with plans for the next meeting already underway. The organizers of PPMM '93 would like to thank SPS Technologies for their kind and generous support and especially Dr. Yacob Bogatin for his tireless efforts in arranging PPMM '93.

## DIVISION IV DIRECTOR'S REPORT

*by W. K. Dawson*

"Data without generalization is just gossip." Robert Pirsig's admonition is, I believe, an appropriate introduction to the results of last November's IEEE elections. The basic data are Dawson 2345, Johnson 2339. Clearly, the Board had nominated two equally acceptable candidates. If seven more had voted, or four had voted differently, the result could well have changed. So the first generalization is the well known adage that every vote counts. I thank all of you who made the effort to vote and ask for your help in making the IEEE better serve our technical and professional needs as well as be a stronger voice for the profession.

There are more data and, of course, a generalization. Inside the United States the count was Dawson 1701, Johnson 2086 while outside the United States the count was Dawson 644, Johnson 253, in percentage terms the numbers are quite striking. Inside the United States Dawson got 45% of the vote, outside 74%. This difference of opinion is significant. The President-Elect results show a similar but slightly weaker trend. Troy Nagle received 48% of the United States vote and 69% of the non-United States vote. In both cases the outcome was determined by the non-United States vote. This was not the case in the five other Divisional elections where the preferences of voters inside and outside the United States differed in only two cases and by small, possibly insignificant, amounts.

Why should this be? (Here comes the generalization!) The position statements of the candidates in both the President-Elect and Division IV elections showed a clear difference in attitude towards a transnational IEEE. The difference could well have been the major deciding issue for non-United States voters while playing a much lesser role for United States voters. But the difference was crucial and it determined the outcome.

What can we learn from this? We must all be sensitive to the declared goal of the IEEE to strengthen its global character. A global IEEE must try to fairly and equitably represent the needs and aspirations of all its members. In order to succeed the IEEE has to adapt its programs to fit the individual needs of many national groups. For some regions of the world this may be done by establishing agreements with existing national associations concerning joint membership and programs while in other places, such as the United States, the IEEE can best serve its members by also taking on the role of a national organization which presents and represents members needs and aspirations to governmental and other national agencies. And all this diversity must be made into a coherent structure.

Within the IEEE we have the engineering, scientific and technical pursuits and interests that bind us together into a strong organization. These important aspects of our work are shared through conferences, publications and educational programs. I hope that these ties are strong enough to overcome any differences caused by national concerns. I will work to promote the knowledge and understanding required to deal fairly with these issues. But this cannot be done without your assistance. Together we can make the IEEE serve all its members... everywhere.

## STUDENT TRAVEL GRANTS FOR MINNEAPOLIS MMM '93

The 38th Annual Conference on Magnetism and Magnetic Materials intends to award a limited number of grants to support students attending the meeting in Minneapolis. Preference will be given to students who are nearing completion of their graduate studies and who are presenting conference papers. A student should submit a brief letter of endorsement from his or her faculty advisor and an application in the form of a one page letter with the following information:

1. Name, address and phone number of the student, his/her advisor, and FAX/e-mail numbers if available;
2. Title and 1-2 sentence description of the student's thesis;
3. Title of any paper(s) accepted for the '93 Conference;
4. Source and extent of the student's current financial support;
5. Itemized budget for attending the Conference (airline travel should be at the most economical fare possible);
6. Any previous travel awards received for MMM or Intermag Conferences.

Because of the limitation on funds, it is expected that the costs of attendance will be shared by the student and his/her institution. Applications received after August 16, 1993, cannot be guaranteed consideration. Decisions will be made by September 15, 1993. The application must be initiated by the student.

The application should be sent to William Cain, Read-Rite Corporation, 345 Los Coches Street, Milpitas, California 95035; (408) 956-3301; FAX: (408) 956-3210; e-mail: B2NET/B2POST/CCW%READ-RITE2@MSIMAIL.COM.

## REPORT ON ACTIVITIES OF THE IEEE-USA ENERGY POLICY COMMITTEE

*by Alexander Kusko*

The membership of the Committee includes representatives of the IEEE societies, at-large former members, divisional and regional representatives, liaison members with EPRI and DOE, and guests. The Committee meets about four times per year, usually at IEEE Headquarters in Washington, and also at Winter and Summer Power Meetings. Alexander Kusko is the representative of the Magnetics Society.

The work of the Committee includes preparation of reports and position papers on such subjects as energy sources, fusion, renewable energy, conservation and demand-side management. Members of the Committee prepare testimony and testify before governmental committees on energy-related subjects. At Committee meetings, members and guests discuss federal policy and funding on energy programs, activities of federal departments, articles relating to the Committee's work, and results of non-IEEE meetings in the United States and abroad. The individual members of the Committee provide special expertise in the activities of the Committee.

# IEEE U.S. ACTIVITIES BOARD COMMITTEE UPDATES

Magnetics Society members are familiar with the professional activities of IEEE, i.e. the publishing of journals like the Transactions on Magnetics and the sponsoring of conferences like Intermag. However, most Society members are not as familiar with IEEE's political activities which are conducted by the U. S. Activities Board (USAB).

A portion of the dues from each U. S. member goes to support USAB. It has an office in Washington and a paid staff. There are also many volunteers who serve on various USAB committees.

The Magnetics Society is represented on several USAB committees. Among these are the Defense Research and Development Committee and the Engineering Research and Development Committee. These two committees are concerned respectively with military and non-military research and development. They seek to influence government policy in these areas by preparing position papers and by meeting with officials in Congress and the Administration. In particular they support measures that will enhance the international competitiveness of the U. S. in high technology.

These two USAB committees meet about five times a year. From now on, this Newsletter plans to present brief summaries of the minutes of these meetings.

**Defense R & D Committee**

At its last meeting (November 30), the Defense R & D Committee took the following actions.

- Committee member Bob Feik outlined a proposal to promote Federal, industry, academia cooperative research in tripartite federal laboratories and invited committee comments.
- The committee reviewed and approved a proposed IEEE-USA entity position statement on Defense Conversion.
- The committee resolved to seek creation of a national award for technology commercialization to recognize outstanding efforts in federal technology transfer. A task force chaired by Vice Chairman Marvin Hammond will present a proposed action agenda for discussion at the next meeting.
- The committee discussed preliminary plans for 1993 activities. It was agreed that job creation and making economic security an integral part of the national security mission were key themes. Noting that culture change at DoD was imperative, members suggested that the committee consider a legislative initiative to incorporate support for technology transfer into DoD job performance/evaluation criteria and that hearings be sought at which the military services would be asked to compare their respective practices in various areas as a spur to change.

**Engineering R & D Committee**

At it's last meeting (November 30), The Engineering R & D Committee took the following actions.

- Committee member Richard Marsten reported that the committee's proposed entity position statement on "Regaining Strength for Technology Commercialization" is pending approval by the IEEE United States Activities Board. He has informally discussed elements of the proposed position with contacts on the Clinton Administration's transition team.
- Committee member Donald Rathbone invited suggestions on effective means to expand the committee's Legislative Liaisons roster. A number of Legislative Liaisons have been recruited to provide committee positions and perspectives to Congress through their contacts with Members serving on key science and technology committees. Rathbone suggested that one Liaison be recruited per state. The committee also discussed the potential role of PACE in this regard.
- The committee engaged in preliminary planning for 1993 activities. In addition to annual R & D budget testimonies, the committee noted opportunities related to support for passage of the National Competitiveness Act, development of NSF reauthorization legislation, and briefings of new Members of Congress. Issues to be investigated include adequacy of capital for technology commercialization, defense conversion, and needed industry R & D incentives.

# 2ND WORKSHOP ON FINITE ELEMENT METHODS IN ELECTROMAGNETIC WAVE PROBLEMS

**Certosa di Pontiguano, Siena, Italy, May 24-26, 1994**

**Objectives & Conference Themes**

The Workshop will cover the application of the Finite Element Method to electromagnetic field problems with emphasis on problems related to electromagnetic radiation and scattering, guided waves, parameter determination for resonators and filters, and active and passive microwave devices. Particular attention will be devoted to industrial applications.

**Call for Papers**

Authors are invited to submit papers on the outlined topics, and other topics which will fit within the general objectives of the conference. Abstracts of no more than 500 words should be submitted to the conference secretariat by the deadline shown. The official language of the conference will be English.

Authors are encouraged to submit abstracts by electronic mail. To obtain instructions for e-mail submission, send a message beginning with the word "Instructions" to the Internet address SIENA94@INGFI1.CINECA.IT.

Final acceptance will be based upon review of the full length paper which must be submitted in camera-ready form by January 1, 1994. The accepted papers will be published in a Special Issue of COMPEL.

**Deadlines**

| | |
|---|---|
| — Abstracts deadline (500 words) | July 31, 1993 |
| — Acceptance for presentation | October 15, 1993 |
| — Papers deadline | January 1, 1994 |
| — Final acceptance | March 15, 1994 |

**Secretariat**

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## IEEE SYMPOSIUM ON ELECTRONICS AND THE ENVIRONMENT

The IEEE Technical Activities Board (TAB) is sponsoring the first International Symposium on Electronics and the Environment, May 10-12, 1993 in Arlington, Virginia. The conference will include a half-day tutorial on fundamentals of Design for the Environment: Plenary sessions will address international environmental regulations, legislation, public opinion trends and environmental marketing. The General Chair is Diana Bendz, Director of Integrated Safety Technology for IBM corporate worldwide manufacturing and development organization.

For information contact:

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## CALL FOR ADMINISTRATIVE COMMITTEE NOMINATIONS

In accordance with Article 4.3 of the By-Laws of the Magnetics Society, the Nominations Committee (NomCom) hereby solicits nominations for the Administrative Committee (AdCom) from all members of the Magnetics Society. This year eight positions on the AdCom for a three-year term beginning 1 January 1994 will be filled. The NomCom, consisting of E. Della Torre, R. M. Josephs, J. Judy, P. E. Wigen, and D. I. Gordon (Chairman), will consider all names submitted and compose a ballot from these inputs.

Please submit a short biography (250 words or less) with *each* of your *nominations. A nomination submitted without a biography will not be considered.* Also please be advised that a petition for a nominee duly signed by a minimum of 25 society members will **automatically** place that nominee on the ballot.

Please mail all nominations — with biographies — to the Nominations Committee Chairman, at the address shown below, early enough so that they are received by the **deadline date (15 June 1993).**

Daniel I. Gordon, Nominations Committee Chairman
2711 Colston Drive
Chevy Chase, Maryland 20815
U. S. A.
(301) 565-0608
e-mail: 473-3737@MCIMail.com

## BOOK REVIEW:

### *Fundamental Magnetization Processes in Thin Film Recording Media*

— An extended review chapter by H. Neal Bertram and Jian-Gang Zhu, *Solid State Physics,* Volume 46, H. Ehrenreich and D. Turnbull editors, Academic Press, 1992 (271-371).

*Reviewed by T. C. Arnoldussen*

In the first half of this 100 page review, the authors (I) summarize the physics of magnetization and recording processes; (II) review some magnetic properties and microstructures of thin film recording media reported in the literature; and (III) present the essentials of micromagnetic modeling, from Stoner-Wohlfarth theory to the Landau-Lifshitz dynamic equation of motion for magnetization. The second half of the article is primarily a compendium of the authors' applications (over the past six years) of micromagnetic modeling to recording media phenomena. These major topics include (IV) reversal processes and domain structures; (V) magnetic recording processes; and (VI) self-organized behavior. Much of what is now known about the relation of fundamental film properties (crystalline anisotropy, exchange coupling, grain size, easy-axis orientation) to hysteresis, recording processes, and noise is a result of the Zhu and Bertram studies summarized in the last three sections.

This article is a valuable resource on several counts. The authors maintain the even flow of a tutorial. Although they punctuate with copious references, they do not engage in detailed reporting on each. The various Bertram-Zhu studies have addressed longitudinal and perpendicular media, multilayered media, hysteresis, dc-erase noise, and transition noise. While virtually every topic discussed in the present article can be found in the published literature (often as short three page conference proceedings papers), there is great value in drawing them together in one coherent presentation. For those familiar with many of the Zhu-Bertram modeling results, but not the theoretical foundations, part III is recommended reading. Of course, you'll want to wear your mathematician's spectacles for this section.

## CALL FOR NOMINATIONS:

### REYNOLD B. JOHNSON INFORMATION STORAGE AWARD

- An IEEE Field award for significant contributions to information storage.
- Nominees will be judged on the historical significance and the impact of their contribution on the evolution of computer storage systems.
- The recipient will receive $5,000 and a medal.
- Nomination forms are available from:

Maureen Quinn, Manager
IEEE Awards and Recognition
345 East 47th Street
New York, NY 10017
Phone: 212-705-7882
FAX: 212-223-2911

# *CONFERENCE CALENDAR*

**MAY 10-12, 1993**

**IEEE International Symposium on Electronics and the Environment.**
Arlington, VA.

ISEE Conference Registrar, IEEE Technical Activities, 445 Hoes Lane, Box 1331, Piscataway, NJ 08555-1331, TEL: (908) 562-3878, FAX: (908) 562-1571, e-mail g.sacchi@ieee.org.

**JULY 5-9, 1993**

**Joint International Symposium on Optical Memory and Optical Data Storage.**
Maui, Hawaii.

Cathy Goldsmith, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331. TEL: 908-562-3894, FAX: 908-562-1571, E-MAIL: c.goldsmith@ieee.org.

**AUGUST 23-28, 1993**

**EMMA-European Magnetic Materials and Applications.**
Kosice, Czecho-Slovakia.

P. Sovak, Dept. of Exp. Physics, Faculty of Sciences, nam.Febr.vitazstva 9, 041 54 Kosice, Czecho-Slovakia. TEL: xx42-95-21128.

**SEPTEMBER 13-15, 1993**

**The 4th Magnetic Recording Conference (TMRC'93).**
University of Minnesota, Minneapolis, MN.

E.S. Murdock, Seagate Technology, 7801 Computer Avenue South, Minneapolis, MN 55435. TEL: 612-844-4400, FAX: 612-844-8074.

**NOVEMBER 15-18, 1993**

**38th Conference on Magnetism and Magnetic Materials (MMM).**
Minneapolis, MN.

Ms. Diane Suiters, Courtesy Associates, 655 15th St. NW, Suite 300, Washington, DC 20005, TEL: 202-639-5088, FAX: 202-347-6109.

**MAY 24-26, 1994**

**2nd Workshop on Finite Element Methods in Electromagnetic Wave Problems.**
Certosa di Pontignano, Siena, Italy.

Giuseppe Pelosi, Department of Electrical Engineering, University of Florence, Via C. Lombroso 6/17, I_Florence, Italy.
TEL: +39-55-4796759, FAX: +39-55-4796767, E-Mail: SIENA94@INGFI1.CINECA.IT.