E-MRS Spring Meeting Reflects International Collaboration

Strasbourg Venue Draws Large Audience

The popular venue of the Palais of Europe at the European Parliament complex in Strasbourg was once again host to the 1988 Spring Meeting of the European Materials Research Society (E-MRS). The unique setting of the attractively medieval cathedral city of Strasbourg, whose history stretches back some 2,000 years, on the France-German border once again provided a cultural bonus to those attending the conference.

This year, for the first time, and due to the popularity of the topics scheduled, E-MRS organized both a Spring and a Fall Meeting. Close to 600 registered for the Spring Meeting. With a similar number expected in the Fall, it is gratifying to note that 1987's record number of 700 attendees at the single meeting will easily be exceeded in 1988. An indication of the successful blend of international flavors of the conference is shown in Figure 1. Although the geography of the venue clearly ensures a strong French and German attendance, this was still less than 50% of the total.

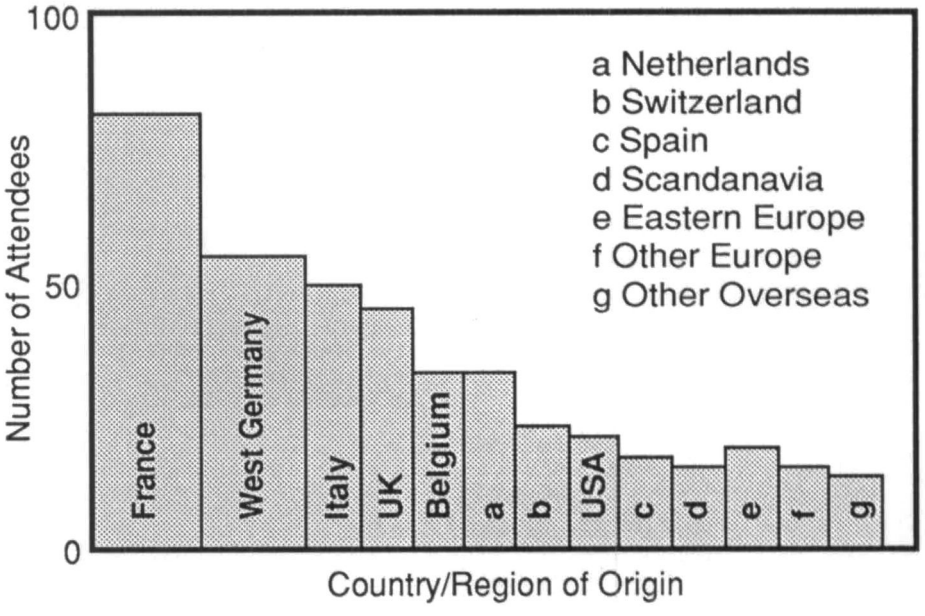

Figure 1. A successful blend of international flavors is clearly indicated in the numbers of attendees from different countries and regions at the 1988 E-MRS Spring Meeting.

These extremely healthy signs are not only a reflection of E-MRS philosophies in a multidisciplinary approach to modern materials research, but also of the growing popularity and recognition of international collaboration within Europe. E-MRS is becoming an important rendezvous for researchers at all levels, from universities and government laboratories to industries and commerce. The conference has also become a venue for the European Community-sponsored Materials Networks within E-MRS to assist in obtaining funding through established programs such as ESPRIT, EURAM, and SCIENCE.

E-MRS president P. Siffert (right) with the 1988 E-MRS Spring Meeting chairs (left to right): D.J. Brook, I.W. Boyd, K. Samwer, M. von Allmen, B. Stritzker, S. Kalbitzer, and and E.F. Krimmel.

Following the common half-day joint plenary session, four symposia were held at the meeting, each extending over two and a half days: A—Ceramics Materials Research, B—Photon, Beam and Plasma Assisted Processing: Fundamentals and Device Technology, C—Deep Implants: Fundamentals and Applications, and D—Preparation and Properties of Metastable Alloys. Highlights from these symposia are published below.

The conference was formally opened by J.P. Massué, Scientific Adviser to the Parliamentary Assembly - Council of Europe, and J.G. Wurm, Division Head of the European Communities (DG-12), Brussels.

Plenary Session Features Four Speakers

The plenary talks were initiated by Prof. M. Hirose (Department of Electrical Engineering, Hiroshima University, Japan), who spoke on "Future VLSI Technology," describing both advanced processes and possible new device architectures. In pointing out the importance of gas-surface

https://doi.org/10.1557/S0883769400064228 Published online by Cambridge University Press

reactions, he indicated that laser, remote plasma, and ion-induced processes have promise over the next decades, with excimer laser lithography most likely enabling production of 64Mbit dRAMs. Novel three-dimensional and high density structures were also presented.

Prof. P. Haasen (Institut für Metallphysik, University of Gottingen) discussed "Analytical Field Ion Microscopy of Hard Magnets". He reviewed the method of atomic probing, combining field ion microscopy for microstructural identification of multiphase alloys, and time-of-flight mass spectrometry for atom-by-atom chemical analysis. Various mixtures of modern hard magnets, including FeCrCo, the Alnicos, and FeNdB were analyzed in the talk, with the aim of understanding their demagnetization processes as well as their high coercive fields.

Prof. F. Koch (Physics Department, Technical University of Munich) gave the third plenary presentation. His paper on "Electronic Properties and Device Perspectives for Delta Doping Layers" incorporated the many modern techniques for obtaining sharply defined layers, especially of Si and Se in GaAs, S in InP, and Sb and Ga in Si. Possible device applications, where the potential profiles could be engineered to the scale of the wavelength of the charge carriers, were described.

Prof. C.J. Humphreys (Materials Science and Engineering Department, University of Liverpool) concluded the plenary talks with a presentation on "Superconducting Ceramics: The Materials Challenge." In addition to explaining current discrepancies in the structure of the orthorhombic YBaCu oxide material, Humphreys also showed how the stability and critical current density could be sustained for months if the material is produced at 100% of its optimum density. Studies of the grain boundaries of polycrystalline layers revealed that although they were atomically sharp, the critical current density achieved was four orders of magnitude less than for single crystals. He also mentioned that since many of the newer superconductors did not contain Cu-O chains, and sometimes not even Cu, the possibilities for discovering new high T_c materials remain wide open.

Students Awards Program Initiated

Conferred for the first time were E-MRS Awards for young scientists or graduate students in recognition of the best work presented at the conference. Each award consisted of a diploma, a cheque for 100 ECU, waiver of the meeting registration fee, and a special badge.

An awards program for young scientists and graduate students was initiated at the 1988 E-MRS Spring Meeting. Pictured are the award recipients with E-MRS president P. Siffert and E.F. Krimmel (6th and 7th from the left).

Proceedings to be Published

E-MRS has recently drawn up an agreement with Elsevier-North Holland to publish all the proceedings of these conferences. It is expected that all refereed and accepted papers will first appear in one of the established journals of the publishers, and later as a separately bound and more generally available books. The proceedings of Symposium C on Deep Implants will appear as a special issue of Materials Science and Engineering, Section B: Solid State Materials.

1988 E-MRS Fall Meeting Announced

The 1988 E-MRS Fall Meeting, scheduled for November 8-10 in Strasbourg, will also feature four symposia: High Temperature Superconductors: Preparation and Applications, chaired by C. Schlenker, P.F. Bongers, and B. Stritzker; Rare-Earth Iron High Performance Permanent Magnets and Their Applications, chaired by J.M.D. Coey, D. Givord, R. Hanitsch, and I.V. Mitchell; Superconducting and Low-Temperature Particle Detectors, chaired by G. Waysand; and On Solid State Ionics, chaired by M. Balkanski.

I.W. Boyd

1988 E-MRS Spring Meeting Symposium Highlights

Symposium A—Ceramics Materials Research

Chair: Prof. R.J. Brook (Max Planck Institut für Metallforschung, Stuttgart).

Symposium A was divided into seven sections: Fabrication, Characterization, and Innovation in Traditional Ceramics, which ran in series, and then Applications and Properties of Ceramics for Electronics, followed by Powders and Raw Materials, both in parallel with Superconductors; and Engineering Ceramics.

Over 80 papers were presented, including 25 invited papers, 30 contributed oral papers, and 26 posters. Fabrication details were covered by the following invited speakers: I.A. Aksay (University of Washington, Seattle), H.W. Hennicke and J. Stein (Technical University Clausthal), P. Messer (University of Sheffield), M.J. Edirisinghe and D. Evans (Brunel University), P. Greil (Technical University of Hamburg), J. Besson and M. Abouaf (ENSM de Paris), L.R. Wolff (Eindhoven University), and C. Brodhag et al. (ENSM de Paris).

Electrical, mechanical, and structural characterization of a variety of materials was described by A. Lagrange (Thomson), J.Y. Laval (CNRS/ESPCI), S. Meriani (University of Trieste), R. Morell (NPL, Teddington), J.S. Moya et al. (CSIC, Madrid), and G.D. Quinn and G. Wirth (DFVLR, Cologne). Innovation was covered in talks

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by F. Handle (Handle GmbH & Co. KG) on new perspectives in old ceramics, and by J. Destermes (KPCL-SAPEC Industrie) on the technological evolution in the fabrication of hard porcelain. G. Aliprandi (ISTIC, Genova) outlined the present Italian situation in the refractory industry, and I. Ramirez (AENOR, Madrid) gave examples of European standardization through ceramic tiles. Technological innovations were described by C.G.A. Clayton (British Ceramics Research Limited), who discussed CAD/CAM approaches, and G. Nassetti (Centro Ceramico, Bologna), who covered the production innovations in the floor and wall tile sector.

R.W. Whatmore (Plessey, Caswell) reviewed pyroelectric ceramics and devices, while R. Waser (Philips, Aachen) and T. Baiatu and K.H. Haerdtl (Universitat Karlsruhe) illustrated the degradation pathways of dielectric ceramics. K.H. Haerdtle detailed oxygen diffusion in perovskites.

During the Powders and Raw Materials session, A.J.A. Winnhubst et al. (University of Twente) discussed compaction of tetragonal zirconia, and J.C. Berner (IPCMS, EHICS) described the challenges for chemical routes for electronic ceramics. In opening the last session of this regime, W. Hartmann presented a talk on fumed oxides as raw materials for applications.

Reliability and performance were major topics of interest in the Engineering Ceramics sessions, and notable presentations were given by J. Lamon (Battelle, Geneva) on ceramic structural reliability and by T. Ekstrom (AB Sandvik Hard Materials) on the effect of composition, phase content and microstructure on the performance of yttrium sialon ceramics.

Symposium B—Photon, Beam and Plasma Assisted Processing: Fundamentals and Device Technology

Chairs: I.W. Boyd (University College London, United Kingdom and E.F. Krimmel (Siemens AG, Munich, West Germany).

Symposium B was one of the largest ever in this rapidly expanding area of beam processing. More than 80 papers were contributed in addition to 14 further invited papers from established experts in the field. The majority of papers (close to 60) were presented in a busy afternoon poster session which turned out to be a popular alternative to the traditional evening sessions of previous years.

The broad scope of this symposium featured a wide range of thin film processing techniques, covering many aspects of photon-charged particle beam and plasma processing. Particularly emphasized were the mechanisms occurring during photon-assisted processes.

After the symposium's plenary talks came the opening session devoted to deposition. J. Nijs (IMEC, Leuven) described the low temperature plasma-assisted deposition of silicon, giving thin highly conductive layers of single-crystal or polycrystalline silicon. These may be used as emitters for bipolar transistors or as source and drain regions for thin film transistors on glass. I. Eisele (Universitat der Bundeswehr Munich, Neubiberg) showed the use of molecular beam epitaxial deposition and subsequent recrystallization to create doping profiles on an atomic scale, and D.H. Lowndes (Oak Ridge National Laboratory) continued the theme of low temperature deposition, using pulsed excimer laser photolysis to grow amorphous thin films and superlattices with highly reproducible layer thicknesses.

A relatively new topic, the growth of semimagnetic semiconductors by photo-assisted molecular beam epitaxy, was addressed by R.N. Bicknell-Tassius (Universitat Wurzburg). Superlattices grown this way can be used to fabricate optically pumped laser structures which may be tuned in wavelength by changing the external magnetic field. F. Briones (Centro Nacional de Microelectronica, Madrid) described the uses of reflected electron diffraction oscillations in controlling atomic scale deposition by molecular beam epitaxy for the growth of short period superlattices. If one of the beams is interrupted in phase with the oscillations, good monolayer-by-monolayer growth results.

C. Trundle (Plessey, Caswell) described the current state of precursor design and synthesis for metal organic chemical vapor deposition of oxides, giving a detailed view of the complexities of organic molecule design. R.L. Jackson (IBM, San Jose) continued the description of the use of organic materials with an account of laser photochemical deposition from group 6 metal hexacarbonyls. The laser may be focused to give localized deposition, or unfocused to deposit over large areas; and variations in deposition rates can be seen perpendicular to the electric vector of incoming polarized light. Nayar and Boyd (University College London) showed directly patterned growth of silicon oxide at linewidths down to the micron level. Their resistless technique used mask projection with an excimer laser, and oxide was formed only when the photons impinged upon the surface.

The next series of presentations concentrated on etching processes. G.L. Loper (Aerospace Corp., Los Angeles) talked about the mechanisms occurring during the use of ultraviolet lasers for maskless etching, and R.R. Burke (CNET, Grenoble) spoke on the application of a microwave multipolar plasma for decoupling plasma excitations from surface interactions. R.B. Jackman (University of Oxford) described some of the fundamental processes occurring at semiconductor surfaces during processing, concentrating on the interaction between halogens and silicon or indium phosphide. These are studied by ramping the surface temperature, and mass analyzing the desorbed species.

After a brief session on laser-assisted doping, the final papers branched out to a wide range of advanced research topics with applications to microelectronics. M.E. Gross (AT&T Bell Laboratories, Murray Hill) showed patterned films of high critical temperature superconducting ceramics formed by ion beam irradiation, and J. Flicstein (CNET, Grenoble) described nucleation processes in photodeposition and the use of scavengers to eliminate carbon containing contaminants. L.R. Harriott (AT&T Bell Laboratories, Murray Hill) reviewed recent advances in the use of microfocussed ion beams for microelectronic applications, concluding that this area has excellent and varied potential.

I.N. Mihailescu (Central Institute of Physics, Bucharest) described the processes occurring when laser irradiation is incident on patterned surfaces, including the amplification of the electric field at the surface, causing periodic structures (ripples) to form, both transiently and permanently. In some cases, it was pointed out, this phenomenon may cause localized processing problems when using coherent radiation. R.A. Lawes (Rutherford Appleton Laboratory) reviewed the techniques available for submicron lithography, and those which will be most useful in the future. The use of electron beams was proposed as the emerging dominant technique for future submicron and sub-tenth-micron lithography. Resolving the practical difficulties of several other methods renders them less useful. It was usefully mentioned, however, that both ion and laser beams could also find realistic applications in areas not requiring the ultimate possible resolution.

Symposium C—Deep Implants: Fundamentals and Applications

Chairs: G.G. Bentini (CNR-Istituto LAMEL, Bologna), A. Golanski (CNET Grenoble), and S. Kalbitzer (MPI für Kernphysik, Heidelberg).

Attended by over 100 scientists from 10

https://doi.org/10.1557/S0883769400064228 Published online by Cambridge University Press

different countries, Symposium C addressed the research, technology and equipment-based aspects of its scientific topic. There were 10 invited papers, 23 oral presentations, and 13 posters presented during 6 sessions and 5 half-days. The symposium began with two elegant invited talks by A.N. Saxena (Rensselaer Polytechnic Institute, Troy) and J. Middelhoek (University of Twente) and focused on the applications of MeV implantation in Si VLSI technology. Although use of MeV implantations allows for considerable reduction of the total thermal budget in CMOS technology, the acceptance of high energy ion beams in industrial production has been slower than for the keV energy range. This may be due to problems related to masking, proximity effects, profile engineering and process-induced defects as well as to the accessibility of suitable equipment. Although high energy implantation offers new possibilities for making semiconductor structures, research efforts are needed before optimum device characteristics can be obtained.

The second session was devoted to the modeling of MeV energy ion interactions with solids. Two invited papers (J.P. Bierseck, Hahn-Meitner Institut, Berlin) and A. Mazzone (LAMEL, Bologna) and three contributed papers presented the state-of-the-art. Cases of multilayered structures and crystalline targets were extensively discussed.

The next half-day session focused on high energy implantation into semiconductors and particularly on the comparison between measured and calculated distribution moments. The subject was covered by 12 papers, including 2 invited contributions. A detailed analysis of the distribution moments and the annealing behavior for MeV B + was discussed in the invited paper presented by S. Oosterhoff (Philips Research Labs, Eindhoven). It appears that the extension of existing models (e.g. TRIM) to the MeV energy range allows a reasonably good prediction of the distribution moments. Less than 10% agreement was obtained for the higher order moments. However, discrepancies as high as 30% for the first moment were also observed. Clearly, further experimental data is needed on ranges and stragglings for the MeV beams.

High energy ion beams may also be used to study the thermodynamic and kinetic properties of amorphous Si. In his interesting invited paper J.M. Poate (AT&T Bell Laboratories, Murray Hill) reviewed recent results on ion-beam-induced diffusion and recrystallization as well as the novel segregation and trapping phenomena observed when the epitaxial crystallization is produced by 2.5 MeV Ar ion irradiation at temperatures in the 200-400°C range.

A special session was devoted to buried layer formation. The present status of the SIMOX technique was described by H. Baumgart (Philips Research Laboratories, Eindhoven). Although low dislocation density SIMOX material can presently be achieved using conventional implanters and high temperature annealing, several questions remain unanswered. For low energy oxygen implantation (150-200 keV) the quality of the SIMOX material in its final state (after high temperature annealing) strongly depends on the implantation conditions and consequently on the morphology of the material in the "as implanted" state. However, the relation between the implantation parameters and the properties of the material in the "as implanted" state has not been clearly established. The low dislocation density SIMOX materials may also be obtained using a single-step implantation in channeling direction or by diminishing the amount of energy deposited in elastic collisions using high (MeV) 0 + beams.

In the second invited paper in this session E.H. te Kaat (University of Dortmund) discussed the buried silicide formation using high energy (6 MeV) Ni implantation and an original technique particularly suitable characterizing of high energy implanted samples and based on the optical profiling on beveled samples. The author described an interesting interplay of defect generation, interaction and transformation, and the superimposed chemical effects.

The next session was devoted to high energy implantation into materials such as metals, polymers, and diamond. The basic chemical and physical effects of ion beam on polymers were extensively discussed by O. Puglisi (University of Catania, Italy). This new and interdisciplinary field clearly needs a better understanding and more quantitative description.

The final session was devoted to the status of the development of high energy implantation equipment. F. Saris (FOM-Institut, Amsterdam) presented an exhaustive review of the different kinds of machines. A need for high energy, high current accelerators has lead to the renaissance of the linac concept. The session offered an excellent opportunity to compare a variety of new machines, linacs or not, in terms of their concepts, technical characteristics and application fields.

Symposium D—Preparation and Properties of Metastable Alloys

Chairs: K. Samwer (University of Gottingen), M. von Allmen (CM S.A. Bienne), J. Bottiger (University of Aarhus), and B. Stritzker (IFF-KFA Jülich)

The intent of the symposium was to bring scientists of basic as well as applied research together to focus on the fundamental relationship of the formation of metastable alloys. The symposium was opened by A.R. Miedema's (Philips, Eindhoven) invited lecture on the thermodynamic aspects of the formation and stability of amorphous alloys, which give a hint toward a glass formation range. The discussion about fundamental questions concerning the crystal-to-glass transition was continued by W.L. Johnson (Caltech), who explained new ideas of a diffusionless transition of the crystalline alloys with respect to vitrification. His thermodynamic description was ideally completed by J.M. Dubois (Nancy), who gave a topological interpretation of the instability problem of metallic lattices. A.L. Greer (Cambridge) discussed entropy functions connected to undercooled liquids and how phenomena like "inverse melting" can occur.

More applied research activities were shown by L. Schultz (Siemens, Erlangen) in his invited talk about mechanical alloying. Besides the known results concerning amorphous alloys, he also focused on microcrystalline NdFeB-hard magnets and showed some aspects of hydrogen in amorphous powders. K.H.J. Buschow's (Philips, Eindhoven) invited presentation demonstrated the fundamental implications in producing strongly ferromagnetic metastable materials ranging from the long-known SmCo-magnet to the newest class of hard magnets.

A large number of contributed papers were devoted to the quasicrystalline materials. K. Urban (KFA Jülich) presented an invited talk on the structural relationship between quasicrystalline and amorphous alloys mainly observed by electron microscopy. A. Traverse (Orsay) detailed the ion mixing problem and presented new results. J. Hafner (Vienne) demonstrated the potential of theoretical calculation of the electronic and atomic structure of amorphous alloys and its interplay in certain examples.

For transition metal alloys J. Strom-Olsen (Montreal) described in detail irreversible and reversible relaxation processes in amorphous alloys measured by differential scanning calorimetry. More than 80 contributed in short talks or papers in the poster session prompted lively discussion about the aspects of the problems described. □

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Fax : 33.1. 47 08 32 39

ISA GmbH
Bretonischer Ring 13
8011 Grasbrunn 1
WEST GERMANY
Tél. : (49) 089-460 20 27
Télex : 524 433 ISA D
Fax : (49) 089-463 197

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Télex : 22912 BRAPAN J
Fax : (81.3) 354 86 08

ISA INC
6 Olsen Avenue
Edison, N.J. 08820
U.S.A.
Tél. : (1.201) 494 86 60
Télex : 844 516
Fax : (1.201) 494 87 96

EDT RESEARCH
14, Trading Estate Rd
London NW10 7LU
U.K.
Tél. : (44.1) 961 14 77
Télex : 8811955
Fax : (44.1) 961 92 10

ISA ITALIA
Via Martiri di Belfiore, 7
20090 OPERA (MILANO)
ITALY
Tél. : (39) 2 (52 44 250)
Télex : 43314430 SDINT I
Fax : (39) 2/524 98 76

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