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EDWARD DELLA TORRE, EDITOR

DIVISION IV DIRECTOR'S REPORT

by Kiyo Tomiyasu

At the invitation of your President Alan Smith, I had the opportunity to attend the Magnetics Society Administrative Committee meeting held on April 16 in Phoenix, Arizona in conjunction with Intermag'86. With over 1000 registrants, Intermag'86 appeared to be a highly successful conference. The following comments were presented to the Magnetics Society Administrative Committee.

Five Senior Members of the Magnetics Society were elected by the IEEE Board of Directors to the grade of Fellow effective January 1, 1986. These were previously listed in the December 1985 issue of IEEE MAGNETICS SOCIETY NEWSLETTER and I wish to mention these individuals again:

Hamman, M. Shawly S.S.
Hasegawa, R.
Oldendorf, W.H.
Strnat, K.J.
Takaoka, M.

Congratulations to these newly elected Fellows!

Your NEWSLETTER Editor, Ed Della Torre, has been diligently putting out a fine publication with much news useful to the membership. The success of the Magnetics Society is due to the large effort exerted by the dedicated volunteer members of the Society. The Society is indeed fortunate in having such dedicated members and leadership.

During the summer of 1985,the IEEE Board of Directors examined the Fellow election process and observed that the number of Fellows elected was constrained by the capstone of 0.6% of the number of IEEE Senior Members. As a consequence, the Fellow Grade population did not increase in proportion to the IEEE membership simply because the Senior Membership population was relatively stagnant. After careful study the IEEE Board of Directors amended the Bylaws to permit more qualified Senior Members to be elected to the grade of Fellow without altering the stringent qualifications. The capstone was changed to 0.1% of the number of Voting Members and this reverted to an early exclusiveness criterion of "one-in-a-thousand." Effectively, the amended By-law now permits about 200 Fellows to be elected each year.

Traditionally the Fellow nomination process has been handled in strict confidence. The Board decided in 1985 that there is valuable data available on the nomination forms which would be useful in searching for candidates for major awards. As a consequence, the IEEE sought the release of the confidentiality of the information contained on only the Nomination Forms of those elected. Over 90% of the nominators agreed to release this confidentiality. The content of these forms are releasable to certain IEEE entities approved by the IEEE Awards Board. This should help in identifying potential candidates and to provide much useful information in the preparation of the nominations of deserving candidates for IEEE awards.

As you know, since my last report in this NEWSLETTER, Dr. Emerson Pugh has been elected IEEE Executive Vice-President. Our congratulations to him. At the IEEE Philadelphia Section Awards Banquet on March 8, Dr. Pugh presented a thought-provoking brief message on the importance of mathematics and science courses in our educational curricula.

As of March 1986, the Magnetics Society had a membership of 3,169 regular members and affiliates. This represents a 5.6% growth and the Society ranks 9th among all IEEE societies. With the abolition of the $15 IEEE entrance fee by the Board of Directors last November, it should be more attractive for non-members to join the IEEE and Magnetics Society.

Last year the Board of Directors passed a Bylaw amendment which would expedite the establishment of student scholarships and other student awards. In the case of Societies, the authority for approval has been delegated to TAB provided the specifications meet the criteria appearing in the IEEE Policy and Procedures Manual. An additional approval by the IEEE Executive Committee is required for the dispersal of IEEE funds.

Early in 1986 I appointed two members of Magnetics Society as Division IV representative to IEEE entities:

James Lommel	TAB Search Committee
Stanley Charap	Publications Board

As your Division Director I have been receiving complimentary copies of the new IEEE Translation Journal on Magnetics in Japan. The journal looks impressive and probably will become a very important addition to the archival literature.

The IEEE TRANSACTIONS on Magnetics edited by

Prof. Stanley Charap is a very professional publication and this is one of the most important outputs sponsored by your Society. Instead of placing the biographical sketches of all authors at the end of each issue, it is suggested that biographical sketches be printed at the end of each paper. In this manner, recipients of reprints will receive the sketches as well. Another suggestion not mentioned at the recent AdCom meeting is the publication of a brief article about the recipients of Magnetics Society awards and recognitions. This archival record should be useful in recalling the history of the Society.

In other IEEE publications, the authors who have ordered reprints have not been receiving them shortly after the issue has been printed. If this has been the experience of any recent author, please communicate with your Society President.

Late in 1985, the IEEE published a very limited number of copies of 1985 IEEE Fellow and Senior Member Index. Copies were distributed to Society and Section Officers. These members are listed by Societies and by Sections within Regions. The Index has been provided with the objective of being helpful to a Member to find references when applying for the Senior Member Grade. It should also be a very useful resource in identifying possible candidates for awards and recognitions. This Index is an experimental project, and we badly need your feedback. It will not be continued without your voice for its continuance. Please send in your comments to Mr. Don Suppers by using the Questionnaire on page ix of the Index.

As you may have noticed in the May 1986 issue of THE INSTITUTE, the candidates for Division IV Director for the 1987-88 term are:

J. Leon Shohet	Univ. of Wisconsin
Gary A. Thele	Univ. of Dayton

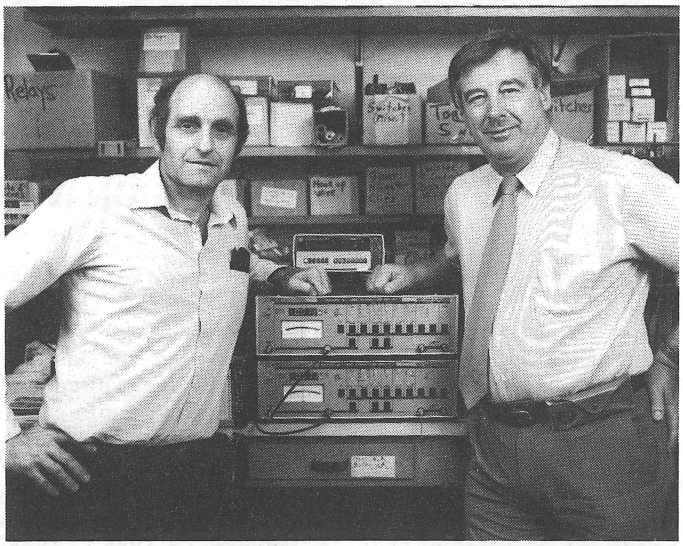
These are two excellent candidates and either one will serve Division IV very well.

If I can be of any assistance to you on any IEEE matter please feel free to contact me. My telephone number is (215) 354-5740, and my address is Generel Electric Company, P.O. Box 8555, Philadelphia, PA, 19101.

The IEEE Magnetics Society Newsletter is published quarterly by the Institute of Electrical and Electronics Engineers, Inc., 345 East 47 Street, New York, New York 10017. The objective of the Newsletter is to publicize activities, conferences, workshops, and other information of interest to the membership of the Society and technical people in the general area of applied magnetics. Copy is solicited from the S-MAG membership, organizers of conferences, officers of the Society and local chapters, and other individuals or organizations with potentially relevant material. Copy should be sent to Dr. Ed Della Torre, Editor, Magnetics Society Newsletter, Dept. of EE & CS, The George Washington University, Washington, D.C. 20052 by the following deadlines, September 20, December 20, April 20 and July 20.

MAGNETICS SOCIETY EQUIPMENT GRANT

The University of California in San Diego received an equipment grant from the Magnetics Society in August 1985. The proceeds of this award were used to purchase two lock-in amplifiers. Below are pictured Sheldon Schultz on the left and John Mallinson flanking the new purchases.



MERIT SCHOLARSHIP WINNER

Richmond B. Clover, Scholarship Chairman is pleased to announce that the winner of the 1986 National Merit Scholarship, sponsored by the IEEE Magnetics Society, is Curt O. Hagenlocher, son of Arno K. Hagenlocher of Santa Rosa, California.

Curt will attend California Institute of Technology, where he will be majoring in molecular biology and is interested in genetic engineering as a career. Curt has done some volunteer work for Sonoma County which he found very satisfying. When he was a junior at Santa Rosa High School he was named "Math Student of the Year". He is also active in the youth group of his church, and has taught Vacation Church School.

Curt enjoys swimming, skiing, and bicycling. He is also interested in computers (both design and programming), biochemistry,animals and motor scooters. Curt also enjoys traveling and likes dealing with other poeple that share his sense of humor and a good time.

Curt will be formally awarded the scholarship at his graduation from Santa Rosa High School, Santa Rosa, California.

SESSION CHAIRMAN'S OVERVIEW

At INTERMAG'86, each morning between 8:00 and 9:15 the conference met in plenary session. At this time the session chairmen for that day's sessions summarized what they expected would happen at those sessions on the basis of the full papers submitted by the authors. The talks were deliberately kept at such a level that nonspecialists in any field could still understand the gist of the sessions.

Despite the scheduling of those talks which participants could easily miss and enjoy an extra hour and a half's sleep, the sessions were well attended. We are informed that the format will be repeated at INTERMAG'87 in Tokyo next year.

INTERMAG SESSION CHAIRMEN SUMMARIES

In order to keep the magnetics community informed, the Newsletter is presenting summaries of the sessions held at INTERMAG, held in Phoenix, AZ from April 14 to April 17, 1986. These summaries, prepared by the session chairman, are not designed to be comprehensive, but merely to present some of the highlights. It is not possible, due to the size of some of the sessions to list all the papers presented, let alone discuss them.

Session BA
Chairman: W.D. Doyle

This session represented a different approach to the usual conference tutorial. Based on attendance (approx.500) and enthusiasm (four hours), it was a success. It had its genesis in a concern that much of the rich history of the problem of magnetization reversal, particularly in magnets, was not well known in the magnetic recording community. As it developed, the session included summaries of the past, but focused on how the concepts related to the materials used in recording today and to current problems in recording.

The speakers and topics were chosen so that after the session,the listener would have a coherent picture of what we know and don't know about the reversal process. In particular, what do we know about the reversal in a single particle and in a collection of particles which may (films) or may not (powders) be exchange coupled. The speakers came together for a two-day workshop in December to pull and tear at the problem, to expose and be exposed to strong beliefs and finally to assimilate new ideas. Topics to be covered in the presentation were agreed upon and the speakers went away to write their papers. These were circulated before the conference for a final critique, and all will appear in the Transactions. The breadth and thoroughness of the papers is reflected in more than 180 references.

The strategy of this session was to state first what can be done now with models of the record process (I.A. Beardsley), what are some problems we don't understand (H. Neal Bertram), what do particles (A.E. Berkowitz) and films (H.Hoffman) really look like, what can an exact theory say (A. Aharoni) and, finally, what can we derive from iterative, approximate calculations (E. Della Torre).

To summarize the results in a few words is impossible. The interested reader must wait for the Transactions. However,to heighten his anticipation, the abstracts are presented here.

Session BB
Chairman: J.A. Salsgiver

Highlighting the session was the invited paper prepared by N. Takahashi et al. of Nippon Steel entitled "Production of Very Low Core Loss Grain-Oriented Silicon Steel." In this presentation, the authors claim to be able to readily produce 0.15-mm thick strip with 50 Hz losses at 1.3T and 1.5T of 0.30 W/kg and 0.41 W/kg, respectively. They do this with a laser scribing domain refinement technique in combination with a gradient annealing method to achieve very high degrees of texture perfection. A closely related paper by R.F. Krause and G.C. Raugh of Westinghouse entitled "Performance of Laser Scribed Three-Phase Laboratory Transformer Cores" detailed the authors' experiences not only with the reduction in core loss of high permeability steels with laser scribing, but also with accompanying effects on permeability, eddy current-to-hysteresis loss ratio, and resulting benefits in the construction of transformers. "The Development of Goss Texture in FE-6.5%Si-2%Ni," by K.S. Narasimhn et al. of Crucible Research was a presentation that dealt with a P/M alloy development attempt to produce ultra low loss grain-oriented high silicon steel.

G. Lyudkovsy of Inland Steel in "Effect of Antimony on Internal Oxidation and Magnetic Properties of Si-Al Electric Steels," discussed his observation that Sb decreases internal oxidation resulting in higher permeability and more efficient laminations for motor and transformer applications. In "The Core-Loss Reducing Effect of Aluminum in Non-Oriented Fe-Si Steels," I.Boc of Csepel Metal Works, Budapest, elaborated upon an "extra" effect from Al additions.

M. Komatsubara of Kawasaki Steel and J.L. Porteseil of Louis Neel Lab authored "Barkhausen Noise Behavior in Grain-Oriented 3% Si-Fe and the Effect of Local Strain." Among many observations, they found that that the Barkhausen noise energy per cycle decreased significantly (50%) with local straining (scribing). R Ranjan and D.C. Jiles of Ames Laboratory and P.K. Rastogi of Inland Steel noted in "Magnetoacoustic Emission, Magnetization and Barkhausen Effect in Decarburized Steel" that both magnetic Barkhausen and magnetoacoustic emission signals vary linearly with grain size. Domain wall dynamics were studied by M. Celasco et al. in "Experimental Study of Block Wall Bowing Anomaly Due to Wall Surface Pinning." An apparatus and method for measuring low frequency hysteresis was given by G. Birkelbach et al. in "Very Low Frequency Magnetic Hysteresis Measurements with Well-Defined Time Dependence of the Flux Density." The intriguing possibility of using a magnetic method to monitor stress in pipelines was discussed by D.A. Atherton and J.A. Szpunar in "Effect of Stress on Magnetisation and Magnetostriction in Pipeline Steel."

Session CA
Chairman: Gordon Hughes

In Session CA on "Longitudinal Thin Film Recording Media", a plurlity of three of the twelve papers discussed cobalt alloy media over chrome underlayers. Ishikawa, et al. discussed mechanisms for CoNiCr coercivity increase with chrome underlayer thickness. The columnar HCP chrome underlayer tends to orient CoNiCr media HCP axes parallel to the underlayer surface, and isolates the grains, thus raising the coercivity and squareness due to the higher in-plane anisotropy energy barrier. Chrome segregation into the media grain boundaries isolates the particles, and further raises the coercivity (towards the Stoner-Wohlfarth limit). Yamaguchi and Yanagisawa showed isolated CoNi FCC/HCP microstructures, when deposited on columnar Cr underlayers. To illustrate the importance of the underlayer, CoNi on polyimid showed no grain isolation, and consequently very low coercivity.

Abe and Nishihara reported a disc sputtering mask geometry that gives circularly symmetric oblique incidence onto a rigid disc substrate, for increased coercivity and squareness, obtaining 3:1 orientation ratios.

Alexopoulos and Geiss gave an invited paper on Lorentz electron microscopy magnetization reversal measurements and microstructure in cobalt alloy films. Zig-zag bit reversal structure was seen in FeCoCr films, and vortex structures in CoPt and CoRe.

The paper by Umeda et al. reports on media chosen for its corrosion resistance rather than its magnetic properties, viz., FeNi.

Langlet, et al., reported on uniaxial CVD deposited gamma and co-gamma Fe_2O_3 films, with magnetic properties approaching those of cobalt alloy thin film discs -- 5,000 gauss nd up to 1,000 Oe.

Session CD
Chairman: Richard M. Josephs

Although at first glance, it might appear that this session of nine papers was somewhat of a "mixed bag", there were two underlying themes. At least six of the papers used digital instrumentation techniques. In fact, the measurements discussed in five of them would have been difficult, if not impossible, with analog techniques. The other theme was that of characterization methods for recording media. R.M. Josephs of the Naval Air Development Center described a technique for characterization magnetic oxide recording media using Fourier analysis of statis hysteresis loops. This method can describe the entire loop to a high degree of accuracy, provides analytic expressions for hysteretic behavior, and can identify subtle differences among various sammples. J.A. Weiss, of Lincoln Lab, described a digital implementation of a technique, first introduced by his co-author G.F. Dionne in 1969, using the approach to saturation region to extract information about the porosity and anisotropy in ferrites. With analog data, the data reduction is quite tedius. However, with digital data, the analysis is very easy and the method may find wider use from now on. G.W. Spratt, of Lancashire Polytechnic, described several different techniques for determining the switching field distribution in particulate recording media. Differences between the static and AC methods were observed and information about the particle interaction fields may possibly be extracted from the results. R.M. Josephs discussed the use of digital signal processing in vibrating sample magnetometry to improve the speed and sensitivity. The essence of the method is to carry out in software the operations of the reference channel and the phase sensitive detector of a conventional lock-in amplifier. V.S. Speriosu of IBM Almaden Research Center, described the use of FMR measurements on thin film of Co-alloys and gamma ferric oxide. A linear relation was observed between the resonance line width and the film coercivity. The results were interpreted using a model in which there was a modulation of the anisotropy arising from structural variations. C.S. Krafft described the use of the longitudinal Kerr effect to measure, for the first time, the surface hysteretic behavior in particulate recording media. Comparison was made between the surface hysteresis loops and those of the bulk as measured with a VSM. For some samples, H_c was the same in both measurements while in others,the surface H_c could be as high as 10% larger then that of the bulk value. T.E. Karis, of IBM Almaden Research Center, discussed a technique for measuring the magnetic particle concentration in suspensions used during media manufacturing. The method consists of measuring the change in the inductance of a coil surrounding a cell holding the suspension. Although the method is designed for process control, it is quite sensitive and is capable of revealing the dynamics of the mixing process. J.C. Lutz of Iowa State University, described the details of a microprocessor controlled probe station for authomatic characterizations of thelocal magneto-resistance values over a 3" diameter thin film coated substrate. In the final paper of the session, T. Mochizuki, of Fuji Electro-Chemical Company, described an automatic system for characterization of cores up to 1 MHz in frequency. The system uses a waveform and then transfer the data to a desktop computer where the necessary data manipulations are performed. The previous technique for core characterization uses an analog voltmeter and is limited in operation to 200 KHz.

Session DC
Chairman: Robert W. Lee

Ten of the twelve papers in this session dealt with Nd-Fe-B permanent magnets and several dealt with the variation of anisotropy field, H_A, with temperature or with elemental substitution for iron. A principal concern was the relatively high temperature dependence of the intrinsic coercivity, H_{ci}. Correlation between H_A and H_{ci} was suggested in several papers. Grossinger, et al., reported an anomaly in H_A below 200°K associated with spin reorientation and showed a similar singularity in the temperature dependence of athe coercivity. Volume domain wall pinning was suggested as the likely coercivity mechanism. Yang et al., showed simultaneous increas in H_A and H_{ci} with Al substitution for Fe. The monotonic increase in coercivity with increasing Dy substitution for Nd reported by Ghandehari also suggests an H_A:H_{ci}

correlation. Jurczek and Wallace showed a similar connection between H(A) and Curie temperature, T_C, for Mn and Co substituted N-Fe-B, further suggesting that coercivity and its temperature dependenced may be controlled by the intrinsic properties, H_A and T_C. Meisner and Fuerst reported lattice constant and Curie temperature dependence for Mn and Co substitution in Er-Fe-B. An unusual decrease in unit cell volume with low level Mn substitution was ascribed to enhanced magnetostriction near T_C. Magnetostriction in sintered Nd-Fe-B was reported by Graham and Flanders to be relatively small with substantial hysteresis at low fields. But large linear forced magnetostriciton was observed at high applied fields. Three other papers reported magnetic properties for one-step Nd-Fe-B magnet fabrication. Chin, et al., described liquid dynamic compaction and Cadieu, et al., reported results for sputtering. Both procedures ar potentially simpler and less expensive than either powder metallurgy/sintering or melt spinning/hot pressing. Two final papers in Session DC dealt with other permanent magent materials. Gotoh, et al., compared microstructure and magnetics of rapidly solidified Fe-Cr-Co and Mildrum described a relatively low field magnetizing procedss for Sm_2Co_{17}.

Session DB
Chairman: M.P. Sharrock

The session devoted to Particulate Recording Media was a very significant one, reflecting the strong interest in this area in recent years. The first four papers dealt with barium ferrite, the most recent addition to the group of particulate materials used in magnetic recording. Barium ferrite has a unique combination of shape anistropy and magnetocrystalline anistropy, and therefore shows unusual behavior that must be understood if successful media are to be designed. Ido et al. (Toshiba) demonstrated the pronounced effects that the shape of the particles has on the way in which coercivity depends upon particle concentration (loading). Speliotis et al. (Advanced Development Corp. and Integrated Magnetics, Inc.) showed the dependence of coercivity and other magnetic parameters on loading, for various particle shapes and dispersion conditions. In a separate paper, Speliotis discussed the coercivity temperature dependence of barium ferrite for perpindicular recording, Takahashi et al. (Fujitsu) described its successful use in a longitudinally oriented rigid disk, with the addition of some conventional acicular particles to improve the coating quality.

An invited paper by Homola et al. (IBM) described a method for improving the dispersion of oxide particles by coating them with chemically modified colloidal silica.

Three papers were concerned with cobalt-doped iron oxide particles. Josephs et al. (Naval Air Development Center) discussed the angular variation of measured magnetic parameters for particulate tapes having oriented and isotropic structures; variation occurs even in the latter, owing to demagnetization fields. Sharrock (3M) and Josephson (Advanced Magnetics, Inc.) described oxide particles, doped with both cobalt and zinc, in which the coercivity had an unusually strong dependence upon time-scale measurement; this was explained as being due to independently switching magnetic subunits. Eiling et al. (Bayer AG) described a new cobalt-surface-modified iron oxide, with substantial FeO content in the core, for which excellent thermal stability and video performance were claimed.

Three papers dealt with metal particles; these, as well as barium ferrite particles, are candidates for use in advanced media such as 8-mm video tapes. A paper by Ohshima (Mitsui-Toatsu Chemicals, Inc.) described a model for interpreting the coercivity of acicular metal particles in terms of their morphology; it involved a "chain-of-spheres" model in which the spheres do not lie in a line. Tagawa et al. (Mitsui-Toatsu) discussed a method for improving the oxide passivation layer on the surface of metal particles through high-temperature annealing. Kishimoto et al. (Hitachi Maxell Ltd.) presented a study of this passivation layer by means of electron microscopy, Mossbauer spectroscopy and magnetic measurements.

Pollard and Oesterreicher (Univ. of Cal., San Diego) described novel particles, for possible use in magnetic recording, having iron/rare-earth/boron compositions and formed into small particles by hydrogen absorption.

Ohtsubo et al. (Yamagata University) described an orientation technique that favors perpendicular magnetization near the surface of the recording medium and longitudinal magnetization at greater depth.

Session FD
Chairperson: Ivan Garshelis

Diversity in application, diversity in material and diversity in research effort were all clearly demonstrated by the ten papers presented in this session. In the order presented these papers descrbed:

The significant reduction of the temperature coefficient of sensitivity of NiFeCo thin film magnetometers with appropriate Co content by utilizing current source excitation.

An extension of the authors' previous work with a feedback system to attain zero core flux to a current leak detector of wide dynamic range. A force sensor using an amorphous ribbon as a vibrating string was also described.

A simple non-contact angle resolver based on the magnetoresistance anisotropy of a pair of permalloy film elements in the field of rotatable permanent magent.

The unusual distribution of alternating currents in coaxial ferromagnetic pipes and how this might be used to heat a liquid carried in the inner pipe thereby facilitating the transport of viscous materials.

How the control region of the magnetization curve may be used to evaluate core materials for potential applications of magnetic amplifiers in the megahertz region.

An analysis of a previously described bridge-connected magnetic circuit used in AC control and a new push-pull adapptation of the device.

The use of ferrite wedges in the stator slots of single phase capacitor run motors to increase the efficiency 6.4% in a general purpose machine.

A novel high speed AC motor in which one core provides the linear and saturable reactor functions of a frequency tripler and simultaneously functions as the motor stator.

The attainment of unusually high AC magnetic fields by the concentrating effect of eddy currents in conductive plates appropriately positioned in the air gap of an electromagnet.

Another significant step in the authors' continued efforts to reduce the magnetic fields required to realize the giant magnetostrictions in cubic rare earth - Fe materials.

Session FE
Chairman: E.Schloemann

This session contained five papers concerned with ferrite materials for millimeter wave applications (30-100 GHz), five papers concerned with magnetic phenomena at microwave frequencies (including magnetostatic waves, FMR damping and high power FMR) and one paper on Brillouin light scattering.

The session began with an invited talk by M. Labeyrie et al. (Thomson-CSF) concerning the magnetic and dielectric loss of strontium hexaferrite at 94 GHz. The paper also describes a new technique for measuring the anisotropy field. The authors find that at room temperature the FMR linewidth is approximately 36 Oe, the dielectric loss tangent 1.0×10^{-3} and the anisotropy field 18,870 Oe, and that the magnetic and dielectic losses are largely determined by intrinsic processes. The second paper (by S.G. Sankar et al., Penn State) described new preparative techniques that are being explored in an effort to provide ferrites with high saturation magnetization, high density and low loss. W.E. Kramer et al. (Westinghouse R&D Center) summarized work on hexagonal ferrite and on materials that are suitable as substrates for growing films of hexagonal ferrites. A study concerning the temperature and frequency dependence of the FMR linewidth in Ba hexa-ferrite was reported by L.M. Silber and W.D. Wilber (Forth Monmouth). P. Grohs et al. (Aachen Technical University, West Germany) described a theoretical and experimental investigation concerning the microwave absorption of diluted, high anisotropy ferrites in the partially magnetized state.

H. LeGall et al. (CNRS and Thomson-CSF) investigated the effect of Ga substitutions in YIG on magnetic properties that are important in magnetostatic wave devices. They found that certain properties improve with Ga substitution (e.g. the temperature coefficient of delay lines), whereas other properties are adversely affected (e.g. the bandwidth). A comparison of various phenomenological descriptions of FMR damping was presented by M.V. Kogekar and C.E. Patton (Colorado State University). It was concluded that only Landau-Lifshitz damping is in agreement with the authors' experimental data concerning the off-resonance response of various polycrystalline ferrites (spheres and platelets) measured at 10 GHz. Two papers by Y.T. Zhang et al. (Colorado State) and J.Smyth and S. Schultz (CMRR and UCSD) were concerned with high power FMR effects in YIG. The first of these described the observation of "fold-over" effects in very thin (7.9 μm thickness) and small (0.5 mm diameter) films of YIG as function of power level and duty rate. The Smyth-Schultz paper (not submitted for publication) describes similar effects observed in YIG spheres.

The last paper by G. Srinivasan and C.E. Patton (Colorado State) described Brillouin light scattering experiments on Cobalt-Chromium films. The experiments yield data on the variation of magnon frequencies (generally in the microwave range), with externally controlled parameters (such as magnetic fieldstrength, and wave number) and can be used to infer magnetic parameters such as saturation magnetization, anisotropy field, g-factor, and exchange stiffness.

Session GA
Chairman: R.F. Hoyt

Session GA was the largest session yet at an Intermag Conference which specifically addressed head-media interface issues, and was very well attended. It consisted of 1 invited and 10 contributed papers, all concerned with modelling and experimental work aimed at detailed understanding of the interface between magnetic media and the recording head. The continued growth of interest in this area reflects the very important role currently played by magnetic disk storage in the information processing industry.

The papers presented in the session fell into three main categories:

1) Those concerned specifically with media wear during sliding, or rubbing contact, GA-1 and GA-2.

2) Techniques and measurements of contacts and those things which effect them, GA-5 and GA-7, and

3) Modelling calculations and experimental measurements of the air bearing slider and its dynamical motion as it "flies" over the disk, papers GA-3 and GA-8-11.

The first two papers of the session discussed media wear and what could be done to vastly reduce it. Paper GA-1 showed that wear lifetime could be greatly enhanced with a double layer carbon overcoat, with the second layer of carbon being partially polymerized; and Paper GA-2 showed that wear life of Co-Cr could be greatly extended by oxidizing the first few hundred Angstroms of the surface.

A detailed technique for the measurement of slider-disk contacts was presented in the invited paper of the session, GA-5. The sensor used was a small piezoelectric crystal attached directly to the air bearing slider body, which was shown to be very sensitive to direct slider-disk contacts. Also included in the talk was a comparison with other possible contact sensing techniques, and application of the sensor to detecting air bearing and disk mechanical properties. Paper GA-7 showed an application of the Laser Doppler Vibrometer to directly quantify non-repeatable disk flutter and its frequency content.

The rest of the papers in the session were devoted to air bearing sliders and their design. Papers GA-3 and GA-4 were concerned with modelling calculation of sliders for stretched surface disk recording and disk substrate effects on sliders' flying performance. Comparison of modelling and experimental performance of sliders flying over a disk was discussed in paper GA-9, and the effect of air flow in existing suspension resonances was discussed in GA-8. The novel design of a slider with side tapers, which is quite insensitive to skew angle, was presented in GA-10. Papers GA-6

and GA-11 both presented experimental measurements of sliders' flying characteristics measured optically (GA-6) and capacitively. The optical technique was shown to have sensitivity in the sub-nanometer region, whereas the capacitance technique of GA-11 was used to measure the fly height, pitch, and roll of the slider and the data used to make a slow motion picture of the sliders' motion during accessing in a fully assembled HDA.

Session GC
Chairman: Herbert A. Leupold

The central theme of Session GC is the technological exploitation of the high energy product, rare earth permanent magnets (REPM). Many novel and formerly impracticable designs are now easily achievable with REPMs, and so effective are they in such designs and so wide-ranging in their applicability that they constitute a difference in kind, rather than in degree, from conventional magnets such as alnicos. This is amply demonstrated by the Session GC papers that are included in three broad categories: 1)novel magnetic circuit designs unobtainable with conventional magnets; 2) in situ magnetization for complex geometries; and 3)improvement in materials properties to broaden the range of applicability. The first paper, by Clarke and Leupole, describes a variety of leakage-free permanent magnet structures that provide solenoidal fields of arbitrary axial gradient to cylindrical working spaces, and that are thus suitable as replacements for electrical solenoids of many times their weight and bulk. Morcos et al. discuss several REPM helical mm-wave, free-electron lasers. Potenziani and Leupold describe both axial and transverse permanent-magnet field sources for whole-body NMR imagers for medical diagnostics. Sebastian et al. describe new modeling and analytic techniques for advanced synchronous motors, and Uehara et al. for brushless dc motors.

The second category comprises two papers that describe novel techniques of in situ magnetization of high-coercivity materials. The paper by Fujiwara et al. concerns mode of orientation if the magnetized material, while that of McDonald emphasizes innovations in the electric circuitry of the magnetizer. Both techniques result in magnetization levels that could not otherwise be obtained in the configurations considered. In Category III, Saito et al. and Hadjipanyis et al. discuss improvement of material properties and fabrication techniques. Narasimhan et al. deal with the problem of temperature compensation in NdFeB magnets and describe the considerable improvement effected by ternary rare earth substitutions. The microscopic processes involved in the magnetization of $SmCo_5$ and NdFeB are analyzed by Fernengel and

Session HB
Chairman: Roger Wood

This session included a total of 13 papers commencing with several papers describing systsems on flexible media and then moving onto the more specific topics of coding, equalization and detection.

Matsuda et al. (Matsushita) described a high-density 3" floppy disc system employing conventional techniques on Co-$8Fe_2O_3$ to achieve 1 Mbyte/surface. Baugh et al. (H.P.) discussed a system on a similar medium in VHS tape format achieving much higher densities by virtue of the high track density and the use of a comprehensive error control strategy. On more exotic media, Nakamura et al. (Matsushita) described signal and noise behavior on single layer CoCr with a 14 μm ferrite head achieving a D_{50} exceeding 200 Kbits/inch. The next three papers involved unoriented Ba-ferrite media. Tonomura et al. and Yamamori et al. (Toshiba) discussed the system and media respectively for a 3.5" floppy disk with 2 Mbytes/surface. The system was unusual in suggesting the use of a wide pre-erase head. Nagaki et al. (Sony) presented an investigation of contact duplication for mass replication of the proposed R-DAT consumer digital audio tapes.

A variety of D.C.-free codes were investigated by Fukuda eta 1. (Sony) for the R-DAT format, an 8/10 code with reduced maximum run-length giving best results. H. Ferreira et al. (Rand-Africaan Univ.) described a rate 1/2, (1,7) run-length limited (RLL) code with significant error correction capability. Simulations by French and Wolf (CMRR) of the compact spectrum partrial response technique showed that four-bit quantization was sufficient to obtain most of the advantage in a Viterbi detector. Newby and Wood (Ampex) used computer simulation to illustrate how nonlinear effects explain the characteristic distortion noted in several previously published class IV eye patterns.

P. Latham (Data General) discussed a design procedure for a transversal filter with realistic LC delay elements applied to peak detection of an RLL (2,7) code. A symmetric transversal filter specifically for the correction of "head bumps" from a thick-pole thin-film head design was investigated by Aikawa et al. (Fujitsu). The final paper by Kato et al. (NTT) on a write equalization technique proved a nice complement on their paper two years earlier on playback equalization; both papers aimed at improving S/N by adding more turns to the head.

Session HE
Chairman: P. Thaymbulli

Among the papers on bubble memory devices, the highlights were the (ion-implanted minor loops, permalloy major track) hybrid devices presented by speakers from Hitachi, Fujitsu and SAGEM/LETI. Preliminary study of Hitachi's 16 Mbit/cm^2 chip showed 10% bias margins for bubble propagation in the ion-implanted and permalloy tracks. Fujitsu's hybrid device aims at 8 Mbit and 16 Mbit densities; a novel device packaging was discussed. Characterization of the SAGEM/LETI 4 Mbit/cm^2 device showed possible -10C to 90C operation, with 10% margins at room temperature.

A paper discussed 4Mbit permalloy device operation at 200 kHz drive field. Another paper discussed a new design for permalloy propagator ends which reduced the propagation gap obtained after processing. An improved design for hybrid junction with over 10% bias margins and good phase margins was presented. A comparison of extended temperature (-55C to 25C) characterization of Motorola's 1Mbit device using their standard bubble material as well as Bi-substitued material showed

the latter material to be far superior at high temperatures.

A paper from Carnegie-Mellon University reported a major advance in bubble material for ion-implanted propagation; their material almost eliminated the propagation anisotropy by reducing the magnetostrictive anisotropy. 15% propagation margins for 2.5 μm tracks could be obtained with 0.5 μm bubbles. The use of TEM to study implantation profiles at the mask edge was discussed in another study. A speaker described results obtained in fabricating 2μm ion-implanted propagation tracks usng Cr/Au, SiO_2 and UV hardened resist; projection as well as contact printing were evaluated. Another study showed that the growth rate of Bi-substituted bubble material can be controlled by adding Mo)$_3$ adn V_2O_5 in the flux. A study on the effect of various capping layers as well as generator design on minimum generate current was also presented.Adler.

MRM'86
International Conference on Magnetic Recording Media

Sala Aurea Parma
Camera di Commercio, Industria & Artigianato

September 2,3,4,5 1986

Parma, Italy

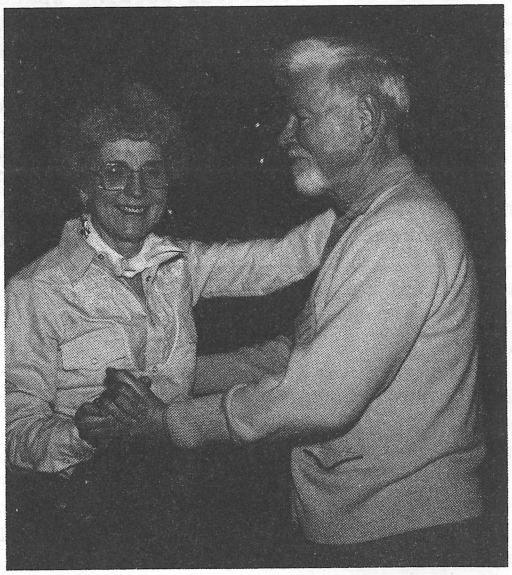
The primary aim of this conference is to offer to the attendants a unique opportunity for direct discussion on the various subjects related to the magnetic recording media. Such discussion will take place after the presentation of pertinent papers and tutorial talks which will inform the audience about the most recent developments and give a broad outline of specific subjects.

This conference is the third of its kind held in Italy after the encouraging success of MRPM'79 (Gardone Riviera) and MRM'83 (Ferrara). Whilst the broad purpose and content of the technical program remains practically the same as it was for the previous events, its fashions and presentation are modified to account for the input of leading scientists in the field and of the Technical and Advisory Committee members.

The program will include a number of contributed and invited talks which will be presented mainly at the morning sessions (8:45-1200) and a number of tutorial speeches and/or workshops to be presented mainly during the afternoon sessions (1400-1730).

The Conference language will be English. As in the past, the technical program will be presented in a single session. So far, no poster session is scheduled. For this reason, and based on the experience of the previous conferences, we strongly recommend to all authors who intend to submit an abstract for presentation at the conference to do so by strictly adhering to the deadlines. This will enable the Technical Committee to allocate the proper amount of time for each presentation and best schedule both the technical and side activities.

1986 INTERMAG SCENES



ELECTROMAGNETIC FIELD COMPUTATION WORKSHOP

The IEEE Region 1 and the Schenectady Section are sponsoring the Electromagnetic Field Computation Workshop to be held at the Ramada Inn in Schenectady, NY on October 20 and 21, 1986. The deadline for one page abstracts in July 1, 1986.

The advance registration fee, due by August 1, 1986 is $125.00. Registration at the conference will be $150.00. There is a special registration fee of $50 for students. Checks should be sent to the address below, payable to IEEE Schenectady Section. Included in the fee are two luncheons and the Steinmetz Memorial Dinner. A feature of the Conference is the Steinmetz lecture to be given by Nobel Laureate Dr. Ivar Yiaver at Union College on October 20, 1986.

For further information contact:

A. Abernethy
GE/CRD
P.O. Box 45
Building 37, Room 319
Schenectady, NY 12301
(518) 387-5098

6th INTERNATIONAL SEMINAR ON MAGNETISM 1987

6th

The sixth international seminar on Magnetism will take place from Monday, March 16 to Friday, March 20, 1987, in the recreation home Dohma, near Dresden, West Germany.

The seminar will be organized by the Hochschule fur Verkehrswesen, "Friedrich List" Dresden, Wissenschaftsereich Physik in cooperation with the "Dresden Seminar for Theoretical Physics." It will be devoted to the following topics:

- Development and application of modern hard-magnetic materials
- Theory of magnetism
- Mixed valent compounds
- Magnetism in disordered systems/spin glasses
- Transport phenomena

Those interested in participating in the seminar, to give lectures, or to get further information are asked to write:

Prof. K. Elk
Hochscule fur Verkehreswesen
Wissenschaftbereich Physik
DDR - 8072 Dresden
Postfach 103

For lecturers the seminar will be free of charge. For all other participants the conference fee is 150,- Mark GDR, additonally about 90,- Mark GDR for board and lodging at Dohma. Due to the limited capacity of the recreation home Dohma (maximum 50 participants) an early reply is desireable.

INTERNATIONAL SYMPOSIUM ON PHYSICS OF MAGNETIC MATERIALS (ISPMM'87)

The International Symposium on Physics of Magnetic Materials (ISPMM'87) will be held on April 8-11, 1987 at Shimin Kaikan (Civic Hall) in Sendai, Japan. This Symposium is being organized as a satellite meeting to the 25th International Magnetics Conference 1987 in Tokyo, Japan under the auspices of The Magnetics Society of Japan and IEEE Magnetic Society.

Purpose and Scope of the Symposium

The purpose of the Symposium is to bring together scientists and to provide an opportunity for presentation and discussion of recent experimental and theoretical advances in the study of magnetic materials. Particular emphasis will be placed on the following areas:

a) The upper and lower limits of hard and soft magnetic properties (rare earth permanent magents, amorphous materials, etc.)
b) Thin films (surfaces, interfaces and ion implantation, etc.)
c) Fine particles (characterization and application, etc.)
d) Disordered and metastable systems (relaxation phenomena and reentrant spin-glasses, etc.)
e) Magnetic anisotropy and magnetiostriction.
f) Magnetic losses at high frequency
g) Other topics (magneto-optics, magneto-elastic waves and new experimental techniques, etc.)

For further information contact:

T. Miyazaki
ISPMM'87
Department of Applied Physics
Faculty of Engineering
Tohoku University, Sendai 980
Japan

INTERNATIONAL SYMPOSIUM ON MAGNETISM OF INTERMETALLIC COMPOUNDS

The International Symposium on Magnetism of Intermetallic Compounds (ISMIC) will be held in Kyoto from April 20 to 22, 1987, as a satellite meeting of INTERMAG'87 (Tokyo April 14-17). The symposium will cover the basic magnetism of intermetallic compounds of transition metals, rare earths and actinides. Pnictides and chalcogenides are also included. Possible topics will be (i) Spin Fluxuations, (ii) Coexistence of ferro- and antiferromagnetism in itinerant electron system, (iii) Spin structure and magnetic phase transition, (iv) Electronic structure and related properties, (v) Transport and thermal properties. The program will consist of invited talks as well as orals and posters. The official language is English.

The place of the symposium will be Kyoto International Conference Hall. The scientific program will start on Monday, April 20 in the morning and will end on Wednesday, April 22 in the afternoon.

The symposium proceedings will appear after the symposium in Journal of Magnetism and Magnetic Materials. The proceedings will contain all the

papers presented at the symposium which are accepted for publication.

For further information contact:

Professor Y. Nakamura
Department of Metal Science
and Technology
Kyoto University, Sakyo-ku, Kyoto 606
Japan

COMPUMAG CONFERENCE ON COMPUTATION OF ELECTROMAGNETIC FIELDS

Graz, Austria
August 25-28, 1987

The sixth COMPUMAG Conference on the Computation of Electromagnetic Fields will be held at the Conference Center in Graz, Austria from August 25 to August 28, 1987. Its aim will be to review recent developments in the analysis of electromagnetic fields for physicists and engineers engaged in the design of electromagnetic devices and permanent magnets. Previous COMPUMAG Conferences were held at Oxford (1981), Grenoble,France (1978), Chicago, USA (1981), Genoa, Italy (1983) and Fort Collins, Colorado, USA (1985).

The principal objective of the conference is to discuss practical applications of numerical techniques to compute magnetic fields. Reflecting the growing importance of coupled problems, it is intended to feature papers on electromagnetic fields coupled to mechanical, electronic, thermal and/or flow systems. In order to present an overview and focus attention on future trends in areas of immediate as well as long term interests to the conference, prominent speakers will be invited to present papers. Preliminary short versions of papers are due at the Conference. The Conference Proceedings will be published in the IEEE Transactions on Magnetics.

Topics of interest to the Conference include:

1. Two and three dimensional magnetostatic and electrostatic field calculations for both linear and non-linear problems. Both new techniques and improvements to existing methods are appropriate subjects.

2. Time-dependent fields, including the transient and steady state behaviour of electromagnetic devices, eddy currents, flux penetration into iron and equivalent circuit techniques.

3. Material properties, including the numerical treatment of anisotropy, hysteresis, permanent magnets and diamagnetics.

4. Electromagnetic fields coupled to a mechanical, electronic, thermal and/or flow system. Examples include actuators, variable speed drives, superconducting magnets, electroheat, nondestructive testing, recording heads, nuclear fusion and power electronic devices.

5. Numerical techniques, including mesh generation, optimization and methods of solving large sets of equations with dense or sparse matrices of coefficients.

6. Practical experience in the application of computer programs for the design of electromagnetic devices, with particular reference to the calculation of forces and other terminal parameters.

7. Software methodology and interactive computer aided design for electromagnetics. Topics of interest include graphics, parallel computation, knowledge base, expert systems and AI-techniques.

An on-line computer display and exhibition of both commercial and university/research organizations is planned during COMPUMAG 87.

For further information contact:

K. Preis, M. Königswieser
INTERCONVENTION
P.O. Box 80
A-1107 Vienna, Austria

NINTH INTERNATIONAL WORKSHOP ON RARE-EARTH MAGNETICS AND THEIR APPLICATIONS

August 31 to September 2, 1987

and

FIFTH INTERNATIONAL SYMPOSIUM ON MAGNETIC ANISOTROPY AND COERCIVITY IN RARE EARTH-TRANSITION METAL ALLOYS

The Ninth International Workshop on Rare-Earth Magnets and their Applications will be held August 31 to September 2, 1987. This conference will be followed by the Fifth International Symposium on Magnetic Anisotropy and Coercivity in Rare Earth-Transition Metal Alloys on September 3, 1987.

Both meetings will be held at the Taunus Conference Center, Parkhotel and Kurhaus D-6232 Bad Soden near Frankfurt, Federal Republic of Germany.

A joint Organizing Committee for these two conferences has been constituted from members of German and Swiss Companies, and from the "Arbeitsgemeinschaft Magnetismus", a joint committee of the "Deutsche Gesellschaft Fur Metallkunde" (DGM), "Deutsche Physikalische Gesellschaft" (DPG), "Verband Deutscher Elektrotechniker" (VDE) and "Verein Deutscher Eisenhuttenleute" (VDEh).

Continuing the pattern of the eight earlier Workshops in the series, the ninth will cover, within three days, all aspects of raw materials supply, alloy metallurgy, materials development and properties, magnet manufacturing technology and magnet properties, magnetic circuit design, and applications of the permanent magnets based on alloys of lanthanide elements and 3d-transition metals.

Those who plan to attend, or just want to keep informed about the Workshop or Symposium, are asked to contact:

Rainer Poerschke
Deutsche Physikalische Gesellschafat
Registration, General Organization,
Publications
AG Magnetismus der Deutschen
Physikalischen Gesellschaft EV
Hauptstrasse 5, D-5340 Bad Honnef 1
West Germany

EMMA '87

Following the success of the Magnetic Materials for Applications Conference held in Grenoble in June, 1985, it has been decided to inaugurate a series of meetings under the title European Magnetic Materials for Applications (EMMA). It is intended that EMMA will be held on a biannual basis and provide a forum for discussion of all aspects of Applied Magnetics research. Plans for the second in the series are well advanced. This will be held from 14th-16th September 1987 at the University of Salford, U.K. The principal topics to be covered will be:

1. Magnetic recording and data storage, media, heads, processes.
2. Permanent Magnets
3. Soft Magnetic materials
4. Magnetic separation
5. Magnetic fluids and printing
6. Thin films
7. Amorphous materials
8. Field calculations
9. Magneto Optics

Anyone with an interest in these or related fields wanting further details of EMMA '87 should contact:-

Dr. P.J. Grundy
Local Chairman, EMMA'87
Department of Pure and Applied Physics
University of Salford
SALFORD
M5 4WT
United Kingdom

CONFERENCE CALENDAR

INTERMAG Conference, April 15-18, 1986, Phoenix, Arizona

IEEE International Symposium on the Applications of Ferroelectrics, June 8-11, 1986, Lehigh University, Bethlehem, Pennsylvania

IQEC'86-International Conference on Quantum Electronics, June 9-13, 1986, Moscone Center, San Francisco, California

CLE'86-Conference on Lasers and Electro-Optis, June 9-13, 1986, Moscone Center, San Francisco, California

4th International Conference on Magnetic Fluids, July 28-August 1, 1986, Tokyo and Sendai, Japan

International Conference on Physics of Magnetic Materials (ICPMM), September 14-20, 1986, Spala, Poland

31st Conference on Magnetism and Magnetic Materials, November 17-20, 1986, Baltimore, Maryland

INTERMAG Conference, April 1987, Tokyo, Japan

Rapidly Quenched Metals 6th Annual Conference, August 3-7, 1987, Montreal, Quebec

ICAME87 International Conference on the Applications of the Mossbauer Effect, August 17-21 1987, Department of Physics, Monash University, Melbourne, Australia.

32nd Conference on Magnetism and Magnetic Materials, November 9-12, 1987, Chicago, Illinois

Joint INTERMAG/Magnetism and Magnetic Materials Conference, July 11-15, 1988, Vancouver, British Columbia

ICM 88, July 25-29, 1988, Paris France.

INTERMAG Conference, April 4-7, 1989, Washington, DC.

(Please show this message to a colleague in magnetics who could benefit from membership in the Magnetics Society.)

JOIN THE MAGNETICS SOCIETY

If you are not yet a member of the IEEE Magnetics Society and are involved in magnetics research, development or engineering, the Society could make a valuable contribution to your professional activities.

You will join over 2000 colleagues in belonging to the only society in this country devoted solely to the interests of those who work in magnetism.

You will have the opportunity of contributing to your profession through membership in its Society and participation in the work of its technical and administrative committees.

You will receive bimonthly the Magnetics Transactions, recognized throughout the world as a leading publication in applied magnetics.

The Society sponsors the INTERMAG Conference and co-sponsors the Conference on Magnetism and Magnetic Materials, which jointly cover the whole subject of magnetism.

Fill out the application blank today. For additional information, you may contact: Barbara Langland, Membership Chairman of the Magnetics Society, HP Labs, Distributed Systems Center, 1501 Page Mill Road, Palo Alto, CA 94304-1181.

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