Rare-earth Information Center NEWS

RARVS

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Institute for Physical Research and Technology
Iowa State University / Ames, Iowa 50011-3020 / U.S.A.

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Handbook Volume 19

Volume 19 of the *Handbook on the Physics and Chemistry of Rare Earths* "Lanthanides/Actinides: Physics II" is the third of a three-volume set of reviews that are devoted to the interrelationships, similarities, differences, and contrasts of the lanthanide and actinide series of elements. It comprises five chapters on the comparative physics and thermodynamics of lanthanide and actinide materials. The first two chapters are concerned with neutron scattering studies, while the next two are concerned with physical property studies involving electronic, thermal and magnetic behaviors. The final chapter covers the thermodynamic properties of metallic systems.

The first chapter "Neutron Inelastic Scattering from Actinides and Anomalous Lanthanides" compares the inelastic neutron scattering behaviors of the lanthanides and actinides. Magnetic excitation spectra of $R_xY_{1-x}Pd_3$ compounds are included, as well as energies of intermultiplet transitions in trivalent lanthanides doped into LaF_3. "Magnetic Correlations in Heavy Fermion Systems: Neutron Scattering from Single Crystals" includes metallic and semiconducting antiferromagnets and nearly insulating paramagnets. Chapter three "Intermediate Valence and Heavy Fermions" is probably the most extensive and comprehensive chapter in the entire three-volume series. It reviews the intermediate valence and heavy fermions in a wide variety of lanthanide and actinide compounds, ranging from metallic to insulating materials. Extensive information is presented on the transport, electronic, and lattice-related properties of lanthanide borides including spectroscopic information and band structure. Samarium monochalcogenides are also included in the description of semiconductors and the valence transition and the IV state. Thulium and ytterbium monochal-

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Honor Roll

20 Years

GE-Lighting

Hitachi Magnetics Corporation

10 Years

Arnold Engineering Company

The Chinese Society of Rare Earth

Magnequench

Mitsui & Co. (USA)

Sumitomo Special Metals America

United Technologies Research Center

Ugimag AG

This year we have two companies that we wish to honor for their 20 years of support. GE-Lighting and Hitachi Magnetics Corporation join the previous twenty two companies on our growing list of long time members.

Seven additional companies, Arnold Engineering Company, The Chinese Society of Rare Earth, Magnequench, Mitsui & Co. (USA), Sumitomo Special Metals America, United Technologies Research Center, and Ugimag AG join the growing number of companies who have been with us for at least ten years. We wish to express our appreciation to all nine companies for their long and continued support. ▲

Handbook Volume 19/*Continued from first column* ⇨

cogenides are covered as well. Empty *f*-levels and hybridization of CeO_2, Yb pnictides, TmS, and $Ce_3Bi_4Pt_3$ are examined as well.

Chapter four "High Pressure Studies-Physical Properties of Anomalous Ce, Yb and U Compounds" deals with the pressure dependence of interactions, specific heat, susceptibility, resistivity and Grüneisen analysis results of Ce, Yb and uranium compounds. Magnetostriction, sound velocities and anisotropic effects and superconductivity of these materials are also discussed. The final chapter is an extensive review of the thermodynamic properties of lanthanide and actinide metallic systems. For the researcher or student requiring a comprehensive array of phase diagrams and thermodynamic data of rare earth-intermetallics, including rare earth-actinide intermetallics, this chapter is prolific in both the amount of information presented, as well as the form in which it is presented, with many tables and graphs.

The 724-page Volume 19: "Lanthanides/Actinides: Physics-II" of the *Handbook on the Physics and Chemistry of Rare Earths* was published in 1994 and includes subject and author indices. The volume was edited by K.A. Gschneidner, Jr., L. Eyring, G.R. Choppin, and G.H. Lander and is available for $322.75 US (Dfl. 565.00). Customers in the USA and Canada should send their orders to: Elsevier Science Inc., P.O. Box 945, Madison Square Station, New York, NY 10159-0945 USA; Tel:212 633 3650; Fax:212 633 3680; elsewhere: Elsevier Science B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands; Tel:31 20 5803 642; Fax:31 20 5803 598. ▲

The radioisotopes Europium 152 and Europium 154 are used in the nondestructive testing of metal coatings.

Latin-American Workshop

The III Latin-American Workshop on Magnetism, Magnetic Materials and Their Applications will be held at Mérida, Venezuela. The workshop will have two goals: one will cover the fundamental aspects of magnetism; the second will deal with magnets and magnetic materials and their applications. Topics to be addressed in the conference include: fundamental concepts and intrinsic properties; molecular magnetism; magnetization processes in ferromagnets; amorphous and nanostructured magnetic materials; semimagnetic and magnetic semiconductors; thin magnetic films and multilayers, surfaces and fine particles; aspects in crystal growth and preparation of magnetic materials; magnetic properties of high Tc superconductors; and magnetooptic materials.

For more information contact: Prof. Vicente Sagredo, Faculty de Ciencias, Universidad de los Andes, Mérida 5101, Venezuela; Tel:58 74 401342; Fax:58 74 401286/401365; E-mail:"magnet@ciens.ula.ve". ▲

Conference Calendar

*** A NEWS STORY THIS ISSUE**

August '95

MAG '95
Alexandria, Virginia, USA
August 8-11, 1995
RIC News, XXX, [1] 2 (1995)

The Third International Conference on Rare Earths Development & Application
Baotou, Inner Mongolia, China
August 21-25, 1995
RIC News, XXIX, [1] 3 (1994)

The Third International Symposium on Physics of Magnetic Materials
Seoul, Korea
August 21-25, 1995
RIC News, XXX, [1] 2 (1995)

September '95

European Magnetic Materials and Applications Conference (EMMA 95)
Wein, Austria
September 4-8, 1995
RIC News, XXIX, [1] 3 (1994)

Rare Earth Metals:Raw Material Processing, Technology of Compounds and Related Products
Krasnoyarsk, Russia
September 11-15, 1995
*This issue

International Conference on Strongly Correlated Electron Systems (SCES'95)
Goa, India
September 27-30, 1995
RIC News, XXIX, [3] 2 (1994)

November '95

III Latin-American Workshop on Magnetism, Magnetic Materials and their Applications
Mérida, Venezuela
November 20-24, 1995
*This issue

September '96

Fourteenth International Workshop on Rare-Earth Magnets and Their Applications and Ninth International Symposium on Magnetic Anisotropy and Coercivity in Rare-Earth Transition Metal Alloys
São Paulo, SP, Brazil
September 1-5, 1996
RIC News, XXX, [1] 2 (1995)

21st RERC

The 21st Rare Earth Research Conference (RERC) will be held July 7-12, 1996 at the Duluth Entertainment and Convention Center in Duluth, Minnesota, and will be hosted by the University of Minnesota. Duluth is a major seaport and is located in Northwestern Minnesota at the western tip of Lake Superior, the gateway to both the Boundary Waters Canoe Area that borders Quetico Provincial Park in Canada and to the Iron Range of Minnesota.

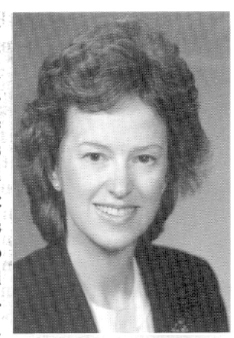
The Program Chair for the meeting is Lynda Soderholm of Argonne National Laboratory and the General Chair is Larry Thompson of the University of Minnesota. The First Circular for the 21st RERC will be mailed early this summer. Because this is a major U.S. vacation area, the organizers encourage participants to make their plans to attend the conference as soon as possible. For more information, contact Dr. Larry C. Thompson, Department of Chemistry, University of Minnesota, Duluth, MN 55812 USA; Tel:218 726 8716; e-mail:"lthompso@d.umn.edu" ▲

Krasnoyarsk '95

The International Conference on Rare Earth Metals: Raw Material Processing, Technology of Compounds and Related Products, Krasnoyarsk '95, will be held September 11-15, 1995 in Krasnoyarsk, Russia. The aim of the conference is to discuss the state of research and perspectives of the rare earth and niobium metals, alloys and compounds. The conference will focus on four areas: 1) ore deposits, geology and mineralogy; 2) ore enrichment and concentrate production; 3) chemico-metallurgical technology; and 4) chemistry of rare earth metals and niobium compounds and their products.

For more information, contact the organizing committee: Institute of Chemistry and Chemico-Metallurgical Processes SB RAS, K. Marx Str., 42, Krasnoyarsk, 660049, Russia; Tel:391 2 27 38 31; Fax:391 2 23 86 58; E-mail:"root@prksc.krasnoyarsk.su". ▲

National Academy of Engineering


Dr. Kathleen C. Taylor

Dr. Kathleen C. Taylor, Head of the Physical Chemistry Department at the General Motors Research and Development Center, has been elected to the National Academy of Engineering. Dr. Taylor has conducted numerous studies on the uses of rare earths as catalysts. She has been instrumental in their use as three-way catalytic converters in the automobile industry. ▲

13th International Workshop and 8th International Symposium

by

I. R. Harris

The University of Birmingham was the venue for the *The Thirteenth International Workshop on Rare Earth Magnets and Their Applications* and *Eighth International Symposium on Magnetic Anisotropy and Coercivity in Rare Earth-Transition Metal Alloys.* It was attended by 230 delegates from 25 countries. The Workshops began under the chairmanship of Professor Karl Strnat in 1974. Sadly, Karl is no longer with us. I was particularly pleased that my co-chairman, Alden Ray, gave the first Karl Strnat Memorial Lecture. A long-time scientific colleague and friend, Al provided a vital link with past workshops. The lecture was entitled, "Department of Defence and NASA Applications of Rare-Earth Magnets". Another friend and colleague of Karl's, Marlin Walmer, attended the workshop and wrote a tribute to Karl for the proceedings.

It was appropriate that the Workshop was opened by Prof. R. E. Smallman, who is the president of the Federation of European Materials Society. Much of the work on rare earth magnets in Western Europe, including the UK, is part of Concerted European Action on Magnets, which is funded by the European Commission in Brussels. Activities within the UK are also supported by the Magnetism and Magnetic Materials Initiative funded by the Science and Engineering Council.

At the Workshop and Symposium, 150 papers and posters were presented, 20% on applications, 17% on Sm_2Fe_{17} interstitials, and the remainder largely on materials and processing aspects of Nd-Fe-B. The program was organized to promote the maximum exchange of views and ideas. Particular effort was made to ensure that applications were well covered, in order to reflect their pivotal role in "wealth creation", and hence in the future of the subject.

The proceedings were, as usual, available to the delegates upon arrival. An additional 100 copies were printed and these are available for sale to any interested parties. The Workshop and Symposium proceedings consist of 926 and 479 pages, respectively. It is impossible to encapsulate accurately the technical content of such a large and comprehensive meeting. It is only possible, therefore, to make some general comments and to urge the reader to have a look at the

Continued in next column ⇨

proceedings. For details on acquiring the proceedings and a full review, see *RIC News*, XXX, [1] 4 (1995).

As stated earlier, there was a strong emphasis on the applications and the need to analyse the economics of the whole system. An interesting new development was the use of permanent magnet devices to produce variable flux sources. Applications of magnetostrictive devices based on Tb-Dy-Fe were also described. The proceeding sessions dealt with melt spun, HDDR sintered, and hot-worked material and the economics of their manufacture. It is apparent that the scale of operation had a marked bearing on the cost. There were lively discussions on the cost and availability of the rare earth metals and alloys, and it was interesting to see the impact of other technologies. Significant advances have been made in the production of high (BH)max magnets based on Nd-Fe-B and the new technique of rubber isostatic pressing was described. Advances were reported in the processing and characterization of $Sm_2Fe_{17}N_3$-type magnets, but the routine production of high (BH)max bonded magnets based on this material has not yet been achieved.

An exciting new area considered was that dealing with exchange coupled magnets. In these magnets there is an excess of α-Fe (up to 40 volume %) which couples with the hard magnetic phase, either $Nd_2Fe_{14}B$ or $Sm_2Fe_{17}N_3$. The phases have to be on a nanometer scale and the required microstructures are produced either by melt spinning or by mechanical alloying.

There were a number of papers in the Symposium dealing with the computer simulation of coercivity behavior in rare earth permanent magnets. Clearly, these models are becoming sophisticated, and convincing correspondence is being obtained between theoretical and experimental data. The modeling of particular microstructures could lead to new promising permanent magnet materials.

In summary, the whole spectrum of activities in rare earth permanent magnets was considered in the Workshop and Symposium. The international community was extremely well represented and it was very satisfying to see such a strong contribution from the United Kingdom. ▲

LETTER TO THE EDITOR

3 April 1995

Dear Editor:

I read with interest the comprehensive review of the Workshop and Symposium Proceedings held in Birmingham between 11-15 September last year. However, I am not sure that the reviewer appreciated the severe time constraints under which these proceedings were produced and I would like to explain these to your readers.

We received the camera-ready version of the papers up to two months before the meeting. Some of the papers had to scanned and revised significantly before publication. They then had to be sent to the publishers for the production of two hard backed volumes which were then given to the delegates on arrival at the Workshop. The contents of the proceedings were in the same order as the conference programme so that the delegates could follow the talks with the Proceedings in front of them. This is why it was not simply a question of publishing the proceeding on the basis of subject matter alone. I am pleased to report that the delegates were very happy with these arrangements which followed the traditional Workshops initiated by Karl Strnat in 1974.

Yours sincerely,

Professor I.R. Harris
Faculty of Engineering
School of Metallurgy and Materials
Edgbaston, Birmingham
B15 2TT UK

REVIEWER'S RESPONSE

The production and publication of a conference proceeding is indeed a monumental task. The above insight to this complex process, provided by Professor Harris, is deeply appreciated. As with all of our comprehensive reviews, we attempt to provide as much unbiased information about recent publications as possible to our readers. The Proceedings is a top-rate publication and the full-length review appeared on page 4 of the March 1, 1995 issue of the RIC News.

Sincerely yours,

E. Joel Calhoun
Staff Writer RIC ▲

Chemistry Award

Dr. Velmer A. Fassel, Iowa State University, has received the Pittsburgh Analytical Chemistry Award from the Society for Analytical Chemists of Pittsburgh. Dr. Fassel has conducted intensive studies on various optical, spectroscopic, and other non-spectroscopic analytical techniques for determining purity levels and amounts of impurities occurring in rare earth elements, compounds and alloys. His most recent work dealt with the processes and procedures of analysis by inductively coupled plasma. ▲

Dr. Velmer A. Fassel

Baotou 94' ISREST Proceedings

The First Baotou International Meeting on Rare Earth Science, Technology, Trade and Cooperation, 94' Baotou International Symposium on Rare Earth Science & Technology (94' ISREST) was held in Baotou, China, August 28-31, 1994 {*RIC News;* **XXIX**, [4] 1 (1994)}. Conference attendees were treated to a spectacle unparalleled in the history of rare earths as dance teams, motorized floats and other festivities illustrated the importance of the worldwide rare earth industry to this part of China. They were also presented copies of the conference proceedings which includes speeches by 30 invited speakers who are experts in their related fields.

The topics of the papers included in the conference demonstrated the current diversity of rare earths world wide. The papers cover: applications of rare earths for the twenty first century and beyond, uses of the rare earths in Japan, markets and production of Nd-B-Fe magnets, rare earth extraction and separation, recent developments in the application and production of magnetostrictive alloys and Terfenol-D, and others.

The 276-page soft cover proceedings contain neither author nor subject indices and is printed on newsprint-quality paper. Proceedings of the 94' Baotou ISREST was published in 1994 and is available for $280.00 US from Yan Junxi, China Rare Earth Information Centre, P.O. Box 131, Baotou, Inner Mongolia 014010, China; Tel:(0472)554411; Fax:(0472)552008. Price includes shipping and handling. ▲

Rare Elements in Glasses

Modern glass material is being used in many high-tech applications today. The rapid expansion of glasses as the materials of choice for optical, electronic, and other uses has led to a major expansion of the use of rare earth elements. Rare earths have been known for some time to impart desirable properties to certain glass materials and now new applications are finding economic viability in the marketplace. Rare earths are responsible for the unique magnetic and optical properties of many glasses, as well as structural improvements these glasses possess.

Rare Elements in Glasses appears as *Key Engineering Materials*, Volumes 94-95 (1994) under a single cover and, as the title implies, provides recent research results that have been conducted on rare earths, including rare elements, in glass materials. The book includes sixteen chapters that have been written by twelve different authors on the subject. Over half of the information deals with rare earths in glasses. Chapters that deal specifically with rare earths include: Rare Earths as Major Components in Oxide Glasses; Rare Earths as Modifiers in Oxide Glasses; Structure and Properties of Rare Earth Gallium Sulfide Glasses; Magnetic Properties of Glasses Containing Rare Earths; The Faraday Effect in Glasses Containing Rare Earths; Neutron Scattering Studies of Glasses Containing Rare Earths; Rare Earths in Glasses for Laser Applications; Rare earth Aluminosilicate Glasses for *in Vivo* Radiation Delivery; Infrared and Raman Spectra of Glasses Containing Rare Earth Ions; and Scandium, Yttrium and Indium in Oxide Glasses.

The book describes interesting new uses of rare earth glasses in medicine. These materials can be used in the treatment of malignant cancer tumors by delivering high radiation doses to the affected area with little collateral damage to adjacent tissues. Some other uses include non-linear optics, Faraday rotators, magnetism, and very high temperature sealing glass.

The 428-page soft cover book, *Rare Elements in Glasses*, was edited by James E. Shelby and was published in 1994. The book contains a subject index, and a list of references at the end of each chapter. The authors were considerate to those of us who find graphical display useful as the book is replete with tables, diagrams, figures, and micrographs. For more information, or to

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Permanent Magnet Market Analysis

A recent article by Thomas Abraham appeared in *JOM*, 47 [1], 16-18 (1995), "Magnets and Magnetic Materials: A Technical Economic Analysis" that reaffirms the exciting field of permanent magnets. The author points out that there is indeed a bright future for rare earth permanent magnets and magnetic materials in domestic and international markets. The article provides a technical economic overview of permanent magnets (i.e., hard ferrites, bonded, samarium-cobalt, Nd-Fe-B, and Alnico) and soft magnetic materials (e.g., soft ferrites, iron-silicon electrical steels, ferromagnetic amorphous alloys, and nickel-iron alloys).

Nd-Fe-B permanent magnets are one of the permanent magnet industry's major players and will continue to have an impact on the industry in the foreseeable future. Nd-Fe-B magnets can be produced by two different methods: conventional powder metallurgy followed by sintering, and rapid solidification followed by a consolidation technique. Rare earth magnets have many applications, such as electromechanical devices, mechanical force and torque devices, electron- and ion-beam control, and medical applications.

The author reports that although there will be no major market changes by 1997, the market shares of ceramic and metallic magnets will decrease slightly compared to bonded magnets. The 1992 market has been estimated to be $455 million US and is expected to reach $763 million US by 1997, reflecting an overall 10.9% annual growth. Electromechanical devices demand the lion's share of the market for permanent magnet materials. Market growth will be rapid with applications including large motors using ceramic magnets and military applications that utilize samarium cobalt magnets. Nd-Fe-B magnets will continue to be primarily used in voice coil motors in computer disk drives.

The good news for rare earth permanent magnet manufacturers, as well as their raw material suppliers, is that the annual 17.5% growth rate for Nd-Fe-B magnets is expected to continue through 1997. ▲

Rare Elements in Glasses*/Continued* ➪

order your copy, send SFr. 220.00 ($146.00 US) to Trans Tech Publications Ltd., Trottenstr. 20/CH-8037, Zürich, Switzerland; Fax:41 12 72 10 92. ▲

Supertrons

A new and novel application for bulk high T_c superconductors, lenses for electron beams, coined "Supertrons" was proposed and reviewed by H. Matsuzawa in *J. Appl. Phys.*, 74, [12], R111-31 (1994). The paper also presents information on other novel superconducting devices, such as current leads, magnets, and bearings.

The principle of an electron beam lens is simple, and utilizes a superconducting tube to confine the electron beam. When one injects an electron beam into a narrow superconducting tube, the tube confines the beam to the bore of the tube and focuses the beam into a thinner one.

The intense electron beams (340 keV, 1 kA, 10 ns) were focused in the Supertrons, which were made of both powder-pressed yttrium-bismuth-thallium, and melt-processed yttrium-based superconductors. The experiments showed that the powder-pressed lenses work best for short pulsed, low repetition-rate electron beams, and that melt-pressed lenses may be used for continuous or slowly time-varying electron beams. The operation of the Supertrons and their ability to focus electron beams are dependent upon temperature, but the best results were obtained in experiments conducted with the lenses cooled to 65K. The author also describes the design, including cross-sectional views of the lenses, as well as a powder-pressed bulk superconductor wiggler.

To illustrate the potential of Supertrons, Matsuzawa describes two applications: a wiggler for free-electron lasers and an electron-beam guide for induction linear accelerators. The possibility of an active lens exists, whereas the electron beam is not held in place by its own self-generated magnetic field, but by the shape and size of the Supertron. This could increase the magnetic field of the beam path to perhaps ten to one hundred gauss. Electron beams were focused in an atmosphere of 0.1 Torr, which generated plasma along the path of the electron beam. This proves that focusing electron beams confines a plasma. However, further work needs to be conducted to prove that Supertrons show promise in confining high temperature plasmas. ▲

Gd_2O_3 is used as a special phosphor activator, and also as a dopant in dielectric ceramics.

Record Superconductor

Researchers at Los Alamos National Laboratory, Los Alamos, New Mexico, have recently developed a flexible superconducting tape that has the ability to conduct 100 times more electrical current than other similar superconducting tapes {*C&EN*, 73, [17], 6-7 (1995)}. The flexible tape is able to carry more than 1.3 million Amp cm² at liquid nitrogen temperature (77 K).

Previous tapes were constructed using a "thin film" technique, where the $YBa_2Cu_3O_7$ (YBCO) is deposited on a single crystal substrate to a thickness of about 0.5 µm. Thin film superconductors have achieved 10 million Amp cm², however, they are not suitable for many practical applications. The new superconductor tape is 1 to 2 µm thick and is deposited on a nickel alloy tape that is inexpensive and can be used in a myriad of commercial and industrial applications. The Los Alamos researchers used a novel technique to deposit the YBCO on the nickel alloy by first depositing cubic zirconia (ZrO_2) on the metal tape. This ZrO_2 buffer layer is necessary to provide a suitably aligned surface on which to deposit subsequently-deposited YBCO crystals. Aligned crystals are a requirement to carrying large currents. If YBCO is deposited directly on the metallic substrate, then the YBCO crystals would align themselves randomly, greatly reducing the superconducting properties of the material.

The zirconia layer is aligned on the metal tape by using two argon ion beams. One beam removes ZrO_2 particles from a target block and deposits them onto the nickel alloy. Meanwhile, the other beam is focused on the metal at a specific angle which orients the ZrO_2 crystal grains properly as they grow. The YBCO is then deposited on top of the ZrO_2 which then achieve a similar alignment.

The resulting tape is flexible enough to be wound into coils, so it could be used in superconducting motors, magnetic resonance imaging devices, electrical transmission lines, and other superconducting applications. In addition, since the tape can handle so much current, small supermagnets could be made for miniaturized, highly-efficient electrical devices. So far, the team has produced tapes 5 cm in length and 1 cm wide, but is hoping to set up a process where long, continuous lengths can be manufactured. ▲

Storing Holographic Images

Researchers at Nippon Telegraph and Telephone Corporation (NTT) have developed a crystal that can store holographic images at ultra-high speeds. The material is an Eu-doped yttrium silicate which is produced by adding Eu ions to a yttrium silicate crystal {*Jpn. New Mater. Rep.*, 9, [3], 10-11 (1994)}. The material has a high optical response speed which makes it possible to record multiple data points at a single physical location on the crystal by continually altering the frequency of the laser which writes the image. With this type of system, it is theoretically possible to record an optical image, or a single frame, every one-billionth (1×10^{-9}) of a second. This would allow the visual recording of objects in motion.

In an experiment that used a precision dye laser as a light source, NTT researchers succeeded in recording and playing back a holographic motion picture for about 20 seconds. The recording process utilizes a photochemical hole burning technique that dopes an organic material with a dye to take advantage of the material's optical absorption characteristics.

Primary uses of this system would be to send visual signals that would exceed the capability of current optical recording systems that only record one bit of data at a time on a disk with a laser beam. With a playback rate of 30 frames per second, a single crystal of Eu-doped yttrium silicate could store 30 hours of color video images, or 100 hours of monochrome programming. In addition, with its nanosecond recording speed, the crystal is 10,000 times faster than existing high speed cameras, which require mechanical shutters to expose individual frames. The downside of this promising technology is that the crystal records images at -266 °C, but the images are lost if the temperature is allowed to rise above -266 °C. Perhaps further research will yield a material with a much greater operating range. ▲

We Apologize!

RIC apologizes to our readers in Europe, Middle East and southwest Asia for the delay in delivery of the March 1, 1995 issue of the *RIC News*. The problem has been corrected and we will endeavor to ensure that our readers receive future issues in a timely manner. ▲

GM to Sell Magnequench

The U.S.-based rare earth permanent magnet producer Magnequench will be sold as a culmination of General Motor Corporation's three-year-old plan to restructure its parts and components business. The Magnequench operation will be sold to San Huan Group Inc. of Beijing, a group of Chinese investors {*The Wall Street Journal*, A11, March 22, 1995}. San Huan Group Inc. has been trying to purchase the plant for the past two years.

The Group will reportedly purchase Magnequench for $56 million cash, a $14 million note and a guarantee that San Huan will honor GM's 1993 national contract with the United Auto Workers union. The terms of the sale have yet to be approved by GM's board.

Magnequench posted sales of $75 million in 1994 and is the last of the 14 parts businesses in GM's Automotive Components Group Worldwide (ACGW) that had been slated for liquidation. Magnequench was opened by GM in 1986 for the manufacture and marketing of rare earth permanent magnet motors and other products. The plant is located in Anderson, Indiana and employs about 400 workers. ▲

Rhône-Poulenc Reorganizes

French chemical giant Rhône-Poulenc has merged its organic and inorganic intermediates unit with its specialty chemicals operation to form a worldwide chemical sector. The consolidation has made the company more unified and less complex, enhancing customer service. Customers will now be served by one business entity and one person.

The chemical sector is divided into "Enterprises" which are structured around markets, product lines and technologies. These are organized to facilitate serving customers in various geographic zones. These geographical zones are Asia-Pacific, Europe, North America and South America. The number of Enterprises in each geographical zone varies depending on the markets served by the company. There are 11 Enterprises in Europe and 13 in North America. The Rare Earths and Gallium Enterprise is headed by J.D. Matthews, who is also in charge of the European zone. The North American chemical zone is headquartered in Cranbury, NJ and has 5,000 employees

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Rhône-Poulenc*/Continued* ➪

and is managed by J. Forti and E. Haaijer.

The Rare Earths and Gallium Enterprise will offer products and services dedicated to automotive catalysts, polymerization & petroleum catalysts, colored pigments, electronics (phosphors and ceramics), glass polishing powder & additives, and sintered & bonded magnet alloys and rechargeable battery alloys. ▲

MEGON Back in Production

After a three-year hiatus from the rare earth production business, Hydro Megon a.s. (formerly MEGON, Metal Extractor Group of Norway) is resuming the operation of its rare earth separation and processing facilities for domestic use and export. Norsk Hydro will start production of rare earth concentrate in Glomfjord, Norway in 1995. The concentrate will be extracted from apatite, which is the feedstock material for the company's fertilizer production. The company will employ a new cost-efficient process that produces the concentrate in the form of a nitrate solution. The plant will produce 1,300 tons REO per year, of which most has already been sold on a long-term contract.

Hydro Megon a.s. will be responsible for all rare earth activities in Norsk Hydro. Andreas Rygg, a director of Norsk Hydro's Industrial Chemicals Division, has been appointed managing director. Gunnar Norum will continue in the company as marketing director and Morten Røsæg will act as technical director. Extratec a.s. (another fully owned Hydro company) specializes in the extraction and separation of rare earths and is the processing expert in the Hydro Group. More information can be obtained by contacting: Hydro Megon a.s., Drammensveien 40, P.O. Box 2877 Solli, N-0230 Oslo, Norway; Tel: 47 22 432380; Fax: 47 22 432393. ▲

Scandium

Charlotte Square Capital Ventures is offering 162 Kg of scandium metal and 107 Kg of scandium oxide at a discount. An independent laboratory analysis and price quote is available upon request. For more information contact: Bruce G. Rossiter, Charlotte Square Capital Ventures, 1300 Bristol Street North, Suite 200, Newport Beach, CA 92660; Tel: 714-252-0400; Fax: 714-252-1405. ▲

Coolidge Fellowship Award

Dr. Mark. G. Benz, a metallurgist at General Electric's Research & Development Center, Schenectady, New York, has been presented with the Center's highest honor, the Coolidge Fellowship Award. The Coolidge Fellowship Award is presented once a year to recognize continued outstanding contributions to science or engineering.

Dr. Mark G. Benz

Dr. Benz was honored for his contributions to products manufactured by a wide variety of GE businesses. Products that he has contributed to include superconducting magnetic resonance imaging systems manufactured by GE Medical Imaging Systems, jet engines by GE Aircraft Engines, and steam and gas turbines by GE Industrial and Power Systems. Rare earthers will remember that Dr. Benz was also a co-inventor of GE's process for making the world's strongest permanent magnets. These Sm-Co magnets were two to three times more powerful than any previously known. The fabrication technology pioneered by Dr. Benz, along with Dr. Martin and Dr. Das for the manufacture of RT_5 and R_2T_{17} permanent magnets is still used (where R=rare earth, T=transition metal) {*Appl. Phys. Lett.* **17**, 176-7 (1970)}. He has published more than 50 technical papers and holds 41 patents. ▲

Molycorp's Sales Office

Molycorp's Sales Office, previously located in White Plains, New York, has moved. Their new address is: Molycorp, Inc., A Unocal Company, Executive 46 Office Center, 710 Route 46 East, Fairfield, NJ 07004 USA; Tel: 201 808 8880; Fax: 201 808 9060. However, their remittance address remains: Union Oil Company of California, Molycorp, Inc., P.O. Box 651581, Charlotte, NC 28265-1581. ▲

Handbook of Magnetic Materials Volume 8

As with the first seven volumes of the *Handbook of Magnetic Materials*, **Volume 8** continues the legacy of serving as both a ***textbook*** for those wishing to be introduced to a given topic in the field of magnetism, as well as an authoritative ***reference*** for scientists and research professionals that are active in magnetism research. This latest volume of the growing *Magnetic Materials* series will be a welcome addition to the library of the serious researcher.

The book is made up of topical review articles comprising five chapters, of which three contain information on rare earth magnets, authored by leading figures in their respective fields. The five chapters are entitled: Magnetism in Artificial Metallic Superlattices of Rare earth Metals; Thermal Expansion Anomalies and Spontaneous Magnetostriction in Rare-Earth Intermetallics with Cobalt and Iron; Progress in Spinel Ferrite Research; Anisotropy in Iron-Based Soft Magnetic Materials; and Magnetic Properties of Rare Earth-Cu_2 Compounds.

The first chapter contains a detailed account of achievements on rare earth based artificial multilayered structures. Included are results of neutron scattering and artificial metallic superlattices, magnetic scattering, structure, and coherence of various binary rare earth compounds. Magnetoelasticity in rare earth superlattices and films and the suppression of ferromagnetism, in-

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Hooked on Photophonics

Communications companies are able to transmit voice data at the speed of light by using fiber optic telephone cables. These cables allow light to be transmitted with relative ease in a much smaller space than older metal conductors by converting sound into transmitted light pulses. However, in order to hear the coded light pulses, they must be converted again to sound by transforming the light into slower electrical signals. These electrical signals are converted into mechanical energy that we hear as sound. It is this final step in converting light to sound via a mechanical device that "slows down" information exchange.

K. Uchino, a materials scientist at Penn-

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Handbook/*Continued* ➪

cluding magnetoelastic energies in Dy superlattices and films, is also included.

The large body of experimental results that have become available for the many intermetallic compounds in which rare earths are combined with *3d* transition metals is described in the second chapter. These also include spontaneous magnetostriction in RFe_2 and RCo_2 Laves phases, as well as R-Co and R-Fe intermetallics (R=rare earth).

Chapter five brings us closer to the understanding of the magnetic properties of rare earth-Cu_2 compounds. Following a brief survey of rare earth and rare earth-Cu and RCu_2 compounds, the chapter provides information on the theoretical aspects of these materials, such as crystal field and exchange interactions. However, most of the chapter is devoted to magnetic properties of RCu_2 compounds, including $CeCu_2$, $PrCu_2$, $NdCu_2$, $SmCu_2$, $GdCu_2$, $TbCu_2$, $DyCu_2$, $HoCu_2$, $ErCu_2$, and $TmCu_2$.

The third and fourth chapters do not contain information on rare earth materials, but still may be of interest to many of our readers: these deal with spinel ferrites, and laminated amorphous and electrical steels, respectively.

The 530-page *Handbook of Magnetic Materials*, **Volume 8**, was published in 1995 and is edited by K.H.J. Buschow. The hardbound book is available for $217.75 US by contacting the publishers at Elsevier Science B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands; Fax:31 20 4853598; or in the USA/Canada from: Elsevier Science, Inc., P.O. Box 945, Madison Square Station, New York, NY 10159-0945 USA; Fax:212 633 3680. ▲

P.I.D.C.

Due to recent growth in the rare earth business, Pacific Industrial Development Corporation (P.I.D.C.) has moved to a new location in order to better serve their customers. Inquiries regarding their rare earth production capacity and the rare earth products and services they supply should be directed to Mr. Wei Wu at the company's new address: P.I.D.C., 4952 Ravine Ct., Ann Arbor, MI 48105; Tel:313 930 9292; Fax:313 930 9293. ▲

Hooked on Photophonics/*Continued* ➪

sylvania State University, has made preliminary steps in developing a material that converts light *directly* into sound without using mechanical devices {*Science*, **266**, pp. 1807-8 (1994)}. This "photophone" utilizes a new class of "photostrictive" materials that convert light directly to mechanical movement, creating sound. The material is PLZT (Lead Lanthanum Zirconium Titanate) and is well known for its ability to convert light into electricity, the photovoltaic effect, and the piezoelectric effect which converts electrical energy into motion, and vice versa.

Uchino added trace amounts of tungsten oxide to the PLZT ceramic material which may allow the transformation of light energy into motion. The resulting material, when subject to a brief electric field, is slightly asymmetrical, which may account for the materials' "photophonic" ability. Although the exact mechanism for this "photostriction" is somewhat problematic, it is believed that the material converts light to electricity when incoming photons excite electrons orbiting the lanthanum and tungsten atoms. The resulting energized electrons, each with a negative charge, begin to move through the crystal lattice. And since the crystal has an asymmetrical structure, these electrons accumulate at one end of the crystal, creating an electric potential. It is this resulting voltage that forces the crystal to change shape. This effect can also be reversed, allowing the crystal to expand and contract, producing sound waves. Although the resulting sound waves are too faint to be heard without amplification, it is still a step forward in the development of a more efficient and effective method of information exchange.

The development of this new material promises other applications, such as controlling tiny robots remotely by using light, as well as making resonators vibrate faster. ▲

Phase Separations

A 33-page review article by E.L. Nagaev entitled "Phase Separation in Degenerate Magnetic Semiconductors and High-Temperature Superconductors" appeared in *Phys. Stat. Sol.* (b) **186**, 9-42 (1994). The paper not only reviews the published literature concerning the theoretical aspects of phase separation in magnetic semiconductors and superconductors, but contains experimental results of electronic phase transitions in selected rare earth chalcogenides and La_2CuO_x superconductors.

Following a brief introduction, the paper contains four sections: Model and Heterophase Self-Trapping, Electronic Phase Separation in Degenerate Magnetic Semiconductors, Impurity Phase Separation, and Phase Separation in High-Temperature Superconductors.

Experimental data confirm antiferromagnetic-ferromagnetic phase separation in EuSe and EuTe. This is important because it not only verifies theoretical calculations, but may be applicable to other rare earth semiconductors. Although neutron scattering would be an ideal tool to study this phenomenon, it cannot be used for Eu because it is a strong neutron absorber. However, magnetic, optical and electric measurements support theoretical calculations.

The impurity phase separation in rare earth degenerate semiconductors is also supported by work conducted on $LaMnO_3$. Results of neutron scattering experiments at low temperatures compared to higher temperatures indicate some phase separation. High-temperature superconductors may also hold some phase separation in $La_2CuO_{4+\delta}$ due to its temperature-dependent resistivity. Other rare earth superconductors that exhibit phase separation are $YBa_2Cu_3O_{7-\delta}$ and $ErBa_2Cu_3O_x$.

The review is recommended reading for those working in this field or are planning research in this or related areas. The author has supplied ample background information as the paper includes 135 references. ▲

Ceramic YAG Laser

Researchers from Nagoaka Technical University and Osaka Institute of Technology have succeeded in operating a yttrium-aluminum-garnet (YAG) laser which uses a sintered body as the lasing element {*Jpn. New Mater. Rep.* 9, [5] 7 (1994)}. Using a ceramic lasing element has several advantages over conventional elements which are

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***Ceramic YAG Laser**/Continued* ➪

produced by crystal growth technology. Advantages include a large rise in production yield, low cost, and the ease at which the output power of the laser can be boosted.

YAG ceramic lasing elements, however, must be made so that their transparency is increased. The researchers accomplished this by improving the technique for mixing the raw material powders. The raw material is a mixture of aluminum oxide, yttrium oxide, and neodymium oxide powders. The mixture is then pressed using a cold isostatic press (CIP) process at about 400 atmospheres. This process produces a cylinder which is 10 mm in length and 200 mm in diameter. The cylinder is then heat hardened in a vacuum at about 1750°C. Both ends of the cylinder are then polished. The ceramic laser element produces 1.06μm infrared laser light. ▲

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Since the March issue of the RIC News went to press, RIC has received support from 5 new family members, and renewed support from 22 other organizations. The supporters from the fourth quarter of fiscal year 1995 who wish to be listed, grouped according to their appropriate category, and with the number of years that they have contributed to the center in parenthesis, are listed below.

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