RARE-EARTH INFORMATION CENTER NEWS

INSTITUTE FOR PHYSICAL RESEARCH AND TECHNOLOGY
IOWA STATE UNIVERSITY / AMES, IOWA

Volume XXIV | September 1, 1989 | No. 3

Editor's Trip Report
Japan—1989

The editor visited Japan to participate in the Rare Metals Forum, a one-day meeting sponsored by the Society for Non-Traditional Technology (SNTT) in Tokyo, Japan. The papers included work on rare earth materials and covered solvent extraction, metallothermic reduction of the fluorides, solid state electrolysis, laser beam separation of rare earth metals, ICP analysis, influence of impurities on the $YBa_2Cu_3O_{7-x}$ superconductors, and low temperature behavior of rare earth intermetallic compounds.

Following the New Metals Forum symposium, visits were arranged by SNTT to Nippon Steel in Kawasaki, the National Chemical Laboratory and National Research Institute of Metal (NRIM) facilities at Tsukuba, and the NRIM facilities at Meguro.

Nippon Steel Corporation

I spent most of a day visiting the R & D Laboratories-I of Nippon Steel Corp. at Kawasaki. There are 519 persons working at the Laboratory, of which 481 are researchers and technicians. The Laboratory is subdivided into seven groups: (1) Chemical Research, (2) Materials Research—I (ceramics), (3) Materials Research—II (advanced metallic materials), (4) Materials Research—III (electronic materials), (5) Materials Research—IV (magnetic materials), (6) Materials Characterization Research, and (7) Future and Frontier Field Research. My host was Mr. M. Saeki who is the General Manager of the Materials Characterization Research Group. Some of the work that is being carried on includes: hydrogen storage alloys, such as Fe-Ti containing 10 wt.% mischmetal (MM);

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25 Year Challenge

The Rare-earth Information Center and *RIC News* will start its 25th year in 1990. We would like to commemorate this anniversary by publishing some articles written by our readers. These stories could be concerned with: what rare earths have meant to you or your company or how you got started in the field; the impact of RIC or *RIC News* (or *RIC Insight*) had on you, your company, or a product; or a rare earth related story about someone who inspired you or some humorous incident. *RIC News*, plans to publish as many as we can in 1990 and if enough response is received we plan to publish them in a booklet, similar to the one we published to commemorate the 200th anniversary of the discovery of the rare earths.

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rare earth permanent magnets, R-Fe-B (R is primarily Nd, but also includes Pr) and Sm-Co; and high temperature superconductors.

Tsukuba Science Center

In Tsukuba, I visited Dr. M. Kubota of the National Chemical Laboratory for Industry. Dr. Kubota is responsible for supplying standard solutions for inorganic analyses in Japan and for developing new techniques for determining trace elements, including rare earth materials.

The next visit was with Drs. T. Katayama and T. Okuda of the MITI Electrotechnical Laboratory. We discussed the use of rare earth-transition metal amorphous alloys for magneto-optical erasable, direct read after write (EDRAW) storage disks. The nominal composition of the amorphous alloys is $Tb_{25}(Fe_{0.9}Co_{0.1})_{75}$. Nd is added to improve the Kerr rotation. This year Sony has gone into commercial production of

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ROSKILL SURVEY

Did you know that:

1)U.S. demand for purified rare earths rose by 34 percent in 1987; in contrast, apparent consumption of rare earths fell by 20 percent?

2) Western world production of neodymium magnets is forecast to grow from 250 tons in 1987 to as much as 10,000 tons in 1997?

3) Phosphors form the main area of growth for yttria in China?

4) In industrialized countries the addition of yttria to zirconia and silicon nitride is growing rapidly with estimated consumption for ceramics expected to reach 500 tons per annum (tpa) by 2000?

5) High demand for separated rare earths is leading to diversification of sources with two new processing plants in Japan coming on stream in 1988 and a third planned?

If not, you may wish to obtain a 400 page report, *The Economics of Rare Earths 1988*. These are just a few of the conclusions, drawn by Roskill Information Services, Limited from their seventh addition of their market survey. It does *not* contain information about scandium, which is the subject of an earlier survey.

The price for this market survey is £485 (U.S.$765 or DM1490) and can be obtained from Roskill Information Services Limited, 2 Clapham Road, London SW9 OJA, England. Address your inquiries to Ms. Judith Chegwidden.

Belated Thanks

We wish to thank Eastman Kodak Company for their support during the 1989 fiscal year. We were amiss not listing them when we received their pledge of support. It was their 12th year of support. We wish to express our regret of the oversight.

CONFERENCE CALENDAR

IV Conference on Chemistry of Lanthanides and Actinides
São Paulo, Brazil
October 9-13, 1989
**This Issue*

XI Symposia Latino Americano Fisica del Estado Solido (XI SLAFES)
Caracas, Venezula
October 23-27, 1989
RIC News, **XXIII,** [4] 4 (1988)

3rd CECRI Conference on Luminescence
Karaikudi, India
January 12-14, 1990
**This Issue*

International Conference on Magnetic Phase Transitions (MPT'90)
Osaka, Japan
April 13-16, 1990
RIC News, **XXIV,** [2] 2 (1989)

NATO-ASI, Supermagnets, Hard Magnetic Materials
Il Ciocco, Italy
June 10-23, 1990
**This Issue*

1st International Conference on f-Elements (ICFE)
Leuven, Belgium
September 3-7, 1990
RIC News, **XXIII,** [4] 4 (1988) and **XXIV,** [2] 2 (1989)

REE in Processes of Petrogenesis
Tashkent, USSR
September 1990
RIC News, **XXIV,** [2] 2 (1989)

Rare Metals '90
Kokura, Kitakyushu, Japan
November 14-16, 1990
**This issue*

**News Story This Issue*

Lanthanide Chemistry

A symposium entitled, "Chemistry of Lanthanides and Actinides," will be part of the XIV-Annual National Symposium of the São Paulo Academy of Sciences. This will be the fourth such symposium on this subject held in conjunction with the national symposium. The symposium is being held October 9-13, 1989, in São Paulo, Brazil.

The program will consist of plenary lectures and contributed papers in several fields of rare earth and actinide chemistry. The papers will be presented mostly in Portuguese but some will be in English.

For more information, contact professors L. B. Zinner or G. Vicentini, University of São Paulo, CP. 20.780, 012498 São Paulo, SP. Brazil, or Dr. Alcidio Abrão, Instituto de Pesquisas Entergêticas e Nucleares-IPEN-CNEN, CP.11.049, 05508 São Paulo, SP. Brazil.

NATO Mag School

A NATO-Advanced Study Institute (ASI) will be held June 10-23, 1990, at the conference center Il-Ciocco." The Center is located about 40 miles north of Pisa in the Tuscany region of Italy. The ASI is titled, Supermagnets, Hard Magnetic Materials.

This ASI is designed to provide an advanced introduction to the field of hard permanent magnets to doctoral students, research scientists, and engineers. The ASI will cover the fundamentals of magnetism as they apply to hard permanent magnets, the preparation of new magnetic materials, and the engineering associ ated with the use of these new magnets in various practical applications.

The five members of the organizing committee and 12 invited lecturers will present 47 lectures during the 10 days that classes are held. There will be plenty of time for interaction with the lecturers and other attendees.

For more information contact Professor G. J. Long, Department of Chemistry, University of Missouri-Rolla, Rolla, MO 65401, U.S.A or Professor F. Grandjean, Institut de Physique, B5, Univesite de Liege, B-4000 Sart-Tilman, Belgium.

Application deadline is March 1, 1990.

Rare Metals '90

An International Symposium on Processing of Rare Metals will be held November 14-16, 1990, in Kitakyushu, Japan. The conference is being organized by the Mining and Materials Processing Institute of Japan and the Kyushu Institute of Technology.

The theme of the conference will be the processing of rare metals. Subjects to be covered include extraction, alloying, and powder and thin film processing of rare metals and their compounds and alloys. The symposium will include rare earth metals, high purity metals, refractory metals, high temperature metals, and by-products from base metals.

Abstracts of proposed talks are due November 1, 1989, with notification of acceptance sent by February 1, 1990. For more information, write Dr. Shinya Yao, Department of Materials Science and Processing, Faculty of Engineering, Osaka University, 2-1, Yamada-oka, Suita-city, Osaka 565, Japan [fax (06)876-4729].

LUMINESCENCE

Luminescence [Phenomena, Materials and Devices] is the name of the 3rd CECRI Research Conference to be held January 12-14, 1990, in Karaikudi, India. The aim is to bring scientists working in the field of luminescence together for discussions in all areas of luminescence phenomena, including photo-, cathodo-, thermo-, bio-, electro-, chemi-, and tribo-luminescence. Participation is limited to 100 scientists including 50 invitees. For further details contact, Dr. R. P. Rao, Convener, 3rd CECRI Conference, Central Electrochemical Research Institute, Karaikudi 623 006, India.

Luminescence Applications

H. G. Brittain has written a review entitled "Applications of Lanthanide Ion Luminescence from Inorganic Solids." It appeared as Chapter 5 in *Molecular Luminescence Spectroscopy: Methods and Applications, Part II,* edited by S. G. Schulman and published in 1988 by John Wiley & Sons, Incorporated.

The number of inorganic compounds that exhibit some type of luminescence phenomena is staggering and thus, according to Brittain, a total review is not possible. He has limited the majority of his discussion to luminescence phenomena associated with members of the lanthanide series. An additional area of interest to rare earthers is that many of the hosts are yttrium compounds and a few contain scandium.

After a brief discussion of the basics of luminescence of lanthanide ions, the review is divided into sections on cathode-ray-tube phosphors, fluorescent lamp phosphors, phosphors used in x-ray intensifying screens, electroluminescent phosphors, and materials used in in frared-to-visible upconversion. Among the hosts discussed are various forms of oxides, oxysulfides, sulfides, sulfates, fluorides, chlorides, silicates, aluminates, borates, phosphates, molybdates, tungstates, vanadates, niobates, titanates, zirconates, and hafnates. The review ends with a bibliography of 344 references.

To obtain a copy of this review write to Dr. Harry G. Brittain, Research Group Leader, The Squibb Institute for Medical Research, Route 1 at College Farm Road, P.O. Box 191, New Brunswick, NJ 08903, U.S.A.

$$ Fast Start $$

Fiscal 1990 is off to one of the best starts ever. We have received support from 9 new family members, renewed support from 2 former members, and continued support from 40 of our regular members. Thus, 51 pledges of support have been received since our fiscal year began.

The sponsors wishing to be listed, with the number of years they have been benefactors in parentheses, are listed below.

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Baotou Iron and Steel Company, People's Republic of China (1)
Can-Pacific Rare Earths and Metals Corporation, Canada (1)
CERAC Incorporated, U.S.A. (14)
The Chinese Society of Rare Earth, People's Republic of China (5)
Companhia Industrial Fluminense, Brazil (17)
Davison Chemical Company Division of W. R. Grace & Company, U.S.A. (22)
Department of Industry, Technology and Commerce, Australia (3)
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Fundacão de Technologia Industrial, Brazil (1)
General Research Institute for Non-ferrous Metals, People's Republic of China (2)
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Howmet Corporation, U.S.A. (3)
Hunan Research Institute of Rare Earth Metals, People's Republic of China (2)

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Rhöne-Poulenc Incorporated, U.S.A. (10)
Ronson Metals Corporation, U.S.A. (22)
Santoku Metal Industry Company, Limited, Japan (20)
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Shin-Etsu Chemical Company, Limited, Japan (20)
Sumitomo Light Metal Industries, Limited, Japan (6)
Treibacher Chemische Werke AG, Austria (18)
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USR Optonix Incorporated, U.S.A. (19)
Wheeler Associates, U.S.A. (4)
Wimmera Industrial Minerals Pty. Limited, Australia (2)
Yue Long Chemical Plant, People's Republic of China (9)

Chinese Production

The May 1989 issue of *China Rare Earth Information* gives the following statistics on the rare earth business in China. Mine production was up 38 percent to 29,640 metric tons (mt) (~16,300 mt REO equivalent), domestic consumption was up 28 percent to 16,000 mt, and export was up 28 percent to 8,320 mt.

RE HANDBOOK 12

The eight chapters of Volume **12** of the *Handbook on the Physics and Chemistry of Rare Earths* brings to 87 the chapters the editors have assembled in their quest to enlighten and inform the scientific and technical community of the rapidly expanding body of knowledge about the rare earths. In this volume, two chapters deal with the preparation and growth of single crystals, three are concerned with various aspects of the magnetic behaviors of lanthanide compounds, two involve liquid or gaseous rare earth materials, and one is on laser spectroscopy.

In the first chapter on growing single crystals, J. S. Abell covers the more common methods used in the field, including solid/solid growth (strain anneal), liquid/solid growth (float zoning, Bridgman), and vapor/solid growth. He discusses the methods and lists some of the crystals formed. The second chapter on crystal growth is by Z. Fisk and J. P. Remeika and deals with growing intermetallic compounds from molten metal fluxes.

The first of three chapters on magnetism deals with one of the most important and fastest growing areas of rare earth magnetism, that of the Nd-Fe-B based permanent magnet materials. It was authored by E. Burzo and H. R. Kirchmayr. The second chapter on magnetism was written by A. Szytula and J. Leciejewicz. It covers the crystallography and the physical and magnetic properties of the rare earth ternary compounds that crystallize with the $ThCr_2Si_2$-type structure. The third chapter, by H. Maletta and W. Zinn, deals with spin glass systems. It is primarily concerned with $Eu_xSr_{1-x}S$ based systems, but also covers the amorphous Gd_xAl_{1-x}, and Sc- and Y-rich intra rare earth alloys containing the heavy lanthanides. Other systems, especially Cu-Mn, are discussed to give a better perspective of the physics and nature of spin glasses.

Most of the vast body of knowledge concerning rare earths is on the solid state. Volume **12** of the *Handbook* contains two reviews on other states of matter, namely liquid and gaseous. J. Van Zytveld has reviewed the physical, magnetic, electronic transport,

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Lasers and Amplifiers

IEE Proceedings, **135,** Part J. 385-407 (1988) is a paper by P. Urquhart entitled, "Review of Rare Earth Doped Fibre Lasers and Amplifiers." This subject recently has received growing attention in the technical and scientific literature and at conferences. It is claimed that these devices will provide low cost, easily produced sources and amplifiers at wavelengths that are important to both current and projected future requirements in fields such as telecommunications, medicine, sensing, and spectroscopy.

This review provides an account of recent developments with preferential consideration given to applications in telecommunications. The author's aim is to provide a point of entry to a rapidly growing body of literature for new workers in the field; a broad overview for scientists in related work areas who could be in a position to make use of the results and products arising from current research activity; and to stimulate a general awareness of the availability of an emerging class of lasers.

Two restrictions were taken into consideration in the writing of the review: only optical fibers made from glass were considered, and short length cylindrical waveguiding structures were excluded. Also, the treatment is qualitative in nature with no theory section, primarily because the scope of published theory was limited.

In the introduction a fiber laser is defined, its merits are discussed, and a brief account of the history of the subject is given. Following the introduction is a section on lasing in an optical fiber. Included are subsections on absorption and emission of light, what is lasing, four- and three-level lasers, the rare earth elements and ions, influence of the host material, concentration ranges of rare earths in the lasers, Fabry Perot cavities, and superfluorescent fiber lasers and amplifiers.

The third section is devoted to making rare earth doped fibers. Sections on silica fibers address making them without rare earths and on incorporating rare earths by the solution, dopant carrier chamber, frit, vapor phase axial deposition, and rod-in-tube methods. Also included is a section on incorporating rare earth

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Lost RERC Papers

Manuscripts of six papers presented at the 18th Rare Earth Research Conference were inadvertently left out of the two volumes of *Journal of Less-Common Metals* in which the proceedings were published. They are scheduled to be published, prefaced by a Publisher's Note explaining the circumstances, in the August 1989 issue of the journal. Persons who received the earlier two-volume set of the proceedings will receive copies of the six papers from Elsevier.

Y_2O_3 CONCRETE

ORPAC Incorporated, P.O. Box 1119, Oak Ridge, TN 37831, U.S.A. has introduced, according to a news release, an ultra-high temperature, chemically resistant, yttrium oxide microconcrete, which is called Type "YMC." YMC contains 0.2 percent ZrO_2 and is usable to 2200°C in all atmospheres with improved thermal shock and corrosion resistance. It can be used for fabricating crucibles, setter plates, trays, etc. and for patching, filling, and bonding. It is made by mixing solid Y_2O_3 with a liquid component, formed into the desired shape, and sintered at 600°C.

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ions in fluorozirconate fibers by the casting method.

The fourth section describes the spectroscopy of rare earth ions in glass. Among the subjects discussed are measurements of absorption and fluorescence and details of the absorption and fluorescence spectra of Nd^{3+} and Er^{3+} in silica and other hosts.

Sections five and six are devoted to silica and fluorozirconate fiber lasers, respectively. Included are discussions of absorbed pump power, output power, lasing spectra, and fiber length effect for each type.

Sections 7, 8, and 9 are on resonant structures for fiber lasers, Q-switching and mode locking, and rare earth doped fiber amplifiers. Discussed are the fundamentals, the physical apparatus, possible areas where problems may occur, and the scope of possible applications of power amplifiers, optical repeaters, and optical preamplifiers in telecommunications.

The conclusion reviews the potential uses of the two types of fiber lasers and suggests areas where more research is needed.

Rare Earth Workshop

Basic and Applied Aspects of Rare Earths is the title of a soft cover book that contains the proceedings of a workshop held May 26-27, 1988, in Venice, Italy. The workshop was organized by the Istituto di Chimica e Tecnologia dei Radioelementi del Consiglio Nazionale delle Ricerche of Padova and Centro Ricerche Venezia-Temax of Venice. The English language book contains 213 pages and was edited by P. Guerriero, R. Guerriero, L. Meregalli, and P. A. Vigato.

Thirty-one papers were presented during the two-day workshop. The basic emphasis was on the many varied applciations of rare earths with special attention given to European and Chinese rare earth industries and to research going on in Europe. Three papers were presented an analysis of rare earths using ICP-MS, NAA, and SIMS. Applications connected with phosphors, superconductors, metallurgy, magnets, catalysts, medicine, organometallic chemistry, and biology were among those discussed.

The RIC has no details on the cost or the address from which to order, but interested readers can write to Dr. P. A. Vigato, Consiglio Nazionale delle Ricerche, Istituto di Chimica e Tecnologia dei Radioelementi, Corso Stali Uniti 4, 35020 Padova, Italy.

RARE EARTHS IN IRON AND STEEL

The Application of Rare Earths in Iron and Steel is a compilation of 37 papers written by various Chinese authors. The 397-page book was published by the Metallurgical Industry Publishing House, No. 30 Songzhu Yuan Bei Xiang, Beiheyen Dajie, Beijing, People's Republic of China in December 1987. The editor-in-chief was Yu Zongsen and the deputy editors were Zhang Liangfang, Sheng Da, and Chen Jizhi.

The papers cover a wide range of topics concerning the use of rare earths in cast iron, ductile iron, and steels. The phase diagrams, on which the applications are based, are reviewed in one paper. The reasons for using rare earths and the amounts used in the industry are discussed in several papers. Other papers deal with such diverse subjects as surface treatment, welding, mechanical

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POSSIBLE NEW LASER

T. Gbehi, J. Thery, D. Vivien, R. Collongues, G. Dhalenne, and A. Revcolevschi report on a new potential laser material in *J. Solid State Chem.* **77,** 211-22 (1988). It is based on the fact that calcium and lanthanide hexaaluminates form a full series of solid solutions, which they labeled CLnA. Single-crystalline rods, suitable for lasing studies, can be grown in air by the floating zone method if MgO is added at about the same level as the lanthanides.

The authors investigated single crystals with compositions represented by the formula $Ca_{1-x}(La_{1-y}Nd_y)_xMg_xAl_{12-x}O_{19}$ (CLnA), where x and y both varied from zero to one. They found that the CLnA series melted congruently and that for x from 0.3 to 0.7 and y at 0.1, the lattice parameters of this magnetoplumbite type phase are intermediate between the parent compounds, $CaAl_{12}O_{19}$ and $LnMgAl_{11}O_{19}$.

The authors studied the optical absorption, fluorescence, and ESR spectra of powder and crystalline materials, concentrating on the Nd^{3+} ions. In CLnA only two of three possible sites were shown to be occupied. Furthermore, one of the two sites, with nearly axial symmetry, is much more populated than the other. It also was found that the higher the Ca content, the higher the Nd^{3+} occupancy in this axial site. The authors plan, as a result of this study, to examine the laser properties of CLnA materials. They based their decision on the following observations: (1) in a CLnA laser almost all the neodymium would contribute to the estimated emission of the material; (2) according to the crystal growth results, it seems feasible that large single-crystalline rods necessary for the study can be made; and (3) the neodymium dilution, which is necessary to prevent concentration quenching of fluorescence, can be achieved by varying simultaneously the lanthanum and calcium content of the material. This additional degree of freedom could be important for optimizing their properties as lasers.

Iron and Steel

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properties, solubility and distribution, grain boundaries, and applications. English abstracts of the 37 papers appear at the end of the book.

Thanks and Thanks

Readers in Japan will notice a change in the return address of the envelopes in which they receive their *RIC News*. We wish to thank the Mitsubishi Corporation, 6-3, Marunouchi 2-chome, Chiyoda-ku, Tokyo 100-86, Japan for their long-time service to the Rare-earth Information Center. They have generously supplied the postage to mail the *RIC News* in Japan for many years.

We would like to express our appreciation to the Santoku Metal Industry Company, Limited, No. 14-34, 4-chome, Fukae-Kitamachi, Higashinada-ku, Kobe, Japan for their offer to assume this service. This mailing of the *RIC News* greatly reduces our postage costs.

New Mg Alloys

Two new Mg alloys have been developed by Allied-Signal Incorporated and Magnesium Elektron Incorporated. The Allied-Signal alloy (Mg-Al-Zn-Nd) can match the corrosion resistance of 2024 Al alloys in an aqueous saline environment. It shows superior pitting resistance over conventional magnesium casting alloys, still retains equivalent mechanical properties. Also, it is said to have good castability. The Magnesium Elektron alloy (Mg-Y-Nd-Zr) is reported as having corrosion resistance comparable to high-strength Al alloys, with the added capability of stability up to temperatures of 300°C.

Reactor Experiments

Good wishes go to a long-time sponsor of the RIC, Reactor Experiments, Incorporated, of San Carlos, California. The business started 30 years ago when the nuclear industry was in its infancy and great things were expected (i.e. nuclear-propelled submarines and ships, cheap electrical power, medical applications, widespread irradiation of food, etc.). Reactor Experiments changed with the times and now concentrates on radiation shielding and neutron activation foils. They sell more to nuclear medical customers than to the power producing industry. Last year the company became part of Eberline Instruments. We hope that the next 30 years are even more successful for this RIC supporter.

Hydrogen Storage

It has been nearly 20 years since the first major international conference on metal-hydrogen systems was held. In the intervening years hydrogen storage materials have been the object of a broad range of studies, both theoretical and experimental, and both basic and applied in nature. An extensive body of journal literature exists but relatively few summaries and critical reviews by experts in the field. Volume 31 of *Materials Science Forum,* "Hydrogen Storage Materials" edited R. G. Barnes, was planned to address this situation. It consists of 12 review chapters, by established experts in the field, on a selection of topics dealing with applications, materials, and metal-hydrogen interactions. More than half the chapters include materials containing rare earths. Two chapters, "What Materials to Use in Hydride Chemical Heat Pumps?" by P. Dantzer and F. Meunier; and "Hydrogen Locations in $LaNi_5$ and Related Hydrides" will be of special interest to rare earthers.

The 324-page volume was published in 1988, costs SFr120.00 (~U.S.$72.00 and can be ordered from Trans Tech Publications Ltd., Trans Tech House, P.O. Box 10, CH-4711 Aedermannsdorf, Switzerland.

Nd Isotope Geochemistry

Radioactive ^{147}Sm, with a half-life of 106 billion years, decays to ^{143}Nd, which is stable. The resulting changes in the isotopic ratio of ^{143}Nd to other Nd isotopes, together with the Sm/Nd ratio, can be used to determine the ages of rocks and, hence, the timing of events in the chemical evolution of planets. D. J. DePaolo has written a review of the subject entitled, *Neodymium Isotope Geochemistry, An Introduction.*

Part I, "Principles and Processes," presents background information. DePaolo summarizes the chemical properties of Sm and Nd, compares them to other nuclide pairs used in geochronology, discusses their isotopic abundances, describes the Sm-Nd method, and outlines the methodology used in the study of planetary evolution and igneous processes.

Parts II and III are devoted to results. Part II contains an overview of the results as they apply to problems

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Russian Acquisitions

The RIC has received the Russian book *Fizikokhimiya i Tekhnologiya Vysokotemperaturnykh Sverkhprovodyashchikh Materialov (Physical Chemistry and Technology of High Temperature Superconducting Materials).* The book includes articles on the results of physical and chemical research on high temperature superconducting materials, the exploration of conditions for synthesis and fabricating various forms of the materials, the results of studies on the influences of different outside factors on structure stability, and the characteristics of ceramic high T_c superconductors.

The soft cover book contains 241 papers in 507 pages. It was edited by N. P. Lyakishev and published in 1989 by Nauka in Moscow. No details on availability or price are available to the RIC.

The RIC also has received number 29 of *Redkozemel'nye Poluprovodniki i Durgie Soedineniya RZM. Ukazatel' Oteshestvennoi i Inostrannoi Literatury (Rare Earth Semiconductors and Related REM Compounds. Index of Russian and Foreign Literature)* edited by V. P. Zhuze. It was published by Bibliateka Akademii Nauk SSSR, Leningrad, USSR, in 1988. It cites 923 references published in 1987. The citations are in English for foreign publications and Russian for the rest. Unlike earlier bibliographs, there is no cross translation.

Isotope Geochemistry

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on a planetary scale. This includes a review of data on Nd isotopic variations; correlation of these with other isotopic variations; and discussion of the data as it applies to models of crust-mantle evolution, including applications to sedimentary rocks and oceanography. Part III, devoted to petrogensis, contains discussions of results related to problems of the origins of igneous rocks. It discusses isotope variations in ocean crust and mantle, continental magmatic arcs, and continental mafic rocks. A list of almost 400 references is at the end of the volume.

The 187-page book, published in 1988, costs DM82 (~U.S.$42). It may be ordered from Springer-Verlag GmbH & Company KG, Heidelberger Platz 3, D-1000 Berlin 33, West Germany.

Cat Cracking

ACS Symposium Series No. 375 entitled, *Fluid Catalytic Cracking, Role in Modern Refining,* edited by M. L. Occelli, was derived from a symposium sponsored by the Division of Petroleum, at the 194th Meeting of the American Chemical Society held August 30-September 4, 1987, in New Orleans, Louisiana. The 353-page book was published in 1988 by the ACS and costs U.S.$79.95 in the U.S. and Canada ($95.95 elsewhere). It may be ordered from ACS Distribution Office, Department 390, American Chemical Society, 1155 16th St. NW, Washington, DC 20036, U.S.A.

Rare earths have been used for many years in cracking catalysts although their use has been declining. Demand for higher octane gasoline and ongoing research indicates this trend might be reversed.

This book explores advances in the design and refinement of cracking catalysts. New catalysts are compared to older ones that have been widely used. Other discussions include control of sulfur emissions, effect of metals on catalysts, and the application of fluid catalytic cracking to heavy and low-grade oils. Some of the new catalysts are proprietary and their composition guarded but rare earths are mentioned in many of the chapters.

TFEL Devices

Thin-film electroluminescence (TFEL) devices using doped ZnS thin films have been around for some time. New reports on TFEL devices using doped SrS thin films are now appearing in the literature. S. Okamoto, E. Nakazawa, and Y. Tsuchiya recently wrote of their experiments with SrS thin films doped with trivalent ions of Nd, Sm, Dy, Ho, and Er. [*Jpn. J. Appl. Phys.,* **28**, 406-9 (1989)]. Their emission colors were found to be orange-white, orange, yellow, greenish white, and green respectively. The luminescence levels were all over 200 cd/m^2, except for SrS:Ho^{3+} (110cd/m^2), using a driving voltage in the 70-100 V range and a frequency range of 3-5 kHz. The main spectral regions of these spectra were found to shift to shorter wave lengths than those of the same ions in ZnS-based TFEL devices.

HONORS

National Medal of Science

In July 1988, then President Ronald Reagan presented 20 National Medals of Science to outstanding scientists. Among those receiving the award was Paul C. W. Chu of the University of Houston. He received the award for his contributions to the achievement of superconductivity at 94 K in a rare earth material. He received his B.S. from Cheng-Kung University in Taiwan in 1962, M.S. from Fordham University in New York in 1965, and Ph.D. from the University of California-San Diego in 1968. He spent two years at AT&T Bell Labs, nine years at Cleveland State University in Ohio, and, since 1979, has been a professor of physics at the University of Houston in Texas.

Shigeo Shingo Prize

Globe Metallurgical Incorporated, of Beverly, Ohio, and Selma, Alabama, was awarded the first Shigeo Shingo Prize for Manufacturing Excellence by the Utah State University's College of Business Partner's Program. Shigeo Shingo is regarded as the dean of Japan's quality consultants. Globe was the only company of those considered to receive a positive rating in the stringent profit-to-cost ratio formula used in judging. A committee of 25 business executives, from across the nation, made the selection. Globe, the largest U.S. producer of foundry ferroalloys and silicon metal, recently received the 1988 Malcolm Baldridge National Quality Award [RIC News, XXIV, [1] 8 (1989)], and the Ford Q-1 and General Motors Mark of Excellence awards.

Argonne Honors

The U.S. Department of Energy's Argonne National Laboratory honored some of its employees in ceremonies held July 27 at the Laboratory.

Distinguished Performance Awards consisting of a medal, certificate, and a $2,500 cash bonus were awarded to four people with rare earth connections.

Patricia and Joseph Dehmer shared an award for their independent work in the area of vacuum ultraviolet photophysics including early work on lanthanum and cerium.

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Bauxite Tailings

Bauxite Tailings "Red Mud" is a comprehensive document on the subject of the disposal of highly caustic Bayer Process muds of alumina industries around the world. The 22 articles deal with the different aspects of the tailings problem, from characterization to the dynamics of the disposal ponds, from rheology of the waste to solar dehydration methods, and from its utilization in construction to the extraction of rare earths. The methodologies developed are useful in the disposal problems of other mineral industries also. The rare earths in Jamaican bauxites range from about 700 to over 1,000 ppm and average about 2,500 ppm in the dry red mud from the tailings ponds.

The 22 papers were presented at an international conference held October 26-31, 1986, in Kingston, Jamaica. The conference proceedings were published by The Jamaica Bauxite Institute and the University of the West Indies. The 171-page book, edited by A. S. Wagh and P. Desai, was copyrighted in 1987, and is available from Publications Section, Institute of Social and Economic Research, University of the West Indies, Mona, Kingston 7, Jamaica, West Indies, or The Jamaica Bauxite Institute, Hope Gardens, P.O. Box 355, Kingston 6, Jamaica, West Indies. The cost is U.S.$60 including handling and postage.

RIC News
(USPS 464-960)
Vol. XXIV, No. 3 September 1, 1989
Published
quarterly in March, June,
September, and December
by
Rare-earth Information Center,
Institute for Physical
Research and Technology,
Iowa State University,
Ames, Iowa 50011-3020

Second-class postage
paid at Ames, Iowa

Postmaster: Send address changes to:
RIC News, Rare-earth Information Center,
Institute for Physical
Research and Technology,
Iowa State University,
Ames, IA 50011-3020
Telephone: (515) 294-2272
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Trip Report—Japan

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the disks, which are used for information storage for personal computers.

My last stop in Tsukuba was a brief visit to a portion of the NRIM laboratories. The group, headed by Dr. H. Maeda, is working on superconductivity and magnetic refrigeration.

National Research Institute for Metals—Meguro

The major portion of NRIM is located in Meguro in Tokyo, but within five years all of NRIM will be located in Tsukuba. My first visit was with Drs. A. Matsushita and T.Matsumoto who are concerned with magnetic susceptibility (4.2 to 500 K) measurements and low temperature heat capacity (1.5 to 100 K) studies at one atmosphere and at pressures up to 25-30 kbars.

Next, Dr. T. Ozaki described his work on using laser beams to separate rare earth metals from each other in an atomic beam. He uses two different wavelength laser beams to effect such a separation. The first excites a specific atom, e.g. Nd, and the second ionizes this excited atom, which as it passes through an electronic field is deflected. The wavelengths are chosen so that the above two steps occur only for one particular element (in this case Nd), and the other rare earth elements, e.g. Sm, are not excited or ionized, i.e. they remain neutral, and since the electric field does not deflect them a separation is realized.

Lastly, Dr. R. Hasegawa discussed his xenon lamp, single crystal growing and his solid state electrolysis (SSE) apparati. A variety of single crystals, including La_2NiO_4 and LaB_6 have been grown. The SSE set-up has an RF coil between the two electrodes so that a liquid zone can be formed, thus in principle they can simultaneously zone refine and carry out SSE. One advantage of the liquid zone is that electromigration is much higher in it than in the solid.

Department of Physics, Tohoku University

Before I left Japan, I visited Tohoku University in Sendai. One afternoon was spent visiting with Prof. T. Kasuya, Department of Physics, and his staff, Drs. T. Satoh, M. Kohgi, and M. Kasaya. They are involved with studies on heavy fermions, mixed

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valence, and Kondo systems, which generally contain Ce. They are expanding their research efforts to U materials—Dr. Kasuya mentioned that he is in charge of one of the two new major research efforts in Japan sponsored by the Ministry of Education—the heavy fermion project involving primarily actinides.

My discussions with Drs. T. Satoh and M. Kohgi dealt with $CeSi_x$ ($1.65 \leq x \leq 1.90$) alloys. We have a strong mutual interest in these materials and much of their work on this alloy system complements our studies.

Dr. M. Kasaya described his experimental studies on $CeRh_2B_3$, $SmRh_2B_3$, etc., and his ideas concerning the high ferromagnetic Curie temperature for mixed valent $CeRh_2B_3$, and how it changes when the Ce concentration is diluted by La additions.

Institute for Materials Research, Tohoku University

My last day in Japan was spent visiting the Institute for Materials Research (formerly the Research Institute for Iron, Steel and Other Metals). The first laboratory I visited was the high field magnet facilities which is headed by Prof. Y. Nakagawa. When I visited here in 1982, the facilities were in the process of being completed, but now have 11 operational steady state high field magnets. The major ones used are a 23 T (230 kOe) hybrid 50 mm bore magnet and a 30 T hybrid magnet. Their studies include magnetic properties of Nd-Fe-B base materials, the Laves phases $(Sc_{0.75}Ti_{0.25})Fe_2$ and $Ce(Al,Fe)_2$, and superconducting materials.

Prof. Y. Muto, who heads the experimental superconductivity group, has been given responsibility by the Ministry of Education to head the second new major research project on the flux creep problem in the high temperature ceramic superconductors. There are approximately 30 scientists from all over Japan involved.

Prof. K. Suzuki and Dr. K. Kai are working on hydrogen in metals and amorphous metal alloys, including crystalline—LaH_2-LaH_3, LaD_2-LaD_3, the corresponding Sc and Y series and amorphous $Pd_{0.35}Zr_{0.65}D_x$ ($0 \leq x \leq 0.80$).

It was a short, power packed trip—a lot of good, exciting science is going on. The Japanese were most gracious hosts—many thanks.

I G Technologies

Recoma, Incorporated and Carbone-Lorraine Industries, both of Boonton, New Jersey, have acquired 80 percent and 20 percent, respectively, of I G Technologies, Inc. of Valparaiso, Indiana. The two companies are members of the Pechiney Group, which also owns American-National Can and Howmet.

This merger will increase the financial resources of I G Technologies and simultaneously increase the technical resources available to I G Technologies and Recoma, and also to Ugimag, another member of the Pechiney Group. The Pechiney Group is the largest permanent magnet producer in Europe and is now possibly the largest non-Japanese magnet producer in the world.

Mr. Jean-Michel Escondeur will become president of I G Technologies. John A. Johnson will become chairman of the board.

RE Handbook

(Continued from page 3)

and thermodynamic properties, and the electronic structure of the liquid rare earth metals and alloys. M. S. Chandrasekharaiah and K. A. Gingerich review the thermodynamic properties of the gaseous rare earth metals and their gaseous compounds. Compounds discussed include those with other metals, carbon, oxygen, and the chalcogenides.

The final chapter in this volume is by W. M. Yen. It deals with the impact of laser sources on the study of the spectroscopic properties of the rare earths and the knowledge that has resulted from this. The knowledge has led to a much better understanding of the electronic nature and optical behavior of solids and to a variety of devices and uses.

Volume **12** of the *Handbook on the Physics and Chemistry of Rare Earths,* edited by K. A. Gschneidner, Jr. and L. Eyring, was published in 1989 by North-Holland and contains 486 pages. It costs Dfl. 270.00 (~U.S.$123) and it and the previous 11 volumes, can be ordered from Elsevier Science Publishers, Book Order Department, P.O. Box 211, 1000 AE Amsterdam, The Netherlands; or in the U.S.A. and Canada, from Elsevier Science Publishing Company, P.O. Box 882, Madison Square Station, New York, NY 10159, U.S.A.

Narrow-Band Phenomena

Narrow-Band Phenomena—Influence of Electrons with Both Band and Localized Character contains the proceedings of a NATO Advanced Research Workshop held May 31-June 5, 1987, in Staverden, The Netherlands. It is Volume **184** in the NATO ASI Series: Series B, Physics. There are 28 papers in four sections plus an introduction for each section and for the book. The introductions were apparently written by the editors, J. C. Fuggle, G. A. Sawatzky, and J. W. Allen.

The theoretical treatment of scientific problems associated with the electronic behavior in solids, when some of the valence electrons have both localized and band-like characteristics, is one of the central problems in physics. Some 40 scientists participated in the workshop and were asked to give a short account of the major problems in their field.

The resulting book, written by eminent theorists and experimentalists, summarizes the situation and redefines the real problems of the field in light of the recent major advances in techniques and concepts. The papers are separated into sections entitled: Ground State and Near Ground State Phenomena, Theoretical Descriptions of the Ground State, High Energy Spectroscopies of Narrow Band Materials, and High Temperature Superconductors.

The 228-page book was published in 1988 by Plenum Press and costs U.S.$59.50 in the United States and Canada ($71.40 elsewhere). It can be ordered from Plenum Publishing Corporation, 233 Spring Street, New York, NY 10013, U.S.A.

High Temperature Fuel Cell

H. Yahiro, Y. Baba, K. Eguchi, and H. Arai have authored the paper "High Temperature Fuel Cell with Ceria-Ytria Solid Electrolyte," which appeared in *J. Electrochem. Soc.*, **135**, 2077-80 (1988). The ceria-yttria solid solutions showed high ionic conductivity and had a high ionic transference number for oxygen. These lead to higher current and power densities for a fuel cell with $(CeO_2)_{0.9}(YO_{1.5})_{0.1}$ as the solid electrolyte when compared to CaO stabilized zirconia, especially at 500 to 600°C. Electrodes of the mixed oxide, $La_{0.6}Sr_{0.4}CoO_3$, with a perovskite structure produced the highest power density and were used in the cell rather than platinum. The low operating temperature eliminated the problem of solid-state reaction between the electrode and electrolyte. A thin film of yttria stabilized zirconia is quite effective in suppressing the reduction of ceria with hydrogen, which is one of the most important problems for ceria-based oxide fuel cells.

HONORS

(Continued from page 6)

David Hinks was honored for his contributions to the development of superconductors and analysis of the underlying principles. He has worked with the cuprate superconductors as well ternary borides and molychalcogenides, all of which contain rare earths.

Alan Smith was recognized for his leadership as a nuclear physicist and as the director of an internationally known team that operates the only single-energy neutron facility in the world.

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