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Conference Reports

Magnetism in Washington

By Frans Greidanus*

The 1989 INTERMAG (International Magnetics Conference, Washington, USA, March 28.–31.) provided a forum for engineers and scientists to discuss the field of magnetics, from basic research to applications. The sessions included invited and contributed papers, poster sessions, workshops and tutorials. The total number of participants was approximately 800. The diversity of the field was indicated by presentations covering all branches of magnetics and related technologies. Topics discussed included recording heads, superconductivity, microwave components, numerical techniques and field calculations, hard magnets, amorphous magnets, magnetic measurements, recording systems, coercivity mechanisms, domains and domain walls, magneto-optics, magnetic separation and biomagnetism, thin film media, soft magnetic materials, perpendicular recording, and bubble and bloch line memories. Most of the conference took place in six parallel sessions. In the plenary session on March 29. Professor *Iwasaki* from Tohoku University was awarded the 1989 Cledo Brunetti Award for his contributions to the miniaturization of magnetic recording systems.

Also on March 29. a workshop on scanning electron microscopy with polarization analysis (SEMPA) was organized by *J. Unguris* from the National Institute of Standards and Technology (formerly called NBS). SEMPA is a relatively new technology which enables high resolution imaging of magnetic domains by the analysis of the polarization state of electrons reflected from a magnetic surface. In general there was much interest in magnetic domain imaging and related new techniques. Another new tool in this field is the magnetic force microscope. Its possibilities were reviewed in an excellent paper by *Rugar, Mamin, Stern, Fontana, Kasiraj, Mc-Fadyen* and *Lambert* from IBM and optical imaging techniques were reviewed in a paper by *Argyle*, also from IBM.

Materials played an important role at the 1989 INTERMAG conference. Examples are Ba-ferrite as a promising new magnetic recording material, the use of magnetic Co/Pt multilayers for magneto-optical recording, and the application of NdFeB permanent magnets in magnetic imaging devices for clinical applications using NMR.

A substantial number of papers dealt with magnetic recording. Of these about 100 were devoted to magnetic recording, and about 40 to magneto-optical recording. On March 28. a symposium on the status and future of magnetic and magneto-optical disk-drive technologies was organized by Professor *M. Kryder* from Carnegie Mellon University. In this symposium *G. Hughes* (Seagate), *F. Greidanus* (Philips), *D. Rugar* (IBM) and *T. Toshima* (NTT) presented their views. Magneto-optical recording will find its place in the market, but the question whether it will (partially) replace Winchester technology remains to be answered.

An important issue in magneto-optical recording is "direct overwrite." Papers by *Nakao, Sukeda, Ojima, Taka* and *Nishiyama* (Hitachi) and *Greidanus, Jacobs, Spruit* and *Klahn* (Philips) discussed the field-modulation technique. *Kryder, Shieh, Schultz* (Carnegie Mellon), *Meiklejohn* and *Skoda* (MOVID Information Technology) showed real time movies of the writing and erasing of domains with a single laser, operating under different conditions. *Van den Berg* and *Röckelein* (Siemens) proposed two new "direct overwrite" schemes, employing two magnetic layers separated by a thermal insulating layer. It is clear that this subject will attract more attention in the coming years.

Kano, Shono, Kuroda, Koshino and *Ogawa* (Fujitsu) reviewed the possibilities of sputtered garnets for future applications in magneto-optical disks. With garnet layers deposited on Gandolinium Gallium Garnet (GGG) single crystals

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they have been able to achieve a carrier to noise ratio (CNR) of 60 dB ($v = 0.5$ MHz, $bw = 30$ kHz, $v = 10$ m/s). By depositing the same layers on glass substrates the CNR dropped to 50 dB. Most papers in the session on magneto-optical recording materials were devoted to multilayers (or layered structures) consisting of alternating Co and a non-magnetic metal e.g. Pt or Pd, each individual layer having a thickness of only a few atomic layers. *Ochiai, Hashimoto* and *Aso* (Sony) reported on the magnetic and magneto-optical properties of Co/Pt and Co/Pd ultrathin multilayered films. *Tsunashima, Nagase, Nakamura* and *Uchiyama* (Nagoya Univ.) discussed the possible role of magnetostriction in Pd/PdCo multilayers. *Zeper, Greidanus* and *Carcia* (Philips-Du Pont) were the first to report on thermally written domains and recording experiments in Co/Pt multilayers. In thin (20 nm) films they obtained a CNR of 53 dB ($v = 1.0$ MHz, $bw = 30$ kHz, $v = 5$ m/s). This value approaches the CNR-values obtained in GdTbFe thin films. Multilayers of Co and Pt offer the advantage of increased magneto-optical efficiency in the blue, an important feature for future higher density recording. Furthermore, they are very resistant against corrosion and oxidation and there is no need to apply protective layers. The application of multilayers for magneto-optical recording is an exciting possibility, and increased activitity in this area is anticipated.

In this short report it is impossible to review all subjects discussed at the 1989 INTERMAG. Those who are interested in further information I refer to the contributed and invited papers which will be published in the IEEE Transactions on Magnetics.

Liquid Crystals in Schladming

By Peter Laggner*

One hundred years after the discovery of liquid crystals by the Austrian botanist *Friedrich Reinitzer* was a good time for the VI. European Liquid Crystal Winter Conference (5.–10. March 1989) to be held in Schladming, Austria. This triennial series of 'European' conferences tends to be different from the bigger 'International' conferences as the program is topically confined in order to promote coherent discussion, to reflect the interests of the groups in the organizer's country, and to leave plenty of time and opportunity for less formal interaction.

A specific attraction of this series of conferences is the choice of venue. Previous conferences were held at Les Arcs (France), Madonna di Campiglio (Italy), Garmisch-Partenkirchen (FRG), Bovec (Yugoslavia) and Borovets (Bulgaria) all being winter sports centers. A sport hotel at Schladming this year served this purpose admirably.

The aim of this conference was to bring into fusional contact the two traditionally separate nuclei of liquid crystal research, biology and technology, in order to cross-fertilize the separately developed but related physical and chemical concepts. Thus, under the title "Liquid Crystals in Biology and Technology: Supramolecular Structure, Dynamics and Function" about 130 scientists from 21 nations (not only European) gave 17 lectures (35 min.) and 20 oral contributions (15 min.) and presented 69 posters, representing fields of interest ranging from medical biophysics, chemistry and physics to polymer and display science and technology.

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The topics covered in biology included the following: Biomembrane structure and dynamics, polymorphism and dynamics of lipids, Langmuir-Blodgett films, and carbohydrate liquid crystals. Technological topics included amphotropic polymer liquid crystals, chiral main-chain liquid crystals, thermal imaging systems and plastic materials.

An overlap region was presented in the fields of molecular engineering, membrane mimetic chemistry, and drug delivery systems. The first day was devoted to these overlapping topics where concepts from the study of biological membranes combined with synthetic chemistry are used to design devices in the true sense of molecular engineering. *A. Ruaudel-Teixier* (CEN, Saclay, France) and *J. Fendler* (Syracuse University, USA) presented two technically distinct approaches, the LB-film technique on solid interfaces and the BLM (bilayer lipid membrane) technique, where a single membrane of a few nanometers thickness separates two macroscopic aqueous compartments. Both approaches were originally analytical tools in membrane biophysics but are now developing rapidly in the direction of molecular electronics, photonics and sensing devices of ultimate miniaturization. Still in its infancy, as far as marketable products are concerned, this line of research was shown to hold great promise.

Ambitious molecular engineering projects require intelligent chemistry combined with structural information. *L. Feigin* (USSR Academy of Sciences, Moscow) emphasized this point and showed how X-ray small-angle diffraction techniques can provide useful data on the supramolecular architecture of oligo- and multilayer systems of high complexity. Particularly instructive, also in this context, was the