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PRESIDENT'S LETTER

I am honored to be the President of the Magnetics Society at a time of great change, and the centennial anniversary of the founding of the IEEE. Magnetics has, of course, been an active participant in electrical engineering from the beginning.

Significant structural changes in the IEEE itself are being proposed. The effect of these is to strengthen the technical influence of the Board of Directors. The proposal before the June Board of Directors meeting is to amend appropriate sections of the by-laws so that there shall be an equal number of division directors and region directors. At present there are ten regional directors and eight divisional directors.

The IEEE is a matrix organization. One dimension of this matrix are the ten world-wide regions, six in the United States. Each member belongs to a region. The other dimension is technical interest and the thirty Societies that make up the IEEE are divided into eight divisions. Under the revised by-laws, the technical societies and councils would be reorganized into ten divisions, with ten division directors, thus giving equal weight on the Board of Directors of both technical interests and geographical interests.

For the first time at Intermag this year, the number of non-U. S. authored papers exceeded the number of U. S. authored papers by the ratio of 135 to 129. This "unscientific" account was made by identifying the organization of the first author of each as being either U. S. or foreign. Thus, the Magnetics Society has become a truly international organization.

Another interesting statistic is that while only 1.1% of the IEEE members are Fellows, 3.1% of the Magnetics Society's members are Fellows! This could be interpreted two ways: either we're better engineers and scientists than the rest of the IEEE or, more likely, our membership is getting older. It is going to be one of my aims as President to encourage more young people to go into the field of magnetics.

To this end, three institutions have put together proposals for magnetic research centers. These are the University of California at San Diego, Carnegie-Mellon in Pittsburgh, and the University of Minnesota. The first two have already been funded while the latter is well on its way. It is through institutions such as these that more magneticians can be educated.

Finally, I'd like to point out another statistic, and that is that the dollar volume of magnetic recording products shipped from Silicon Valley is slightly in excess of the dollar volume of semiconductors!

Clark E. Johnson, Jr.

SESSION SUMMARIES, 1983 INTERMAG CONF., PHILA., APRIL 5-8

Session AB. PERMANENT MAGNETS: MATERIALS, DEVICES, APPLICATION, THEORY. K.S.V.L. Narasimhan.

The permanent magnet session covered a wide variety of topics ranging from amorphous magnetism to crystalline materials. A total of 10 papers were presented. G. Hadjipanayis et al reported an achievement of 7MGOe in an alloy of $PrTbFe_2$ by a process of crystallization of amorphous alloy. The origin of the coercive force is not clear but may arise from unidentified small particles (400Å) present in the high coercive force material. Similar results were obtained with other rare earths substituting for Pr. J. Becker reported a novel technique to monitor the coercive force of FeBCoSi, FeNiP amorphous alloys during crystallization. A resistivity ratio R/R_o (R_o = initial resistivity) measurement is a good indicator of the coercive force. Also, Becker reported that a pulse heating of the amorphous ribbons produces a higher coercive force than furnace heating. F. Cadieu et al reported for the first time that $SmCo_5$ films can be prepared with square hysteresis loops by controlling the oxygen and by a thermalized sputtering process. These films had a BH_{max} of ~14MGOe without any heat treatment. A. E. Ray et al reported that magnets with potential energy product exceeding 30 can be obtained using $Sm(CoCuFeZr)_{8.35}$ alloys. These alloys can be made with intrinsic coercive force exceeding 20kOe. A selective thermal heat treatment process has been shown by S. Trout to improve the distribution of magnetic properties of rare earth cobalt magnets. Kumar et al developed a sophisticated test fixture to measure the flux delay in $SmCo_5$ magnets to 10ppm. They find that the closer the $SmCo_5$ magnet is to stoichiometric composition the better the stability. Walkiewicz et al reported that Sm-free misch metal magnets can be made with a BH_{max} of 12.7MGOe by adding more Pr to the misch metal.

Session AC. RECORDING MEDIA. N. Heiman.

Particulate Media:

Papers showed that Co adsorbed γ-Fe_2O_3 particles had superior temperature and stress characteristics. Properly prepared disks with these particles combined with 80% reduction in Al_2O_3 filler, an improved binder and lubricant could have D_{50} densities as high as 38,000 FRPI when flying heights are reduced to 4 microinches.

Particles of γ-Fe_4N suitable for recording can be produced by evaporating Fe in an NH_3 atmosphere. Characteristics are: $H_c \simeq 700$ Oe, M=195 emu/gr and sizes from 50 - 2000 Å diameter.

Mossbauer spectroscopy is a convenient technique for observing orientation in particulate media. The technique showed that demagnetizing effects are minimal for $H_c > 1000$ Oe.

Thin Film Longitudinal Media:

Fe metal evaporated at a high angle of incidence (80^0) has recording possibilities but the highly canted grain structure gives films a uni-directionality.

New materials for longitudinal recording films include SmCo/SmFe and CoPt alloys. The SmCo/SmFe compositions with most promise have 25-30 at % Sm. Corrosion resistance of CoPt (10-20 at % Pt) is increased by the addition of some (10 at %) Ni. Recording on these films to a D_{50} density of 50,000 FRPI could be achieved at flying heights of 5 microinches.

Perpendicular Media:

A number of papers showed the dependence of CoCr (or CoRe or CoMo) films on various parameters. CoMo proved to be amorphous above 12 at % Mo and CoRe behaved like CoCr deposited onto hotter substrates. Substrate or underlayers have a key role. Si and Cr seem to be bad growth layers while Ti, glass, and metallic glasses seem good.

A new candidate for a perpendicular recording medium may be RE-TM alloys. A Gd Tb Fe alloy with $4\pi M \simeq 1000G$ and $H_c \simeq 700$ Oe showed interesting recording possibilities.

Session AE. MAGNETIC DEVICES AND APPLICATIONS. P. P. Biringer.

Most of the papers dealt with practical electromagnetic and converter problems. The paper by Burke et al is an important one presenting two different shielding methods for large reactors when placed on steel reinforced concrete floors. Dewan et al dealt with alternatives to the presently used inverter, converter circuits for induction heating applications. The six-pulse circuit is able to operate at a somewhat lower frequency than the known three-pulse circuit. The voltage source inverter visualizes the use of GTO devices. An interesting power inductor tester was shown that allows the testing of filter inductors under almost perfectly simulated circuit conditions.

Session BA. MAGNETIC SEPARATION II. S. Hall, J. Finch, and R. Gerber.

In this session, the results of HGMS research applied to various industrial processes were reported. The opening paper by Oda, Kunisue and Masuda (BA-1) described the use of HGMS for the removal of the inorganic sulphur and ash components from dry pulverized coal. Various matrix layouts, designed to prevent the mechanical entrainment, were used and coal recovery and ash reduction data were reported for single and repeated pass experiments (with 3 passes giving 33% ash reduction with 85.5% coal recovery). The electrostatic effect on ash removal was also investigated and the improvement in the ash content of the mags was found to be dependent on the wire configuration. Preheating of the fluidizing air increased both the mags yield and ash content.

T. A. Liu, in presenting the following two papers, discussed the fluidization of fine particles in magnetic fields. The first paper (Colberg and Liu, BA-2) dealt with the principles of fluidization in magnetic fields. The stabilizing effect of a magnetic field can be used to eliminate bubbling from a gas-fluidized bed of ferromagnetic particles. The magnetic field in this case is relatively weak (<1000e), uniform and applied coaxially with the bed. An investigation of the magnetic stabilization of HGMS fluidized beds for the separation of paramagnetic and diamagnetic particles, such as pyrite removal from dry pulverized coal, was also carried out. In this case large fields (more than 12kOe) are necessary and the stabilization is actually undesirable since it eliminates the motion of particles and reduces their capture.

The second paper (Liu, BA-3) reported results of a project, conducted for the U. S. Dept. of Energy, to clean sulphur and ash from dry coal of a complete size range (-74 μm). The dry pulverized coal was fluidized into a matrix in a superconducting magnet, capable of producing fields up to 50 kOe. Optimum desulphurization conditions were established and several interesting experimental techniques described.

M. R. Parker presented the work of Lua and Boucher (BA-4) on secondary effects in magnetic filtration. The single wire model was found to be inadequate in describing real gaseous magnetic filtration systems. The relevance of high Reynolds numbers, wire separation and filter length were investigated using stainless steel matrices to trap basic oxygen furnace dust. Wire interference was shown to be detrimental and a critical wire separation, where the benefit of the increase in flow is outweighed by the reduction of gradients and wire "shadowing," is shown to exist. It was concluded that for a systematic analysis these effects should be considered.

In presenting the first of two papers D. R. Kelland described techniques to achieve selective separation by the design of a matrix in the form of an array. The paper (BA-5) by de Latour, Schmitx, Maxwell and Kelland investigated the magnetic capture by sealing caught magnetite particles in a quick-setting epoxy resin. From these captive patterns various wire arrays were evaluated and compared with the computer model. It was shown that by an appropriate separation and shielding of the matrix elements it is possible to achieve a more efficient separation of mineral particles.

In the second paper (Kelland, Nolan, Wechsler and Doulin, BA-8) the critical pressure drop and flow velocity in axial HGMS matrices for the capture of fine magnetite from coal slurries was investigated. Matrices comprised of vertical expanded metal screens arranged in a pilot-scale continuous type HGMS enabling high flow rates of high density slurries were tested. For one pass through the matrix a critical velocity is reached, above which magnetite recovery drops off sharply; two passes gives almost perfect recovery at all velocities tested.

E. Maxwell presented a paper (BA-6) by Shalom and Doulin of Sala Magnetics, which showed particle size selectivity when particles having a wide size distribution are captured on a typical wire matrix.
B. B. Emory described (BA-7) the removal of activated corrosion products (largely sub-micron) from primary coolant circuits of pressurized water reactors. The magnetic filter used in his tests was formed from a 1/4" expanded stainless steel mesh and the effect of fluid velocity and magnetic field intensity upon removal efficiency and matrix loading was evaluated. Magnetic filtration is ideally suited for this application, since a low maintenance, high efficiency unit is required which can operate under severe and irradiated conditions (1400 psi and ≃300°C.

The paper by Watson and Rassi (BA-9) described the concentration of gold and uranite from the backed tailings of South African gold ores. The tests were conducted on the -25 μm size fraction, which constituted one third of the mass, but contained more than half of the total uranium. The results obtained, using HGMS in a superconducting magnet up to 7%, are very promising. Uranium enhancement factors in the range between 3 and 4 have been achieved.

Session BB. CURRENT DEVELOPMENTS IN MILLIMETER WAVE MAGNETIC MATERIALS, DEVICES AND APPLICATIONS. D. C. Webb.

In this session a wide spectrum of millimeter wave magnetic material activities were surveyed. Gordon Harrison of Georgia Tech opened the session with an informative discussion of material considerations for millimeter wave devices. For nonresonant devices such as circulators and phase shifters, the most important properties sought are high saturation magnetization and low dielectric loss tangent. Resonant devices such as filters and limiters require high anisotropy fields so that prohibitively high applied fields are not required. Materials which are or

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could be used for both classes of application were surveyed. In response to a question Dr. Harrison stated that although important advances in millimeter wave magnetic materials appear possible, there has been little activity in this area recently because the quantities of materials required for existing and projected applications have been insufficient to stimulate investment in their development. Don Forester and Fred Tachford of the Naval Research Laboratory surveyed techniques for characterizing magnetic and dielectric materials at millimeter wavelengths and then focussed on the quasi-optical reflectometer system used at NRI. These speakers and subsequent speakers emphasized the importance of evaluating magnetic materials over a broad range of frequencies in the range where they will actually be used. The phase shifter promises to be one of the most widely used millimeter wave ferrite component. Chuck Boyd of Microwave Applications Group (MAG) described design and operation of a particular implementation (dual-mode) which has resulted in excellent performance at 35 and 60 GHz. A key property of this device emphasized by Dr. Boyd in the discussion of the paper was that very high saturation magnetization was not critical to its operation since for a fixed sample length the decrease in magnetic activity is compensated by an increased electrical length. The keys to good performance at the shorter millimeter wavelengths are low loss materials and the ability to fabricate ferrite "toothpicks." In the fourth paper of the session Jorg Raue of TRW described design and performance of a very wideband class of circulators, another key ferrite device in many emerging millimeter wave systems. Excellent results were obtained between 7 and 140 GHz except for a range of frequencies between 20 and 60 GHz where a suitable combination of dielectric and magnetic properties are not available in existing materials. In the final paper of the session John Pippin of Electromagnetic Sciences, Inc. described configurations used in electronically controllable antennas for commercial satellite communication with emphasis on ferrite components for this application. Overall, the session was well received by the attendees and the talks stimulated lively discussions.

Session BC. RECORDING THEORY, EXPERIMENT, AND HEADS.
I. A. Beardsley.

In this session, in addition to the invited paper on electron holography, there were five papers on perpendicular recording, three on heads, one on modeling, and one on conventional recording in metallic media. All five papers on perpendicular recording at least partially addressed the combination of a ring head and a soft magnetic underlayer.

BC-1. Okuwaki et al of Hitachi (invited) reported on the observation of recorded magnetization patterns by electron holography. In particular they looked at the saw-toothed structure of the transition region in thin Co films. A constant amount of magnetic flux is contained between every pair of interference fringes. The stray field at the edge of the recorded track can be observed and was used to estimate the intensity of the recorded magnetization. The width of the sawtooth was found to obey the relationship $\ell = (M_r t)/H_c$ very closely. Transitions were observed at a density of 170 kBPI in a 0.03 micron film with H_c = 1400 oe.

BC-2. Bertram and Fielder of Ampex reported on high density recording on thin metallic (CoP) coatings with a range of coercivities. They gave density response curves and bit shift for an MFM pattern and stated that their medium with a coercivity of 900 oe can be used out to 70 kFRPI and is virtually equivalent to Hitachi's vertical medium.

BC-3. Chi et al from Sperry reported on experimental comparisons of perpendicular and longitudinal recording. They used a MnZn head with a gap of 0.35 microns to record and read back from a NiCo thin longitudinal film and two CoCr films, one of which was on a soft magnetic underlayer. Write current was adjusted to satisfy a -24 dB overwrite criterion. It took twice as much write current to saturate the single layer CoCr, and the double layer CoCr had high amplitude but a very broad pulse. A thin film head with a gap of 1 micron did not saturate the single layer CoCr. A Hilbert transform was used on the perpendicular readback signal to compare PW_{50} and peak shift with the longitudinal. The single layer CoCr had the smallest PW_{50} but the peak shift was worse than the longitudinal, perhaps because the transform was not optimized and the ferrite head was in saturation.

BC-4. Yeh of Magnetic Peripherals modeled the readback wavelength response for a thin film head on a double layer perpendicular medium. He used three analytic models in the Karlqvist spirit for different degrees of pole-underlayer interaction and computed the gap loss factor of each. The intermediate model gave a good fit to the large oscillations in the readback response which are observed experimentally. These results suggest that either very narrow pole tips and gap or sophisticated equalization will be needed if the thin film head/underlayer combination is to be used at high densities.

BC-5. This was a combined paper by Lopex and Minuhin, both of Magnetic Peripherals, Inc., in which different approaches led to very similar results. Lopez used an approach similar to that of Wallace to derive the combined thickness and spacing loss for a perpendicular medium with a soft magnetic underlayer. He showed that at very high densities where the thickness factor goes to one the spacing loss from a double layer medium is the same as that for a single layer medium. However, the gap/pole width loss function may be severely modified by spacing, leading to a greater overall degradation from spacing for the double layer medium. Minuhin derived a general head-independent theory of playback with a soft magnetic underlayer based on the Tsuboi-Fushida law. He showed that at short wavelengths, media thickness losses are nearly the same for longitudinal and perpendicular recording, and are nearly equal to those given by the Wallace equation without underlayer. Separation losses are more severe with the underlayer, and can be understood as coming from a change in the transducer as well as the Wallace factor $\exp(-kd)$. The relative sensitivities of the transducer to the longitudinal and perpendicular magnetizations are determined only by media thickness. He agreed with Yeh that the underlayer has the effect of spreading the aperture of a ring head to approximately the sum of the gap and pole tip width.

BC-6. Bloomberg, Lean and Kelley from Xerox computed the effect of the soft underlayer on bit shift in finite pole tip ring heads. They used the Boundary Element Method to obtain sensitivity functions for various geometries with and without underlayer. Infinitely sharp vertical transitions were assumed and superposition was used to obtain bit shift for various bit patterns. Zero crossing and inflection point detection were investigated. Zero crossing and an underlayer gave unacceptable bit shift. Zero crossing with no underlayer was better, and inflection point detection with or without an underlayer gave the least bit shift, which was relatively insensitive to the pole tip width.

BC-7. Johnson of Sperry described instabilities observed while modeling perpendicular recording using a loop model constructed from an ensemble of particles. These instabilities in the perpendicular component of magnetization were exacerbated by high ratio of saturation magnetization to easy axis coercivity and by a high aspect ratio of the cells used in the computation. The mathematical problem was related to decreased diagonal dominance, and a possible physical explanation based on the columnar structure of CoCr was given.

BC-8. Heim of IBM presented a conformal mapping solution for the sensitivity function of a shielded magnetoresistive head. He found that the sensitivity function and hence the resolution is relatively insensitive to the shield dimensions for shield thicknesses greater than the gap. A shielded MR head with gap g reads like an infinite poletip inductive head of gap 0.6 g.

BC-9. Calderon, George, Mowry, and Ummel from MPI described two new designs for magnetoresistive heads. They combined the barberpole conductor geometry with special MR geometry designs in attempts to suppress the Barkhausen noise which originates from domain activities in the sensor. Bitter patterns as well as MR(ΔR(H)) behavior for the unshielded elements of both the "hammerhead" and the "picture-frame" designs were presented and discussed.

BC-10. Matsuura et al from Sanyo Electric Co. reported on the construction of a video head using a Co-based amorphous alloy. The saturation flux density of the amorphous film was 8500 gauss and the effective permeability was comparable to that of Mn-Zn ferrite for a film thickness of 20 microns. A head with a 24 micron track width and a gap of 0.2 microns was used to write on a variety of media.

This head was superior to a ferrite head on CrO_2 tape and could record on a 1700 oe medium without head saturation. A question established that there is some problem with wear.

BC-11. Speliotis of Advanced Development Corp. presented a paper with coauthors Iwasaki and Yamamoto of Tohoku University on spacing losses in perpendicular recording. The CoCr medium was 0.29 microns thick and was on a soft magnetic underlayer. Several pole heads and a ring head with a gap of 0.3 microns were used to perform square wave recording with write currents optimized at short wavelength. Spacing was controlled with a sputtered Ti overlayer. The pole heads all had spacing losses of $-99\ d/\lambda$ which was attributed to a read loss of $-55\ d/\lambda$ and write loss of $-44/\lambda$. The ring head spacing loss was dependent on the density and was much worse than the $-99\ d/\lambda$ for densities less than 70 kbpi. They attributed this excess to additional write loss due to the inadequate strength and poor gradient of the perpendicular component of the ring head field. It would seem that some of the additional loss could be due to the modification of the transducer when the head is moved away from the double layer medium as mentioned earlier in the session.

Session CA. BUBBLE GARNET MATERIALS. M. Kestigian.

It should be pointed out that although no significantly new or novel bubble garnet materials were discussed in the session, it is known that progress in improved bubble garnet thin films is being made, especially in the development of materials with specific device performance parameters. For several reasons, these papers are not submitted to this Conference. It is expected that these contributions will be presented at a conference in the very near future. The session was well attended and consisted of one invited paper and seven contributed papers. The invited paper was given by J. A. Nyenhuis of Purdue University and was titled "Wall States in a Bubble Moving in a Rotating Field Gradient." The contributed papers included two which were concerned with annealed garnet films and the thermal analysis and thermal variation in magnetic properties; one which dealt with the magnetic properties of laser irradiated Ga:YIG; another was concerned with the microwave generation of bubble domains. A comparative study of anisotropic fields in magneto-optic garnet films reviewed the three methods of anisotropic field measurements. The final paper of the session described forced oscillations of Néel walls in a (100) garnet film. Finally, the session chair would like to thank publicly all of the reviewers who did a conscientious job on such short notice - and did it well and promptly!

Session CD. MICROWAVE FERRITE MATERIALS AND DEVICES. D. C. Webb.

The first three papers of the session dealt with growth and characterization of various magnetic materials. W. Jantz first described the work by the Freiburg and Regensburg group on MBE Fe films on GaAs substrates. Although they reported good progress in the fabrication and in the understanding of this system, their measurements indicated that the saturation magnetization appears significantly less than that of bulk Fe. This effect is probably not real but as yet has not been satisfactorily explained. The next paper, by Z. K. Kun of Westinghouse, described progress in growth of LPE lithium ferrite films. Interest in these films stems from their potential to increase the bandwidth of such devices as MSW delay lines and limiters although film quality is presently inadequate for most applications. In response to a question Dr. Kun noted that an improved substrate-film lattice match is desirable and a promising approach appears to be incorporating Zn into the film (with proper charge compensation). This would not only improve the lattice match but would raise the saturation magnetization. In the third paper of the session W. D. Wilber of Colorado State University described the measurement of the spin wave stiffness constant D of various lithium-zinc ferrite compounds by Brillouin light scattering. It was noted that D for pure lithium ferrite is twice as large as the corresponding value for YIG but falls rapidly with increasing zinc concentration. The following set of three papers in the session concerned analyses of MSW propagation in various inhomogeneous structures. D. Stancil of North Carolina State University presented a variational formulation of MSW propagation, applicable when either the material or bias field is inhomogeneous. Such inhomogeneities are commonly employed to control dispersion. This formulation offers a simpler and more intuitive approach to such problems than the brute force finite element method. J. Parekh of Stony Brook in the next paper of the session showed that by using a three YIG film geometry some improvement in MSW bandwidth and reduction in group delay ripple is possible. A problem in analyzing the system is that the large number of adjustable parameters makes systematic optimization very difficult. In the next talk N. Chang of Osaka Electric-Communication University in Osaka, Japan analyzed MSSW propagation in a sinusoidally corrugated YIG film by a perturbation method. The last three papers of the session dealt with several important YIG film devices. S. Stitzer of Westinghouse Baltimore presented analytical and experimental results on an extremely broadband microstrip limiter. The nonresonant nature of the design enabled an octave bandwidth to be realized without significant variation in threshold and dynamic range. J. D. Adam of Westinghouse R&D Center described how variable delay can be achieved in a single device by varying the angle and magnitude of the bias field. A satisfactory technique for achieving continuously variable delay has not been achieved to date and would have numerous important military applications. The preliminary results reported by Dr. Adam were quite encouraging. In the final paper of the session W. S. Ishak of Hewlett Packard described design and operation of MSSW filters for UHF frequencies which were capable of being tuned over a wide frequency range. Some of the unique problems of the UHF frequency range were pointed out; overall performance was quite good with phase linearity typically ± 6 degrees and group delay variation ± 5 nsec over a 70 MHz bandwidth.

Session EC. RECORDING CHANNELS. B. J. Langland.

The scope of the signal processing session included equalization, detection, error correcting codes and media noise characterization. Huber opened the session with a detailed description of a dc-null equalized recording channel with an interactive clock recovery scheme. The channel description was sufficiently complex that the discussion of how this method compares to other published equalization methods had to be curtailed. Additional controversy was stimulated by the presentation of Nishimura on the Partial Response method of channel coding. The excellent agreement between the theory assuming white Gaussian noise and experiment was achieved on a rigid disk system. The clock recovery for determining the sampling times of the amplitude detector was achieved by a parallel conventional peak detection channel. Meaningful measurement methods for noise characteristics of different materials was presented by Murdock. The thesis put forward is that the medium noise measurement should be taken under the conditions where the noise reaches a maximum. Results were reported for five materials at which time the audience pointed out that single samples were not representative of all media compositions or processes. Due to the time constraint of the session and the lengthy discussions following these first three papers, the last three papers were presented without a question period. Kessler reported on a modified Reed-Solomon code implemented on a Fairchild Weston Sabre X. Kost and Craig each described an LC ladder network and a transversal filter.

Session ED. MAGNETIC MEASUREMENTS. D. I. Gordon.

General: The international flavor of INTERMAG was clearly evident in this session. Of the six papers presented, two were from England, four from Japan and none from the United States. Three of the papers dealt with improved magnetometers or sensors, one with a torque transducer, one iwth an instrument for measurement of thin film permeance and magnetostriction, and one with harmonic analysis of B-H loops. Amorphous ribbons are used in three of the six devices discussed.

ED-1 by G. R. Hoffman and J. K. Birtwistle (University of Manchester, England) discussed The Performance of Magnetoresistive Vector Magnetometers with Optimised Conductor and Anisotropy Axis Angles. Theoretical and experimental data are shown for two alternative schemes for the angular relationship between the conductor and anisotropy axis for optimising performance. The magnetoresistive sensor patterns are meander lines in a bridge of four sensors found from 50 mm thick zero magnetostriction permalloy film with

uniaxial anisotropy. Each 50,000 ohm resistor in the bridge consists of a 15 micrometer wide conductive track, folded linearly to occupy an area of 2.5 mm^2.

ED-2 by K. Mohri et al (Kyushu Institute of Technology, Japan) discusses Magnetometers Using A Two Amorphous Core Multivibrator Bridge with a dc output. Zero magnetostriction amorphous ribbons, one mm wide are used. External fields from 10^{-5} to 30 Oe in the frequency range of dc to 5 kHz are stably detected. Applications suggested are in the field of power apparatus such as secondary flux detection for torque sensing and vector controls of motors and contactless high current sensors at temperatures up to 180°C.

ED-3 by S. N. M. Willcock and B. K. Tanner (Durham University, England) discusses Harmonic Analysis of B-H Loops of Constructional Steel. This paper on the use of magnetic measurements for non-destructive testing reports the results of changes in Fourier components of the B-H loop of samples of construction steel during plastic deformation and following heat treatment.

ED-4 by I. Sasada et al (Kyushu University, Japan) discusses A New Method of Assembling a Torque Transducer by the Use of Bilayer-Structure Amorphous Ribbons. The two layers consist of (1) a helical amorphous cylinder of amorphous ribbon of Fe-Si-B with $I_s \cong 1.5T$ and $\lambda_s = 24 \times 10^{-6}$, and (2) a magnetostrictive helical amorphous cylinder as the inner layer. The ribbons were glued to the torsion bar after stress-relief anneal. Pitch of the helix $P = 4h/2\pi r$, where 4h is the height given by one revolution along the helix and r is the cylinder radius. This approach provides high reliability for the torque sensor.

ED-5 by K. Mohri and T. Shirosugi (Kyushu Institute of Technology, Japan) discusses Sensitive Pulse Output Type Magnetic Sensors Using Helical Amorphous Magnetostrictive Ribbons. High reliability and sensitivity are claimed for sensors using plastically formed helical thin amorphous magnetostrictive ribbons. Fields greater than 1 Oe in the frequency range from 0.01 Hz to 10,000 Hz produce sharp voltage pulses due to large Barkhausen and Matteucci effects. The sensors made of $Fe_{79}Cr_2B_{17}Si_2$ ribbons operate up to temperatures of 180°C. Applications mentioned include rotational speed sensors (simple and digital), pulse transformers with unilateral signal direction.

ED-6 by K. Kawakami and S. Narishige (Hitachi Research Laboratory, Japan) discusses A High Frequency Permeance Meter for Anisotropic Magnetic Films and Its Application in Magnetostriction Constant Measurements. Permeance of the thin film is measured by measuring the voltage induced in a measuring loop connected to an adjustable cancelling loop to correct for flux in the nonmagnetic portion of the two loops. For 2 μm thick films, proportional accuracy is stated to be $\mp$20%. Frequency characteristics measured in the range of 0.5 MHz to 100 MHz were in good agreement with calculated values obtained when skin effect is taken into account. Changes in permeability due to stress were also measured and the magnetostriction constant was determined from the gradient of the permeance vs. stress curve.

Session EE. ASSORTED OXIDES AND COMPOUNDS.
W. R. Bekebrede.

Paper EE-1, "A Magnetic and Crystallographic Investigation of the $La_{1-x}Ba_xMn_1O_3$ System," was presented by J. Orehotsky. Vibrating sample magnetometry and Debye-Scherrer techniques were applied to this perovskite mixed-oxide system. The susceptibilities of all the investigated oxides except $Ba_1Mn_1O_3$ exhibited Curie-Weiss behavior. The paramagnetism of $Ba_1Mn_1O_3$ was masked by a small but distinguishable parasitic ferromagnetic response. The previous X-ray investigation of the $LaMnO_3$-$BaMnO_3$ system indicated a single phase solid solution range containing up to 50% $BaMnO_3$; however, the X-ray study reported here showed a more limited range of mutual solubilities.

Paper EE-3, "Neutron Diffraction Study of Substituted Erbium Iron Garnet," was given by Henri Le Gall, a colleague of one of the authors (P. Feldmann). Powder samples of $Er_{2.2}Y_{0.8}Fe_5O_{12}$ were investigated by neutron diffraction over the temperature range 4.2K to 300K. Below T_{comp} (56K) a number of superstructure lines appear which are indicative of an "umbrella magnetic structure." Continuous field magnetic measurements were performed on flux grown single crystals up to 150 kOe between 4.2K and 300K.

Paper EE-5, "Self-Focussing of the Sound Wave in Magnet with High Effective Anharmonicity," was presented by V. I. Ozhogin. In this investigation the properties of hematite (γ-Fe_2O_3) were selected for study. This compound is typical of the general class of antiferromagnets with easy plane anisotropy. In hematite the sound velocity exceeds the magnon velocity, a situation which results in bend instability of plane sound waves, leading to self-focussing. A mathematical analysis of these effects was presented.

Paper EE-6, "High Rate Deposition of Iron Oxide Thin Films by Reactive Sputtering," was given by M. Umesaki. A study was made of the effect of oxygen concentration in the sputtering gas on the rate of deposition, species deposited, and saturation flux density during reactive sputtering of iron oxides. It was found that the optimum Fe_3O_4/γ-Fe_2O_3 composition having a large H_c could be obtained only over a limited range in the vicinity of 12% O_2.

Session FA. HIGH DENSITY BUBBLE DEVICES.
P. I. Bonyhard.

T. Yanase of Fujitsu, Ltd. described the design and characterization of a 4 μm period, 30 Kb permalloy magnetic bubble memory test chip. Element geometry, layer thicknesses, hard bubble suppression implant, and directional effects have been optimized with impressive thoroughness. The design is expected to lead to a 4 Mb, ~1/cm^2 chip. Designed with 4 Mb, ~2 cm^2 chips were described by D. Rose of Intel and S. Matsumoto of Hitachi, Ltd. Details of another very thorough optimization job were given by the latter, while both gave details of the chip architecture used. Finally, A. H. Bobeck described 8 μm, period designs leading to 0.5 Mb, ~0.5 cm^2 chips (2 Mb devices) with 1.5 μm minimum features (1.75 μm in the storage area). There was novelty in the swap gate geometry. The session gave evidence of the potential of 4 Mb bubble memory devices. High drive field requirements (60~70 Oe) and, in the case of the "widegap" designs of the first and last papers, apparent dependence on fine details of the geometry appeared to be appeared to be causes for concern.

Session FC. TUTORIAL WORKSHOP ON EQUALIZATION IN MAGNETIC RECORDING. John C. Mallinson.

Some 250 people attended this workshop, which lasted approximately three hours. Mallinson (Ampex) opened the session with definitions of a linear, distortionless system, with flat amplitude and linear phase transfer functions. He subdivided all recorders into those in which the recorder itself is made (by a.c. bias) a linear, distortionless system, as in analog audio recorders, and those where the recorder is highly non-linear, as in analog video and digital recorders. McKnight (Magnetic Reference Laboratory) discussed audio recorder equalization with emphasis upon interchange standards. Felix (Ampex) dealt with the highly specific role of equalization in preserving the zero-crossings of a frequency modulated waveform. He stated that the de-modulation of f.m. is in many ways more difficult than that of a digital waveform because the zero-crossings of f.m. do not occur at quantized time invervals. Haynes (IBM) talked about floppy discs and digital tape. After noting the general absence of equalization in these machines, he reviewed the generalized Nyquist equalization rules which ensure no intersymbol interference. He predicted the widespread use of equalization in the future as linear densities increase. Huber (AIM) similarly noted the general ineffective use of equalization in rigid disc recorders and suggested that these well-known communications theoretical techniques will become common in the future. After the above panelists had made their presentations, some 30 minutes of general discussion, with good audience participation, ensued. In summary, it may be concluded that whereas pre- and post-equalization is absolutely essential in analog audio and video recorders, the digital recorder industry has managed to get by without it and has put the sole responsibility for attaining higher densities upon the head/medium interface. When properly applied equalization enhances the potential of the head/medium interface whilst minimizing its disadvantages and it seems safe to predict that digital recorders will, in the future, make increasing use of the technique.

Session GE. BUBBLE MEMORY SYSTEMS AND APPLICATIONS WORKSHOP. W. D. Doyle.

Five speakers discussed memory applications in which bubble devices from Fujitsu, Hitachi, Intel or Motorola have been chosen to provide non-volatile storage. The session was lively and informative and the audience's reaction suggested that presentations on product-oriented topics would be well received at Intermag.

Jean-Claude Gidrol of Sagem described a large capacity recorder (128 Mbits/265K Mbits) for a space application and a data cassette for military applications. The critical characteristics required were modularity, reliability, large capacity, low weight and volume, wide temperature range and ruggedness.

Joseph Slater from Bubbl-Tec discussed his company's family of plug-compatible memory boards using bubbles from different vendors. These are being supplied to a variety of users for many applications, particularly in the development of military products. Mr. Slater highlighted the confusing history of bubble vendors and made a strong plea for more visibility from bubble suppliers.

David Hunter from Plessey Microsystems told of two of several products Plessey is supplying with bubble memory. These two were a geophysical data collection system and a storage system in a mobile tracked military vehicle. Reliability and ruggedness were stressed. Mr. Hunter pointed out that bubble systems are particularly attractive when users evaluate life costs.

Charles Cunningham from Westinghouse gave a comprehensive evaluation of their choice to replace a tape cassette with a bubble cassette in a remote power metering system. Critical factors favoring bubbles were the ability to read data remotely and reliably. He echoed previous speakers about the need for vendors to tell the good news bubble story.

Finally, Dennis Amundson from Sperry showed a ruggedized military computer using bubbles that will be placed in a new fleet of Coast Guard ships. He pointed out that the unique characteristics of bubble memories give them a natural role in military applications.

Session HA. ION IMPLANT DEVICES AND MATERIALS. F. B. Hagedorn.

This session contained two invited and six contributed papers. In the first invited talk, T. J. Nelson of Bell Labs reported on 4 micron period ion-implant circuit development. Only small test chips were described, but a bias operating range of 30 Oe was shown at 50°C with a 42 Oe rotating field. A new single-pulse NDRO detector was included as part of this report.

The second invited talk was given by M. H. Kryder of Carnegie-Mellon and dealt with the importance of stress relaxation at and near the ion-implant boundaries. Direct observations, in the form of transmission electron diffraction evaluation of the stress relaxation and in the form of magneto-optic photometer investigation of the in-plane magnetization direction near the implant boundary, were presented and discussed. The conclusion was that charged wall behavior can be understood in terms of a model involving λ_{111} and λ_{100} and that the earlier suggestions involving K_1 were not correct.

The first contributed paper, by T. Ikeda of the Hitachi Central Research Laboratory, summarized extensive work that led to optimization of the deep ion-implantation dosages for 4 micron period hybrid circuits, where only the storage area was based on the ion-implant technology. A neon and hydrogen combination was found which gave a uniform strain and uniform ΔH_k in the outer 1/4 micron of the epi-film, giving 10% bias operating range for minor loop propagation with 50 Oe drive field.

The next two contributed papers also dealt with the magnetic effects of ion-implantation but were not concerned with specific bubble device performance. C. Bush of Georgia Tech studied the effects of implanting Ar, Fe, and Mn in pure YIG but was not able to observe direct single ion effects on the magnetic anisotropy. H. Avano of Caltech reported on the annealing behavior of high-dose Ne implanted films, using both FMR and x-ray rocking curve data. His measurements indicated a nonmagnetic layer could be created below the film surface with sufficiently large dose and that subsequent annealing near 500°C caused this layer to become magnetic again.

The fourth contributed paper, given by T. Yoshiie of Carnegie-Mellon, presented transmission electron microscopy measurements of the microstructure introduced into epi-garnets by ion implantation. A clear example of a buried amorphous layer was shown, which then became crystalline if annealed above 200°C. These observations were thus consistent at least qualitatively with the FMR results of Avano mentioned above.

A further interconnection between papers in this session was supplied by R. Wolfe of Bell Labs in the fifth contributed paper which presented observations of bubble propagation on ion-implanted tracks using a (100) oriented garnet film. The 4-fold symmetry effects predicted by Kryder were strikingly confirmed, and it was suggested that avoiding the 3-fold symmetry seen in (111) films might be advantageous to device designers.

The final paper in the session was read by F. B. Humphrey, since none of the Chinese authors attended the conference. The main thrust of this paper was that a commercial ion-implanter, using nitrogen ions, could be successfully employed to suppress hard bubbles.

Session HD. MAGNETIC PRINTING AND TONERS. A. E. Berkowitz.

Variety and vitality marked the presentations in this session. Eltgen and Magnenet presented analytical and experimental data on printed images and toner particle interactions, thus continuing their considerations of the pertinent details of magnetic printing. Hopstock examined the prospects of using toner particles with only the outer shell being magnetic. Iimura et al discussed a very promising carrier material for electrophotography: hexagonal Ba-ferrite. Huijer et al described a magnetic printer system utilizing a plated drum and ferrite combs. Perhaps the most novel presentation was that by Chen. She discussed a master/slave printing system in which the master was a permanent store consisting of soft magnetic bits and the slave is a tape. When slave and master, on contact, pass by a superimposed a.c./d.c. field, the fringe field from the master records the master data on the slave tape. The non-erasible master offers significant advantages over the conventional erasible type, albeit with obvious fabrication tradeoffs.

NEWSLETTER CONTRIBUTIONS

Please note that my address has changed and that all material for the Newsletter should now be sent to

Richard M. Josephs, Editor, S-MAG Newsletter
Naval Air Development Center
Code 5021
Warminster, PA 18974

FOUNDING A LOCAL CHAPTER

A local magnetics chapter provides many benefits, professional, educational, and social; these are illustrated in the accompanying article on the Twin Cities Chapter. If there is a local chapter, an individual can participate in the meetings, meet colleagues working for neighboring institutions, discuss his work at the local meetings either as lecturer or in informal discussions, gain the experience and prestige of helping run the chapter, and benefit from the technical lectures at the meetings.

There are at present only eleven chapters of the Magnetics Society: Los Angeles, San Francisco, Houston, Twin Cities, Massachusetts, Milwaukee, Philadelphia, Pittsburgh, Princeton, Washington and Tokyo. There are enough locations with sufficient membership to form 61 chapters, 48 in the USA and 13 elsewhere.

Forming a local chapter is not difficult. The first step can be to call Jim Torok, 612-456-2397, who will furnish you with a list of the Magnetics Society members in your area, and a blank petition. The next step is to obtain the signatures of twelve members on the petition. This can be done in two ways: the first is to call a meeting (at which a technical lecture may be featured and officers elected). Alternatively, the signatures may be gathered by making Xerox copies of the blank petition, mailing them to individuals who wish to sign, then stapling them together and returning them to the New York office.

A minimum of two meetings a year is required; in the Twin Cities chapter, to which I belong, we have from six to eight. Lectures by local people are popular, as are plant tours. In addition, the national society will pay the expenses of "Distinguished Lecturers" (of which there are three, changed annually) to visit you if desired. These meetings may be joint meetings with chapters of another IEEE society such as the Electron Device Chapter or the Computer Chapter. Although the formation of a local chapter can be expected to greatly increase local membership, we find in the Twin Cities that about 50% of attendees at each meeting are non-members. We find that attendees come from as far as 80 miles away.

More information is available once the chapter is formed. Forming a local chapter is really worthwhile, and will benefit you and your colleagues in your community.

E. J. Torok

THE TWIN CITIES CHAPTER

The Twin Cities Chapter of the Magnetics Society illustrates some of the benefits and operations of a local chapter. It was founded in 1966 by Sidney M. Rubens and William Fuller Brown, Jr. The chapter holds meetings once a month except during the summer. A typical meeting is held at a local restaurant with cocktails from 6:00 p.m. to 6:30 p.m., dinner 6:30 to 7:30 p.m., and the lecture starting at 7:30 p.m. The meeting space is furnished free by the restaurant. Typical attendance is 15 for dinner and 30 for the meeting. The best attended meeting had 125 people, the least, 7. The latter, however, was an excellent meeting. There are variations: sometimes a meeting will be held at one of the local companies and the program will include a tour of the laboratory. On rare occasions a noon meeting takes place. (Some other chapters prefer noon meetings.) Attendees for evening meetings come from as far away as Rochester, MN, 80 miles away, where an IBM plant is located.

There may be from one to three speakers. Local speakers usually talk about their own work in a tutorial designed to be interesting and intelligible to those outside their sub-field. This may be very different from an Intermag-contributed paper. Even a person not performing research can give an interesting and informative talk. The lecturers' dinner expenses are paid by the Section.

There are non-local speakers as well. Among these are some of the "Distinguished Lecturers." These are speakers selected and sponsored by the national organization, the Magnetics Society Administrative Committee. If a chapter invites a Distinguished Lecturer to speak, his expenses for the trip will be paid by the national society.

The following is a list of the monthly meeting topics over the last several years.

4/19/83	COERCIVITY IN MAGNETIC MATERIALS, David J. Wilson, Pfizer
3/29/83	VERTICAL RECORDING, Clark Johnson, Vertimag
3/02/83	MAGNETIC MEASUREMENT METHODS, S. Foner, Francis Bitter National Magnet Laboratory
1/05/83	THEORETICAL AND EXPERIMENTAL COMPARISONS OF LONGITUDINAL AND VERTICAL RECORDING, John C. Mallinson. AMPEX EFFECT OF PARTICLE ORIENTATION ON HIGH DENSITY RECORDING, I. Beardsley, IBM. ISOTROPIC HIGH DENSITY RECORDING MEDIA, James Lemke, Eastman Kodak
12/15/82	MAGNETORESISTIVE HEADS, Greg Mowry, Magnetic Peripherals, Inc.
11/16/82	MAGNETIC FLUID APPLICATIONS, Dr. Sanaa Khalafalla, U. S. Bur. Mines
10/13/82	CONFIGURATION OF RECORDED DIGITAL FLUX TRANSITIONS, Dick Fayling, 3M
5/12/82	AUTOMATED TESTING OF MAGNETIC HEADS, Ted Larson, Northtronics
4/13/82	THIN FILM TECHNOLOGY AT MAGNETIC PERIPHERALS, INC., Pat Bonnie
3/02/82	MAGNETO-OPTICS, Joseph Dillon, Bell Telephone Labs
1/21/82	VERTICAL MAGNETIC RECORDING & EARLY HISTORY OF MAGNETIC RECORDING, Finn Jorgenson, Danvik
1/12/83	TOUR OF 3M TAPE PLANT, 3M Hutchinson Plant
12/10/81	TUTORIAL ON FERRITE MATERIALS, Prof. Carl Patton, Colorado State Univ.
11/10/81	WIND ENERGY - FACT OR FICTION, Gale Jallen, CDC
10/13/81	MAGNETISM OF METALLIC GLASSES, Dr. K. V. Rao, 3M
4/14/81	GARNET FIBER OPTIC SWITCH, John Krawczak, Sperry. MAGNETIC ANAMOLY DETECTOR, Raymond Schneider, Sperry
3/10/81	MAGNETIC RESEARCH AT CDC CRL, Gary Lesmeister, John Bortins, CDC
2/10/81	BASICS OF DIGITAL RECORDING THEORY, Ted Szezech, 3M DRP
12/09/80	FUTURE OF DIGITAL MAGNETIC RECORDING, Dr. Geoffrey Bate, Verbatim
11/30/80	TECHNIQUES FOR SURFACE THIN FILM ANALYSIS, Linfors & O'Clock, PHI
10/14/80	U.M. MICROELECTRONICS & INFORMATION SCIENCE CENTER, Wm. Frante, U.M.
4/08/80	INTRODUCTION TO VERTICAL MAGNETIC RECORDING, Jack Judy, U.M., PRACTICAL DESIGN FOR VERT. MAG. DISC RECORDING, Sheryl Brierley, MPI
3/18/80	TRENDS IN MAGNETIC MEDIA PRODUCTS, Wm. Bernett, 3M, TECHNOLOGY REQUIREMENTS FOR HI-CAP. DISKETTES, James Ehrhart, 3M
2/19/80	SUPERCONDUCTIVITY & THE JOSEPHSON EFFECT, Allen Goldman, U.M. Physics
12/11/79	DOES A DOMAIN WALL REALLY HAVE MASS? Wm. F. Brown, Jr., U.M.
11/13/79	CONTROL DATA CYBER 203 COMPUTER, Brian Shiffman, CDC
9/11/79	PERFORMANCE OF MAGNETO-RESISTIVE MAGNETIC FIELD SENSOR, Tom Casselman, MAGNETO-DIODE RESEARCH AT HONEYWELL, Olin Lutes, Honeywell
4/10/79	MAGNETIC DISC TECHNOLOGY AT IBM ROCHESTER, Plant Staff, Coy Huffine
3/15/79	DIGITAL AUDIO RECORDING, John McCracken, 3M
2/14/79	HIGH FREQUENCY OPERATION OF MAGNETIC BUBBLE DEVICES, Floyd Humphrey, CIT
12/12/78	REVIEW OF MAGNETISM & MAGNETIC MATERIALS CONF., John Bortins, CDC
11/11/78	GEOMATICALLY-INDUCED CURRENTS IN ELECTRIC PWR. SYSTEMS, V. Albertson, U.M.

10/10/78	MAGNETICS RESEARCH AT SPERRY UNIVAC DEFENSE SYSTEMS DIV. STRIPE DOMAIN LIGHT DEFLECTOR, Fred Hewitt & Gary Nelson, CROSS-TIE MEMORY, David Lo & Greg Cosimini, MULTILAYER BUBBLE MEMORIES, Jim Torok & Mark Kamin
9/12/78	6250 TAPE TECHNOLOGY, Matt Grundtner & Mike Drees, Nortronics
4/11/78	APPLICATIONS OF MAGNETIC MATERIALS IN HIGH PERFORMANCE D.C. MOTORS AND TACH-OMETERS, Erland Persson, Electrocraft
3/14/78	MAGNETIC BUBBLES, CDC CRL
12/12/77	ENGINEERING PROPERTIES AND APPLICATIONS OF METALLIC CLASSES PRODUCED BY DIRECT MELT SPINNING, Gerald Bretts, Allied Chemicals
11/08/77	IEEE/AIP MAGNETISM & MAGNETIC MATERIALS CONFERENCE, Minneapolis
10/11/77	MAGNETIC RECORDING SIMULATION USING A TWO-DIMENSIONAL ANISOTROPIC MEDIA MODEL, Magnetic Peripherals
9/13/77	MAGNETIC MATERIALS FOR AUDIO/VISUAL RE-CORDING, John Holm, 3M
5/19/77	HUMAN LIVING IN ENVIRONMENTAL ELECTRICAL & MAGNETIC FLDS., Otto Schmitt, U.M.
3/10/77	REVIEW OF CURRENT STATUS OF CORE TECH-NOLOGY, Roger Thuras, CDC
2/15/77	MAGNETICS AND CREDIT CARDS, Ron Kuck & E. P. Erickson
12/07/76	PERSPECTIVES ON BUBBLE & SIMILAR MEMORIES, Prof. Art Pohm, Iowa State
11/17/76	LASER LIGHT BEAM DEFLECTOR, Tom Johanson, Univac. MAGNETO -OPTIC INFORMATION PRO-CESSING, Dave Fleming, Univac. CROSS-TIE MEMORY, David Lo, Univac
10/18/76	TRANSIENT ELECTROMAGNETIC EFFECTS ON ELECTRONICS, J. Robb. LTRI
9/09/76	MAGNETICS RESEARCH AT HONEYWELL MAGNETIZATION PROP. OF GdCo FILMS, O. S. Lutes RECENT ADVANCES IN MAGNETIC BUBBLE RE-SEARCH, Rich. Fryer & J. Geddes BUBBLE MEMORY MASK FABR. BY E-BEAM LITHOGRAPHY, L. T. Shepherd
5/11/76	FRAUD RESISTANT MAGNETIC STRIPE CREDIT CARDS, Fayling, Szczech, 3M
4/06/76	ELECTRON BEAM ACCESS MEMORIES, Floyd Arntz, Microbit Corp.
3/11/76	APPLICATIONS OF MAGNETISM TO METALLURGICAL SEPARATIONS, Dr. W. Khalafalla, U. S. Bureau of Mines
2/02/76	PLASTIFORM FLEXIBLE MAGNETS, Phil Hinderacker, 3M
12/11/75	SUPER COMPUTER NETWORKS, Peter D. Jones, Development Network Systems
11/13/75	CONTROL DATA ON-LINE-TAPE-LIBRARY
10/07/75	BUBBLES: PRESENT STATUS & FUTURE TRENDS, Andrew Bobeck, Bell Tel. Labs.

There are three officers: chairman, vice-chairman, and secretary. Each year a new secretary is chosen; the old secretary becomes vice-chairman; the old vice-chairman becomes chairman; and the old chairman retires. He has no choice. No one ever stays more than one term in each job. This encourages the selection of young people for officers. An attempt is made not to have two active officers from the same company.

The three officers jointly select the speakers. The vice-chairman usually makes reservations at the restaurant. The secretary sends out meeting notices from xeroxed addresses on adhesive labels, a process that takes about an hour. The chairman loafs.

The result is an organization that presents opportunities for prodessional knowledge, much of which is not available at national meetings, for professional contacts, social contacts, and for knowledge of other companies in the area. We in the Twin Cities have found the local Magnetics Chapter to be very worthwhile.

E. J. Torok

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CENTENNIAL FOCUS OF IEEE HISTORY EFFORTS

The one hundredth anniversary of the founding of the American Institute of Electrical Engineers (AIEE) in New York City in 1884 will be the occasion for a wide range of activities next year. Much of the work of the Center for the History of Electrical Engineering is in preparation for 1984's Centennial celebration, which will include exhibits, ceremonies, numerous publications, and a variety of other events and products.

The production of the IEEE Centennial Exhibit is a major item on the Center's agenda. The exhibit is scheduled to be used at the larger IEEE meetings in the United States, coupled with an expanded IEEE membership/services/publications exhibit. Because of its location on the flooor of large commercial exhibition areas, the Centennial exhibit will feature no artifacts, but will instead be a pictorial treatment of

one hundred years of the electrical engineering profession. It is the intent of the exhibit to concentrate on the people who have made electrical engineering the most exciting and important source of new technology over the past century. Among them are not simply the inventors who are familiarly linked with technological breakthroughs, but also those individuals whose contributions to the profession were in forms not generally recognized by the public but that were no less crucial to the advancement of electrical engineering.

These include educators, entrepreneurs, journalists, laboratory directors and, of course, the leaders of the profession's major societies. The historical, biographical, and pictorial research for the exhibit is under way, and preliminary design plans have been drawn up. The exhibit's production and circulation is sponsored by the IEEE Centennial Task Force.

As a by-product of the Centennial exhibit, the Center will be preparing an audio-visual package treating the exhibit's themes which will be available to IEEE sections and other groups in 1984. Other spin-offs from the exhibit may include publications and duplicates of the exhibit panels.

DOD FELLOWSHIP FOR DOCTORAL STUDIES IN APPLIED MAGNETICS/PERMANENT MAGNET MATERIALS

Description: A fellowship for full-time study and research leading to a Ph.D. or D.E. degree will be available beginning in August, 1983. Required work combines elements of electrical engineering, materials science and applied physics. The dissertation topic must relate to permanent magnets for millimeter-wave devices. Research (mostly experimental) will be done in the Magnetics and the Metals and Ceramics Laboratories of the University of Dayton.

Terms of DOD Fellowship: Candidates must have a B.S. degree in Electrical or Metallurgical Engineering, Materials Science/Engineering or Physics. They must meet U. Dayton's academic requirements for admission to the doctoral program in Engineering. An M.S. degree or prior graduate studies, advanced courses in magnetic fields, devices or materials, and prior laboratory work experience are desirable. U. S. citizenship is required. Appointment will be for the calendar year and includes normal vacation. Renewable up to three years based on satisfactory academic and research progress.

Benefits: A monthly stipend of $1,000 (B.S.) or $1,100 (M.S.) with annual increases. Full tuition remission. Good laboratory and computer facilities.

Application Process:

1. Submit letter indicating interest, a brief curriculum vitae and resume of academic work (degrees, grade average, applicable special courses) by April 15 to Dr. G. A. Thiele, Associate Dean of Grad. Studies and Research, KL-261, School of Engineering, University of Dayton, Dayton, Ohio 45469.

2. Application forms for the University and the Engineering graduate program with three recommendations (on special form) are due by April 30, 1983. Call the above office for forms and academic program information. (513-229-2241)

Selection Process and Time Schedule:

1. Review of general academic qualifications by graduate studies committee of the School of Engineering. (Target date May 31, 1983.)

2. Review of qualifications and specific preparation for research work by prospective dissertation advisor and laboratory directors. Personal interview of candidate with these, if possible. (Target date June 15, 1983.)

3. Approval of final candidate by sponsoring agency may be required.

4. Notification of final selection by June 30, 1983.

5. Anticipated starting date of fellowship is August 16, 1983.

6. The fall semester begins on August 29.

NSF NOMINEE QUIZZED ON SUPER COMPUTERS

The Director-designate of the NSF, Dr. Edward Knapp, encountered some political crossfire at his confirmation hearing April 13 before the Senate Labor & Human Resources Committee. The Los Alamos physicist was assailed on two counts by Sen. Ted Kennedy - for giving undue weight to politics in selecting his deputies and for insufficient concern about the Japanese super computer threat. Dr. Knapp was able to lessen some of the Kennedy concerns on "politicization" by the end of the hearing. He said a list of nominees for the vacancies had gone from the NSF to the White House; that the names were generated by Knapp himself and the National Science Board; that professional societies and organizations had provided advice and inputs; and that managerial skill was the sole criterion applied. Knapp took full responsibility for creating the vacancies. He said he had asked for the resignations of the various Assistant Directors because he wanted to create his own team.

Knapp said he looks forward to rebuilding and strengthening the base of science and engineering research. Some problems he expects to confront now are "the growing obsolescence of research instrumentation and facilities at colleges and universities, the rising cost of graduate education in science and engineering, perceived shortages - developing and existing - of science and engineering professionals in several areas, and the continuing need to broaden the opportunities for minority and women scientists to contribute their talents to a variety of scientific careers."

Knapp, a native of Oregon, has spent his entire professional career at the Los Alamos Labs in the accelerator technology division. He was introduced to the Committee by Sen. Pete Domenici (R., New Mex.).

Kennedy, who is ranking minority member on the Committee, tried to provoke Knapp into a statement of support for some government program on super computers. The Senator, evidently reflecting some loosely-defined message from the computer industry in his state, said the U. S. should not allow Japan to achieve primacy in super computers and that the Foundation, in particular, should develop a "message" to Congress on how the U. S. effort should be structured.

In response, Knapp said the two problems now are the lack of access to super computers by university researchers and the uncertainty about whether our industry can match the Japanese efforts. He also said that the computer industry in the U. S. is very innovative and should be encouraged to continue their research. A government-sponsored program would be counter-productive, he concluded. Knapp noted that an inter-agency committee is preparing strategy on super computers. He has directed his own staff to prepare recommendations on university access.

Kennedy concluded his interrogation with the promise that the Labor and Human Resources staff would work with Dr. Knapp on super computer questions. Knapp was confirmed by the Senate on April 15.

CABINET-LEVEL REVIEW URGED OF U.S. INNOVATIVE CAPACITY AND TRADE COMPETITIVENESS

Advanced technology and trade should be rated among the nation's highest priorities, according to a blue-ribbon panel on high technology. So urgent is the

problem that the Federal government should initiate a biennial, Cabinet-level review to assess our trade competitiveness and the health of our innovative capacity, in both relative and absolute terms. This recommendation is included in a report (International Competition in Advanced Technology) prepared by a panel assembled by the National Academy of Sciences. The report and recommendations were made public in a hearing of the Senate Finance Committee on April 14. The study, which was initiated about two years ago by the Academies of Sciences and Engineering, was conducted by a panel of experts on technology, industry, labor, education, economics, and foreign affairs. Howard W. Johnson, Chairman of the Corporation of MIT, chaired the 22-person panel. The MIT establishment was well represented on it. Among the industry members were Robert A. Fuller (Johnson & Johnson); Ralph E. Gomory (IBM); Bruce Hannay (Bell Labs); William R. Hewlett (Hewlett-Packard); William N. Hubbard, Jr. (Upjohn); Allen Puckett (Hughes Aircraft); John Reed (Citibank); John E. Steiner (Boeing); and William J. Weisz (Motorola). The study was supported by Academy funds, private foundations, and by two Federal entities, the Executive Office of the President and OSTP.

The panel called on the government to abandon its current "uncoordinated and incoherent" approach to high technology in which conflicting policies sometimes help and sometimes hinder technological innovation. It should begin by creating the Cabinet-level instrument to assess and coordinate all government policies that affect the development of advanced technologies. "The U. S. must act now" because "the nation's capacity for technological innovation is vulnerable both from domestic weakness and from damaging practices of other nations."

The Senate Finance Committee welcomed the report and paid high compliments to the ability of its members. However, Sen. Bob Dole, the chairman, and Sens. Bentsen, Moynihan and Mitchell (Democrats) characterized the recommendations as modest proposals. In answer to questions, the panelists were willing to talk tough on semi-conductors, an industry whose needs must get attention now. The problem must get top-priority review and we should be prepared to meet preferred financing methods head-on. It is distasteful but it must be done, they said. Sen. Bentsen and others suggested that the panel make periodic reports to the Committee.

The Cabinet-level review proposed by the panel should be supported by a continuing mechanism that would draw on expertise both within and outside the government. The review should consider the nation's overall performance: the private sector activities and the totality of government actions on technology and trade, as well as the effects of other government practices.

Among the other recommendations were the following:

- Managers of private firms must be cognizant of technological trends. Managers should consider new institutional arrangements - industry-university research relationships, cooperative research ventures among groups of firms, or consortia to seek information and ideas systematically from abroad.

- Internationally, the U. S. should negotiate to encourage a healthy mutual trading system.

- The U. S. should review the content and application of its trade laws to ensure that U. S. industries can obtain timely and meaningful trade and/or other relief in the U. S. market when imports from particular countries, based on unreasonable or excessive foreign industrial policies, threaten them.

- If key technology industries essential to national economic welfare and military security are considered endangered by the actions of another country, then the U. S. should negotiate with the other country. Negotiations should take place first in existing forums. If such mechanisms prove ineffective or too slow, then the U. S. should negotiate directly with the country in question.

29th MMM CONF., NOV. 8-11, 1983 PITTSBURGH, PA

The 29th Annual Conference on Magnetism and Magnetic Materials (MMM) will be held at the Pittsburgh Hilton Hotel in Pittsburgh, Pennsylvania, from Tuesday, November 8 through Friday, November 11, 1983. The Conference is sponsored jointly by the American Institute of Physics and the Magnetics Society of the IEEE in cooperation with the Metallurgical Society of AIME, the Office of Naval Research, the American Society for Testing and Materials, and the American Physical Society.

Members of domestic and international scientific and engineering communities interested in recent developments in magnetism and its associated technology are invited to attend the Conference and to contribute to its technical sessions.

SCOPE OF THE CONFERENCE: This conference will include all areas of basic and applied science related to magnetism. A list of general subject categories follows:

1. Bubble physics, materials and devices.
2. Magnetic recording media, heads and processes.
3. New techniques, new materials, new applications.
4. Hard magnetic materials.
5. Soft magnetic materials.
6. Spin glasses.
7. Amorphous materials.
8. Magnetic insulators, magneto-optics.
9. Mixed valence systems, magnetic semiconductors.
10. Metals, alloys, intermetallic compounds, magnetic superconductors, itinerant magnetism.
11. Surfaces, absorbed and modulated layers, fine particles.
12. Computer methods in magnetism.
13. Critical phenomena, Potts-type models, low d magnetism.
14. Magnetic excitations, neutron scattering, solitons.
15. Microwave and magnetoelastic effects, resonance.
16. Electronic structure, spectroscopy, photoemission.
17. Hyperfine fields, NMR, Mössbauer.
18. Transport, Hall and Kondo effects.
19. Magnetic separation.
20. Interdisciplinary, field theories, ferrofluids.

PROGRAM: The program will consist of invited and contributed papers falling broadly within the scope of the above categories. Some of the invited papers will be tutorial in nature, while others will review recent work in specialized fields.

PAPERS: Contributed papers are solicited. Prospective authors should submit abstracts to be received by the deadline of July 5, 1983. Abstracts should be mailed to:

Dr. R. W. Patterson
Hewlett Packard Laboratories
1650 Page Mill Road
Building 28C
Palo Alto, California 94304

(DO NOT MAIL ABSTRACTS TO AMERICAN INSTITUTE OF PHYSICS.)

A postcard acknowledgement will be sent on the day the abstract is received at Hewlett-Packard. If no postcard is received, the author should promptly contact Dr. Patterson to ensure that the abstract has not been lost in the mails.

22nd INTERMAG CONF., APRIL 10-13, 1984, HAMBURG, GERMANY

The 22nd International Magnetics Conference will be held at the CCH, The Congress Center Hamburg, Germany, from Tuesday, April 10 through Friday, April 13, 1984.

The purpose of the 22nd International Magnetics Conference is to provide a forum for presentation of new developments in applied magnetics, related magnetic phenomena, and information storage technologies.

Contributed papers (12 minutes presentation time) are solicited falling broadly into the scope of the 21 categories indicated below. This list is intended to be suggestive rather than restrictive. In addition, there will be invited papers (30 minutes presentation time) and tutorial sessions. Workshops for less formal presentations and discussions of controversial topics can be organized.

Digests must be received by December 1, 1983. They should be sent to:

G. Winkler
P. Hansen
Philips Forschunglaboratorium
P. O. Box 540 840
D-2000 Hamburg 54
Germany

The digest is not an abstract, it is a two-page condensation or summary which outlines the work to be reported and includes as many of the results as possible. The inclusion of figures, tables and especially numerical results is strongly recommended. The Program Committee must judge by the technical content of the digest when considering the paper for inclusion in the INTERMAG program. Instructions for the preparation of the digest will be sent only to those who return the attached form. The booklet with the accepted digests will be available for all participangs at the conference.

Oral presentations at INTERMAG must be in English: approximately 12 minutes will be allowed. Authors who submit digests for the conference will be expected to submit full manuscripts for the conference proceedings. The September issue of the "Transactions on Magnetics" will have the INTERMAG Proceedings. Instructions for manuscript preparation will be sent to authors of accepted digests. The submitted manuscripts will be subject to usual review procedures. It is expected that March 10, 1984 will be the deadline for manuscript submission and that the length limit will be about 3 "Transaction" pages. Papers not available for publication in the Proceedings issue will be listed by title and author only.

To assist the Program Committee the following categories are to be used in characterizing the subject of each submitted digest:

1) Amorphous Materials: Materials, Technology, Applications
2) Recording: Theory, Systems, Processes, Media, Heads
3) Bubbles: Materials, Physics, Devices, Memories
4) Micromagnetism (Domains, Walls, Anisotropy, etc., excl. Bubble Phenomena)
5) Magnetic Memories (excl. Bubble and Magneto-optical Memories and Recording)
6) Hard Magnetic Materials & Permanent Magnets
7) Soft Materials (excl. Silicon-Iron, Ferrites)
8) Soft Ferrites
9) Silicon-Iron
10) Power Devices, Motors, Transformers, Shielding
11) Computer Methods (CAD of Magnetic Devices, Apparatus)
12) Eddy Current & Field Calculations
13) Magneto-Optics (Materials, Technology, Applications)
14) Microwave Phenomena, Materials & Devices
15) Superconductors
16) Magnetometry (Measurement, Apparatus)
17) Magnetic Separation
18) Interdisciplinary Topics (Magnetics in Medicine, Biology, etc.)
19) Magnetic Levitation & Propulsion
20) Magnetic Sensors
21) Miscellaneous

1983 KRIKOS-OTE TELECOMMUNICATIONS CONF., AUG. 25, 26, ATHENS, GREECE

The 1983 KRIKOS-OTE Telecommunications Conference will be held in Athens, Greece, August 25, 26, 1983. This is the first telecommunications conference cosponsored by KRIKOS, a non-profit organization representing scientists and engineers of Hellenic descent in North America and OTE, the Greek State Telecommunications Organization.

TECHNICAL AREAS

I. OVERVIEW OF NETWORKS & SERVICES

1. Public Switching Telephone Networks (PSTN)
2. Packet Switched Data Networks (PSDN)
3. Circuit Switched Data Networks (CSDN)
4. Integrated Switched Digital Networks (ISDN)
5. Multiple Access Networks
6. Services

II. NETWORK COMPONENT TECHNOLOGY

1. Terminals, Switch Nodes, Front Ends
2. Communication Controllers, Modems, TDM, FDM, PABX
3. Communication Links, Parallel and Serial Highways, Optical Fibers, Buses

III. NETWORK PROTOCOLS

1. Open System Interconnection Architecture (OSI)
2. System Network Architecture (SNA)
3. Electronic Telephone Switching Systems
4. PSDN/CSDN/ISDN Systems

IV, SATELLITE SYSTEMS

1. Satellites
2. Earth Stations
3. TDMA, Reservations, Multiple Access Protocols

V. SERVICES

1. Telephone
2. Telex
3. Teletex
4. Videotex
5. Facsimile
6. Electronic Mail
7. Store & Forward Svcs.
8. Office Automation
9. Teleconferencing

VI. WORKSHOPS/SEMINARS

The workshops will cover additional topics, such as digital signal processing in telecommunications, speech processing and other subjects of interest in telecommunications.

CONFERENCE ORGANIZING COMMITTEE

FROM KRIKOS	FROM GREECE
M. E. Logiadis, RCA/ KRIKOS, Co-Chairman	G. Bafas, OTE/Nat. Tech. Univ., Co-Chairman
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A. Constantinidis, Imperial College, London	G. Kokkinakis, U. of Patras
A. Georganas, U. of Ottawa	D. Lainiotis, U. of Patras
A. Ephremides, U. of Maryland	M. Protonotarios, Nat. Tech. Univ.

TRAVEL GRANTS

There is a possibility (not assurance) that some grants will become available to cover transportation and accommodation expenses. Further information will be available from

M. E. Logiadis
64 Edgecliff Terrace
Yonkers, NY 10705
U. S. A.

(H) (914) 968-0544
(O) (212) 806-7165

7th INT. WORKSHOP ON RARE EARTH-COBALT PERMANENT MAGNETS & THEIR APPLICATIONS, SEPT. 16-18, 1983, BEIJING, CHINA

GENERAL CHAIRMAN'S MESSAGE

This will be the seventh in a series of conferences that aim to bring together those who study, develop or use permanent magnets based on alloys of 3d-transition metals and lanthanide elements. The three-day working meetings cover all aspects of the

topic: materials science, production engineering, magnet properties and testing, application development, raw materials, etc. They attract persons with a wide range of interests - from mining and chemistry through physics and powder metallurgy, to various branches of electronic, powder and mechanical engineering, even medicine, and from the scientific to the business side of the subject.

The choice of the capital of China as the location for the 7th Workshop on Rare Earth-Cobalt Magnets is very appropriate. For the last ten years, many laboratories in that country have worked hard and with much success to advance the scientific understanding, the production metallurgy and engineering applications of the REPM. Several magnet types manufactured in China, equal to the best, are becoming commercially available in other countries. The identification and present development of the world's largest rare-earth ore body, near Baotou, will favorably affect the future raw material supply situation - especially, too for samarium. It may well establish China as the main source of rare earth metals and oxides for the magnet industry and for other rare-earth users anywhere.

Along with many U. S. colleagues, I look forward to this workshop as an occasion to discuss recent progress and the exciting prospects with our Chinese counterparts, and to visit their home institutions. Growing opportunities for such exchanges in science, technology and business have begun to bear fruit in the magnetic materials field. May this meeting do its generous share to promote and intensify cooperation for mutual benefit. I expect that many participants of the earlier workshops and other interested persons from everywhere on the globe will find it possible and worth-while to attend.

Hope to see you all in Beijing in September 1983 for this most interesting and productive conference planned by our Chinese hosts!

Karl J. Strnat
University of Dayton, Ohio
USA
513-229-3535

ORGANIZATION

Karl J. Strnat, General Chairman
Local Committee:
Li Dong-Ying, Chairman
Wu Er-Zheng, Vice-Chairman
Program Committee:
Ho Wen-Wang, Chairman
Fang Ying, General Secretary

CORRESPONDENCE

All correspondence concerning the workshop should be sent to the General Secretary of the 7th Workshop, Ms. Fang Ying.

Address: The Chinese Society of Rare Earth
2 Xin Jie Kou Wai Dajie
Beijing, People's Republic of China

Tel. 66.6431-597
Telex. 22604 MIEC CN

4th INT. CONF. ON FERRITES, OCT. 31-NOV. 2, 1984 SAN FRANCISCO, CA

About the Conference:

The ICF 4 is being organized to provide a forum for presentation of the latest scientific and technological developments in ferrites and related materials, devices, and systems applications. The last such conference was held in Kyoto, Japan, in 1980 at which time more than 200 technical papers were presented and more than 500 persons attended. This is the first time that such a conference is being held on the North American Continent, under the auspices of the American Ceramic Society.

Call for Papers:

Contributed papers describing original work are solicited in these broad areas:

- Physics and Chemistry of Ferrites, Garnets, and Other Ferrimagnetic Oxides, Magnetic Perovskites and Related Oxides
- Crystal Growth, Diffusion, Precipitation, Phase Transitions, Sintering, and Microstructure
- Raw Materials, Manufacturing Processes, and Equipment
- Novel Techniques of Property Measurement and Control
- Magnetic Recording Media, Recording Head Materials, and Related Materials Such as Fine Metal Particles and Thin Films
- Magneto-Optical Materials, Optical Wave Guides, and Optical Recording
- Magnetic Bubbles and Other Memory Media
- Ferrites and Other Competing Materials for High Frequency Power Supplies
- High Permeability Ferrites, Low Loss Ferrites, Inductors and Transformers
- Permanent Magnet Magerials including Intermetallic Compounds
- Magnetic Separation and Environmental Technologies
- Biological Applications

The thrust of this conference will be on ferrites. However, it is also the intent to assess competing technologies. In addition to regular technical sessions, there will be poster sessions, panel discussions, and workshops to facilitate maximum exchange of technical information. There will be a number of invited Papers as well. The official language of the conference will be English.

Additional Information:

Dr. Bhaskar B. Ghate
ICF4 General Secretary
Bell Laboratories, Room 2A-009
555 Union Blvd.
Allentown, PA 18103, U.S.A.

CONFERENCE CALENDAR

14th Annual IEEE Power Electronics Specialists Conf., Albuquerque, June 6-9, 1983.

NATO Advanced Study Institute: Magneto-Structural Correlations in Exchange Coupled Systems, Castiglione della Pescaia, Italy, June 18-30, 1983.

3rd Int. Conf. on Magnetic Fluids, Univ. College of North Wales, Bangor, June 29-30, 1983.

Cryogenic Engineering Conf. & Int. Cryogenic Materials Conf., Colorado Springs, Aug. 18-19, 1983.

1983 KRIKOS-OTE Telecommunications Conf., Aug. 25, 26, 1983, Athens, Greece (see announcement).

8th Int. Conf. on Magnet Technology, 5-9 Sept., 1983, Grenoble.

7th Int. Workshop on Rare Earth-Cobalt Permanent Magnets & Thin Applications, Sept. 16-18, 1983, Beijing, China (see announcement).

INTELEC '83, Tokyo, Oct. 18-21, 1983.

29th Annual MMM Conf., Pittsburgh, Nov. 8-11, 1983 (see announcement).

22nd INTERMAG Conf., April 10-13, 1984, Hamburg, Germany (see announcement).

4th Int. Conf. on Ferrites, Oct. 13-Nov. 2, 1984, San Francisco, CA (see announcement).

JOIN THE MAGNETICS SOCIETY TODAY

Membership in the IEEE Magnetics Society entitles you to receive, for the low Society fee, the IEEE Transactions on Magnetics, and the quarterly Magnetics Society Newsletter. You are kept informed of latest developments, meetings, and conferences in your areas of interest, and are entitled to purchase informative conference records and other helpful educational aids at greatly reduced rates for members.

Use the convenient coupon to become a member of the IEEE Magnetics Society. If you are not a member of the IEEE, but would like to join, please check the appropriate box on the coupon. Descriptive materials and an IEEE membership application will be sent to you upon receipt.

Society Fee: $7.00 for IEEE members of all grades except Student.
Student Fee: $3.00. These rates apply to payments received September 1 through February. On payments received March 1 through August 31, remit one-half of the above rates. (Payments received September 1 through December 31 apply through December 31 of the following year.)

MEMBERSHIP APPLICATION/
IEEE MAGNETICS SOCIETY

Send to: IEEE Service Center, 445 Hoes Lane,
Piscataway, NJ 08854.

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Company_____

Field of Interest_____

(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: E. J. Torok, Membership Chairman of the Magnetics Society, Sperry Univac, UlT25, P. O. Box 3525, St. Paul, Minn. 55165.

IEEE MAGNETICS SOCIETY NEWSLETTER
c/o RICHARD M. JOSEPHS, EDITOR
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