Rare-earth Information Center NEWS

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

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Springtime in Japan

The editor was fortunate to be able to attend and participate in the international conference, **Rare Earths '92 in Kyoto**, and to visit several universities and other organizations.

Tokyo Institute of Technology

My host at the Tokyo Institute of Technology (TIT) was Prof. T. Hashimoto, Department of Applied Physics. In the morning he and his staff, and some former students briefed me on their work on (1) magnetic regenerator materials, (2) active magnetic regenerator materials, and (3) magnetic refrigeration materials. The first group of materials makes use of the large heat capacity due to magnetic ordering, but no magnetic field is applied. These materials, primarily Er_3Ni, have replaced lead in commercial cryocoolers to reach ~ 2 K (with lead the lowest attainable temperatures was ~ 10 K). Primarily, it is the much larger heat capacity of Er_3Ni (compared to lead) below 15 K due to antiferromagnetic ordering at ~ 7 K.

The other main topic discussed at TIT was the use of gadolinium gallium garnet (GGG) and dysprosium aluminum garnet (DAG) as magnetic refrigeration materials for an active magnetic regenerator (AMR) magnetic refrigerator (MR) for cooling from 10 to 1.4 K. The refrigerator consists of a static refrigerant and a pulsed magnet. They were able to attain a cooling power of 550mW at 4.5 K using DAG and 100mW at 1.8 K using GGG. The refrigerator was designed and built to obtain superfluid He for cooling a low temperature superconductor, such as Ti-Nb and Nb_3Sn.

Toshiba Corp.

At the Toshiba Research and Development Center in Kawasaki, I visited with Mr. M. Sahashi, who is the manager of the planning staff, Mr. T. Kuriyama, Dr. H. Nakagome, Mr. Y. Tokai, and Mrs. A. Takahashi. They described their research activities on trying to improve on the Er_3Ni materials. One new material, which they have made that will be used to replace Er_3Ni in cryocoolers which need to operate at or attain lower temperatures then is possible with Er_3Ni, is $Er_{0.9}Yb_{0.1}Ni$. The Er_3Ni and $Er_{0.9}Yb_{0.1}Ni$ magnetic regenerator materials are fine spheres, ~ 0.3 mm in diameter which are produced by a rotating disk process developed by Mr. M. Sahashi. Toshiba is the world's largest producers of Er_3Ni. One of the more important uses of their crycoolers is to cool the liquid helium in MRI (magnetic resonance imaging) scanners to about 2 K to reduce the vapor pressure of helium which slows down the loss of liquid helium. This means that the liquid helium needs to be replaced only once a year in the MRI units instead of every three to five months if the liquid helium is maintained at 4.2 K (its normal boiling point).

The Society of Non-Traditional Technology

The next visit was with Prof. H. Kaneko, President, Mr. T. Kurino, Executive Director, and their staff of the Society of Non-Traditional Technology (SNTT) to discuss our co-operative project of sharing our (SNTT's and the Rare-earth Information Center's [RIC]) computer database systems. We will be able to access their factual database for numerical and/or graphic information. They already have access to our literature reference data base. In time we expect that other scientists, engineers and other professionals will be able to access RIC's literature data base electronically without interacting with RIC's staff.

Mitsubishi Materials Corp.

My visit to the Central Research Institute of Mitsubishi Materials Corp. (MMC), Omiya was hosted by Dr. T. Takeshita. They are working on making monolithic $YBa_2Cu_3O_{7-x}$ (1:2:3) ceramics for superconductors for electric motors and silver coated superconducting wires. The monolithic 1:2:3 samples they showed me include disks, an armature motor housing, and a cup ~ 4 cm in diameter, ~ 6 cm high with a 0.5 cm wall thickness. The 1:2:3 samples are prepared by a partial melting of the 1:2:3 phase to precipitate the green phase Y_2BaCuO_5 which serves as pinning sites to stop or reduce flux motion. After this step the materials are sintered under isostatic pressure and high temperature to give the final monolithic 1:2:3 specimen.

We also discussed their process for making anisotropic $Nd_2Fe_{14}B$ permanent magnet powders using a hydrogenation, dehydrogenation process, called the HDDR process. The starting $Nd_2Fe_{14}B$ material is initially hydrided (H) at low temperatures and during the heating to above 650°C it absorbs more hydrogen and decomposes

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John Corbett Elected to Science Academy

John Corbett

John Corbett, a distinguished professor of chemistry at Iowa State University and a senior chemist at Ames Laboratory, Ames, Iowa, has been elected to the National Academy of Sciences. Dr. Corbett is one of 59 new members to join the organization, which now has 1,651 active members. He received the honor in recognition of distinguished and continuing achievements in original research.

Dr. Corbett has produced over 100 papers dealing with the synthesis, structure and bonding of new families of solid state rare earth compounds, especially at high temperatures. His latest work includes: synthesis and structure of $LaGe_{2-x}$ and LaAlGe; condensed rare earth metal clusters in oligimers, $Y_{16}Ru_4I_{20}$, and infinite chains, Pr_3RuI_3 and Y_4OsBr_4.

Discoveries in Corbett's laboratory have provided chemists with a greater understanding of chemical bonding which may lead to the development of new materials. ▲

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Future International RE Conferences

The International Steering Committee on *f*-element Conferences met at the Rare Earths '92 in Kyoto conference in early June and approved the following long-term schedule for future rare earth conferences.

1993 California, U.S.A.
20th RERC, Sept. 12-17,
Monterey, California

1994 Finland
2nd ICFE, June,
Helsinki

1995 China
ICRE, Sept. 26-30,
Beijing,People's Republic of China

1996 Virginia, U.S.A.
21st RERC
Charlottesville, Virginia

1997 France
3rd ICFE
Paris, France

1998 Asia?

Details will be announced in the *RIC News* as they become available (see below for the 20th RERC). The committee is looking for suggestions for 1998, which, according to the usual schedule, would be slated for a country in Asia (which also includes Australia and New Zealand). If anyone is interested, please contact RIC and the information will be forwarded to the steering committee. ▲

Conference Calendar

*** A NEWS STORY THIS ISSUE**

September '92

International Conference on Strongly Correlated Electron Systems (SCES '92) formerly: International Conference on Heavy Fermion and Strongly Correlated Electron Systems (HFSCS '92)
Sendai, Japan
September 7-10, 1992
RIC News, **XXVI**, [4] 2 (1991)
RIC News, **XXVII**, [1] 2 (1992)

8th International Symposium on Halide Glasses
Perros-Guirec, Brittany, France
September 22-5, 1992
RIC News, **XXVII**, [1] 2 (1992)

November '92

International Symposium on Giant Magnetostrictive Materials and Their Applications
Tokyo, Japan
November 5-6, 1992
*This issue

March '93

International Symposium on Radiation Protection in the Mining, Milling and Downstream Processing of Mineral Sands
Bunbury, Western Australia
March 18-20, 1993
RIC News, **XXVI**, [4] 2 (1991)
RIC News, **XXVII**, [2] 2 (1992)

April '93

Rare Earth Minerals: Chemistry, Origin, and Ore Deposits
London, England
April 1-2, 1993
RIC News, **XXVI**, [2] 2 (1991)
RIC News, **XXVII**, [2] 2 (1992)

Rare-Earth Doped Semiconductors
San Francisco, California USA
April 12-16, 1993
*This issue

August '93

European Magnetic Materials & Applications Conference (EMMA '93)
Kosice, CSFR
August 24-7, 1993
*This issue

September '93

20th Rare Earth Research Conference
Monterey, California, USA
September 12-17, 1993
RIC News, **XXVII**, [1] 2 (1992)
*Also this issue

Actinides-93
Santa Fe, New Mexico, USA
September 19-24, 1993
RIC News, **XXVI**, [3] 2 (1991)

20th Rare Earth Research Conference

The site for the 20th Rare Earth Research Conference will be the Monterey Convention Center in Monterey, California, U.S.A. September 12-17, 1993. There will be invited and contributed papers in most major areas of rare earths and actinides. The invited papers will be oral contributions and the contributed papers will be poster presentations. The meeting will follow the format of previous U.S. Rare Earth Research Conferences.

Specific invited papers will be in Symposia selected by the Program Chair for the Conference. Each symposium will have one or two Chairs, who will be responsible for selecting the invited speakers. The Program Chair for the Conference is: Dr. Frederick S. Richardson, Department of Chemistry, University of Virginia, Charlottesville, Virginia 22901 U.S.A. Contributed papers can be in any area of lanthanide research or in related actinide research.

An abstract form and additional information will be contained in a formal announcement this fall. To be sure of receiving this and all future announcements, contact: Dr. Herbert B. Silber, Chemistry Department, San Jose State University, San Jose, CA 95192 U.S.A.; Tel:(408)924-4954 Fax:(408)924-4945. ▲

EMMA '93

The European Magnetic Materials and Applications Conference (EMMA' 93) will be held August 24-27, 1993 in Kosice, Slovakia. This will be the 5th conference in the series that began in Grenoble in 1985. The aim of EMMA' 93 is to stimulate European research in the field of physics, development, fabrication, and application of magnetic materials. Each session will have both oral and poster presentations with the majority of contributed papers being poster presentations. Each session will begin with an oral invited keynote talk on recent advances in the pertinent field.

Two specialized seminars of interest to rare earthers are: magnetism and high T_c superconductivity; and heavy fermions and related topics. Other tentative subjects of interest to our readers are: amorphous magnetic materials; magnetic semiconductors; permanent magnetic materials; magneto-optic materials; and magnetic films, multilayers, and surfaces.

For more information, contact Dr. P. Sovak, Department of Experimental Physics, Faculty of Sciences, P.J. Safarik University, Nam. Febr. vitazstva 9, 041 54 Kosice, Slovakia. Tel:42-95-21128. Fax:42-95-22124. ▲

Springtime in Japan/*Continued from page 1*

(D) to form $NdH_2 + \alpha Fe + Fe_2B$. Then, this mixture is dehydrogenated (D) below 1000°C by pumping off the hydrogen to reduce NdH_2 to neodymium metal, which then reacts (R) to form the anisotropic $Nd_2Fe_{14}B$ powder. The trick is to keep the temperature below 1000°C in the last step, otherwise the powder will be isotropic.

Kumamoto University

After a 7.5 hour train ride from Tokyo we reached Kumamoto, a city of ~ 600,000 persons in the southwest part of Japan on the island of Kyushu, which is the next island south of the main island, Honshu, of Japan. In Kumamoto I visited Assoc. Prof. G. Oomi who is in the Physics Department of the Faculty of General Education. Prof. Oomi's research interests are the physics of condensed matter under multi-extreme conditions of high pressure, low temperature and high magnetic fields. His research interests are focused on three topics: (1) electrical resistivity and magnetoresistance (up to fields of 5 T) at high pressure (up to 2.0 GPa, 20 kB) from 2 to 300 K; (2) thermal expansion and magnetostriction at high pressure (same conditions as item 1); and (3) x-ray diffraction at pressures up to 14 GPa (140 kB). Most of the materials he is studying are: heavy fermion materials; high temperature superconductors, including $YBa_2Cu_3O_{7-x}$ and $La_xSr_{2-x}CuO_{4-x}$; and metallic multilayers such as Fe/Cr. Most of our discussions focused on the heavy fermions $CeCu_2$, which orders antiferromagnetically at 3.5 K, and UNiGa which orders ferromagnetically at 38 K; the anomalous thermal expansion and superconductivity of the $La_{2-x}Sr_xCuO_{4-y}$; and the cross-over from a concentrated Kondo to an intermediate valence state in $CeInCu_2$.

Government Industrial Research Institute of Osaka

The Government Industrial Research Institute of Osaka (GIRIO) is one of 16 institutes located throughout Japan conducting R and D projects to aid industry. These 16 institutes are part of the Ministry of Industrial Trade and Industry (MITI). At GIRIO I spent most of the time visiting the Chemical Metallurgy Section, which is primarily involved with the chemistry of metal hydrides and energy conversion using metal hydrides. This section is headed by Dr. I. Uehara. The main discussions with Dr. Uehara and Dr. T. Sakai were involved with their research on the metal hydride batteries. The metal hydride batteries use $LaNi_5H_x$-base materials as one of the electrodes (nickel is the other). Their early work on these materials has led to the commercialization of these metal hydride batteries in Japan (current production is about 400,000 batteries per month). These rechargeable batteries are expected to replace the Ni-Cd batteries. They have several advantages over the Ni-Cd batteries, e.g. capacity, lifetime, absence of a memory effect, but the major driving force is the removal of Cd from the environment. A typical size battery has an operating voltage of 1.2 V and 2.8 Ah capacity.

Current work involves the development of improved $LaNi_5$-base materials by alloy substitution. These alloys can be quite complex, containing several different metals substituted for Ni, and mischmetal (various compositions) - each providing some special improvement. At present they have several hundreds of alloys on test. Battery performance is continuously evaluated through at least a thousand charging/discharging cycles. They are also working on the construction, development and testing of large stacked (kWh) batteries for electric vehicles and photovoltaic power generation systems. A typical stacked battery has a 12 V output with a 30 Ah capacity.

Metal Hydride Producers Association Meeting

After visiting GIRIO in the morning, we drove to Kyoto (about an hour away) to attend the Metal Hydride Producers Association meeting, which was held that afternoon. At the meeting, Dr. K.H.J. Buschow from the Philips Research Laboratories in Eindhoven and I each presented an invited talk. Dr. Buschow talked about rare earth transition metal intermetallic compounds (primarily R_2M_{17} and RM_5) and their structures, magnetic and electrical properties, and hydride formation properties. My talk was entitled: "Rare Earths: Resources, Properties and Utilization". Prof. Emer. H. Tamura, Osaka Institute of Technology, the president of the Metal Hydride Producers Association, was our host.

Rare Earths '92 in Kyoto

The final stop of my trip was to participate in the 1992 rare earth conference, which was hosted by The Rare Earth Society of Japan. The conference took place in Kyoto on June 1-5, with over 500 attendees. Of these, 399 were from Japan, 27 from the United States, 24 from the People's Republic of China, 12 from France, 7 from Germany and the rest from 20 other countries (no more than four persons from any one of them). The program consisted of 14 combined oral and poster symposia plus three other poster-only symposia. Several of the oral symposia were dedicated to (and named after) senior scientists who have made significant contributions to their respective fields. These include: P. Caro (Cité des Sciences et de l'Industrie, Paris) and B. R. Judd (John Hopkins University, Baltimore) on spectroscopy; G. R. Choppin (Florida State University, Tallahassee) on aqueous chemistry; L. Eyring (Arizona State University, Tempe) on solid state chemistry; K. A. Gschneidner, Jr. (Iowa State University, Ames) on physical metallurgy; H. B. Kagan (University of Paris-Sud, Orsay) on organometallic chemistry; T. Kasuya (Tohoku University, Sendai) on solid state physics - anomalous *f* systems; and M. Sagawa (Intermetallics Co., Ltd., Kyoto) and K.H.J. Buschow (Philips Research Laboratories, Eindhoven) on magnetism and magnetic materials. Each of the honored scientists presented a keynote address. In addition, plenary lectures by K. A. Gschneidner, Jr. on "Systematics and Anomalies" and T. Kasuya on "Exchange Interactions in Rare Earth Compounds" opened the conference. Other keynote lectures were presented by G. Blasse (University of Utrecht, Utrecht) on luminescent materials; P. Falconnet (Rhône-Poulenc Chimie, Courbevoie, France) and B. T. Kilbourn (Unocal/Molycorp, White Plains, New York) both spoke on the rare earth industry; W. J. Evans (University of California-Irvine, Irvine) on organometallics; B. R. Cooper (West Virginia University, Morgantown) on exchange interactions; T. Inui (Kyoto University, Kyoto) on catalysis; N. Edelstein (University of California-Berkeley, Berkeley) on actinide compounds; and K. Sekizawa (Nikon University, Tokyo) and J. E. Greedan (McMaster University, Hamilton) both spoke on high temperature superconductors.

A total of 59 oral presentations were given in the 14 symposia and 266 posters were scheduled for the 17 poster sessions. A lot of exciting and new information was proffered in the 325 presentations. The research and technological activities presented at the Conference were concerned with: coordination chemistry (38 posters [P] and 5 oral papers [O]), hydrogen storage materials (26 P), luminescence (21 P and 4 O), solid state chemistry (19 P and 5 O), organometallics (17 P and 6 O), spectroscopy (17 P and 6 O), permanent magnets (18 P and 4 O), catalysts (17 P and 5 O), actinides (17 P and 4 O), new materials (20 P), physical metallurgy (16 P and 4 O), problems of the world-wide industry plus minerals, separa-

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tion technology and analytical chemistry (combined total - 20 P and 4 O), solid state physics and anomalous *f* behavior (11 P and 4 O), and high temperature superconductivity (8 P and 3 O).

Extended abstracts (each 2 pages long) of 318 of these presentations are available in a bound hard cover abstract book, which is available from Prof. Gin-Ya Adachi, the Rare Earth Society of Japan, Yamadaoka, Suita, Osaka 565, Japan for $230.00 US or 30,000 yen (Fax: 06-876-4754). The conference proceedings will be published in the *J. Alloys Compds*. When it becomes available we will announce it in the *RIC News*.

There were many opportunities to discuss rare earth science and technology with scientists from all over the world, especially Japan, and to meet old friends and make new ones. Prof. G. Adachi and his co-organizers are to be congratulated and thanked for a most excellent, well organized conference.

Epilogue

The Japanese are extremely gracious and generous hosts. My wife, Melba, and I had a fantastic time - thanks for the wonderful memories. ▲

Symposium on Giant Magnetostrictive Materials

The International Symposium on Giant Magnetostrictive Materials and Their Applications will be held November 5-6, 1992, in Tokyo, Japan. The purpose of this symposium is to discuss recent progress in fundamentals and applications of giant magnetostrictive materials. The tentative program is composed of three main topics:(1) Giant Magnetostrictive Materials: magnetic properties, metallurgy, fabrication and machining, and materials evaluation;(2) Applications: magnetic circuits, actuators, sensors, acoustic devices, positioning, and active damping systems; and (3) New Fields for Applications: thin films, micromachines and others.

The symposium will be held at TEPIA (high-technology pavilion), 2-8-44, Kita-Aoyama, Minato-ku which is located at the center of metropolitan Tokyo.

For more information contact the symposium secretariat: Mr. Tadashi Ono, General Secretary, AMTDA (Advanced Machining Technology & Development Association), Sentan-Kako Kyokai Toranomon Sangyo Bldg. 9F, 1-2-29 Toranomon, Minato-ku, Tokyo 105, Japan; Tel:81-3-3501-6701 Fax:81-3-3503-9697. ▲

Letter to the Editor

Dear Karl,

I noticed in the June 1, 1992 *RIC News* [p.8, 1st column] reference to mischmetal and its composition. It was surprising to note that the composition shown in the article is quite different than what the industry has produced during the past many years.

(Bud) Wales A. Otis
Applegate Group, Inc.
Saddle Brook, NJ 07662

Editor's Response

Dear Bud:

You are correct. The composition of mischmetal as commonly used industrially should have been listed as "a mixture of 39.3% La, 37.9% Ce, 6.4% Pr and 16.4% Nd" if derived from bastnasite, or "a mixture of 20.1% La, 49.7% Ce, 6.4% Pr and 20.4% Nd" if derived from monazite. The composition listed in the *RIC News* was for a bastnasite derived mischmetal which had been vacuum melted at 1700°C, and a significant fraction of the Nd was vaporized resulting in the values given. More details will be found in the paper by P. E. Palmer et al. *J. Less-Common Metals*, 87, 135 (1982).

We apologize for any inconvenience or problems this may have caused our readers.

Sincerely yours,
K. A. Gschneidner, Jr.
Director RIC

TMS-AusIMM Rare Earth Symposium

"Rare Earths: Resources, Science, Technology and Applications", edited by Renato Bautista and Norton Jackson, is the published proceedings of the International Symposium held jointly by The Minerals-Metals-Materials Society (TMS) and the Australasian Institute of Mining and Metallurgy (AusIMM). The symposium was held May 1-5, 1992 in San Diego, California. The book is 480 pages long and was published by TMS in 1991. It can be ordered from TMS Publications, 420 Commonwealth Drive, Warrendale, Pennsylvania, USA. The cost is $115.00 US to members of TMS, $96.00 US to student members, and $192.00 US to nonmembers.

The book contains 36 papers dealing with the topics of: geology and mineralogy; economics and markets; beneficiation, extraction and separation (including recovery of rare earths from mining waste residue); preparation and refining of metals and rare earth products; magnetic materials, super-

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Report on 12th International Workshop on RE Magnets and Their Applications by John Cook, CSIRO, Division of Applied Physics

The 12th International Workshop on Rare-Earth Magnets and their Applications and the 7th International Symposium on Magnetic Anisotropy and Coercivity in Rare Earth-Transition Metal Alloys, organized by John Cook of CSIRO, Division of Applied Physics, was held in Australia's capital city, Canberra, New South Wales, July 12-16, 1992. The Workshop was made possible with support from the Australian Department of Industry, Technology and Commerce and was attended by 135 people from 22 countries who enjoyed the approximately 120 presented papers.

The conference was dedicated to the memory of Karl J. Strnat, who passed away May 1, 1992. Marlin Walmer delivered a memorial address in honor of Dr. Strnat, and the Organizing Committee recommended that future Workshops include an Invited Memorial Lecture.

Most interest in materials centered on: mechanical alloying and processing, hydrogen decrepitation (HD), hydrogen decrepitation, disproportionation, and recombination (HDDR) processing for both magnet production and powder for polymer bonding, the 2,17 nitrides and attempts to stabilize Nd-Fe in the $ThMn_{12}$ structure with various additions followed by nitriding or carbiding. Applications were well represented with most interest in rotating machines. The bound proceedings are available in two volumes, Workshop (70 papers) and Symposium (50 papers). If sufficient orders are received by the end of October, there will be a second printing of the proceedings. Please place orders with Professor R. Street, Physics Department, University of Western Australia, Nedlands, Western Australia 6009; Fax:(61) 9 380 1014. Price is Aus$180.00 per set or Aus$90.00 per volume ($134.00 and $67.00 US, respectively).

Professor I.R. Harris announced that the 13th Workshop and 8th Symposium will be held in Birmingham, UK, 11-15 September 1994. For more information contact: Prof. I.R. Harris, School of Metallurgy and Materials, The University of Birmingham, Edgbaston, Birmingham B15 2TT, UK. Fax:44 214145232. ▲

Lanthanides and Actinides

Author Simon Cotton of Felixstowe College writes in the Preface to *Lanthanides and Actinides* the following: "This book is intended to provide an adequate background to the chemistry of the f-block metals for students in advanced undergraduate courses, as well as for postgraduates. It is hoped that it will also be of value to teachers requiring an up-to-date account of the descriptive chemistry of these metals". The volume covers structure (including recent advances in structural study), preparation, handling and reactions of the elements and their compounds. Binary compounds, complexes and organometallics are all treated. Emphasis is given throughout to applications and relevance to industrial processes. Case studies are included for particularly interesting compounds, and the tools of their study, such as spectroscopy, are described.

All books reflect the interests (and prejudices) of their author(s); this one is no exception in that it concentrates its efforts in attempting to give a sound factual foundation, relying on the bibliography to give the reader access to a wider spectrum of the literature. The appendices also provide data on ionization energies and ionic radii of both the lanthanides and actinides in a tabular format.

Lanthanides and Actinides, copyrighted in 1991, contains 202 pages and consists of three chapters: nine pages on scandium; 75 pages on the lanthanides (including Y); and 85 pages on the actinides. A 10 page bibliography is included at the end of the book. To order, send $39.95 US to Oxford University Press, Inc., Book Orders, 200 Madison Avenue, New York, New York 10157-0913, USA; Tel:(800)451-7556 Fax:(919)677-1303. ▲

Workshop in Venice - 1991

The Second Workshop on the Basic and Applied Aspects of Rare Earths was held May 9-10, 1991 in Venice, Italy. Fifteen invited lectures and 17 poster papers have been published in Volume 31 of *Materials Chemistry and Physics*. This, the March-April 1992 issue, contains 198 pages. The guest editors are G. Blasse, P. Guerriero, and P.A. Vigato.

The workshop was organized, as was the first, to bring together participants from science, technology, and marketing. The papers range from general surveys of rare earth markets and applications, to surveys of specific applications, to papers dealing with limited areas of research or applications. Of particular interest to those in the rare earth industry are the papers on: glass technology by B. Locardi and E. Guadagnino, pp. 45-9; Nd-doped solid state lasers by K. Washio, pp. 57-63; "Rare Earth Industry Update" by P. Falconnet, pp. 79-83; "Treibacher Activities on Rare Earths" by E. Baumgartner, pp. 89-91; and "Rare Earth Applications and their Market in China", by Liu Yujiu, pp. 85-8.

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19th RERC Proceedings

The 19th Rare Earth Research Conference (RERC) was held July 14-19, 1991 in Lexington, Kentucky, USA. The proceedings of this conference have been published in book form under the title *Rare Earths 1991* Volumes I and II. They have also been published as Volumes 180 and 181 of *Journal of Alloys and Compounds*, respectively. Volume I contains 443 pages and 53 papers while Volume II contains 551 pages and 60 papers. The editors are L.R. Morss, M.F. Reid, H.B. Silber, and J.D. Thompson. The books and journals were published in 1992 by Elsevier Sequoia S.A., P.O. Box 564, CH-1001 Lausanne 1, Switzerland. They may be purchased postpaid from this address for SFr.700.00 (~$532.00US) for the two volumes, or SFr.350.00 per volume if purchased separately.

Volume I contains the Frank H. Spedding Award acceptance speech by Dr. Karl A. Gschneidner, Jr. It also contains 7 papers on applied science and rare earth technology; 30 papers of spectroscopy, crystallography, surfaces, and catalysis; and 15 papers on coordination and bioinorganic chemistry.

Volume II contains 9 papers on physics and chemistry of actinides; 4 papers on rare earth and actinide magnetism; 28 papers on magnetism, heavy fermions, and superconductivity; 5 papers on metal-insulator transitions and low-dimensional materials; and 13 papers on inorganic chemistry and materials science.

The conference papers integrate basic and applied research with technological developments of rare earth and actinide elements and their compounds, and features contributions from chemistry, physics, materials science, earth sciences, metallurgy, and biological sciences. These proceedings should prove useful to most people working in the field of rare earths. ▲

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This special double issue of *Materials Chemistry and Physics* may be obtained for SFr.300($228.00US) by ordering from Elsevier Sequoia S.A., P.O. Box 564, CH-1001 Lausanne 1, Switzerland. ▲

Landolt-Börnstein Series d2

Landolt-Börnstein: Numerical Data and Functional Relationships in Science and Technology-New Series, Subvolume d2, *Compounds Between Rare Earth Elements and 3d, 4d or 5d Elements*, is a continuation of Volume 19 (Magnetic Properties of Metals, of Group III: *Crystal and Solid State Physics*). Subvolume d2, edited by H.P.J. Wijn, was published in 1990. In the old days, the 1962 *Landolt-Börnstein* (6th edition), Vol. II, part 9, dealt with the magnetic properties of a wide variety of substances. Since then, the volume of published data on the subject has increased enormously and this new compilation was necessary. This volume specifically deals with the magnetic properties of binary and psuedo-binary intermetallic compounds between rare earth and *3d*, *4d*, or *5d* elements.

The first section presents phase diagrams, crystal structure data, and comprehensive magnetic property information with the liberal use of both tables and graphs. This puts critical information quickly at your fingertips. The second section provides tables and figures of magnetic data on metallic and pseudometallic compounds of the rare earth group of elements which contain, besides the rare earth element, at least one *4d*(Ru,Rh,Pd) element or/and one *5d*(Os,Ir,Pt) element. All of the information is arranged in a quick-to-reference, user-friendly format. The two sections contained in subvolume d2 include: Compounds of Rare Earth Elements and *3d* Elements, by H.R. Kirchmayr and E. Burzo; and Compounds of Rare Earth Elements and *4d* or *5d* Elements, by A. Chelkowski.

The 545-page *Compounds Between Rare Earth Elements and 3d, 4d, or 5d Elements* contains 741 figures and is available from Springer-Verlag GmbH & Co. KG, Postfach D-1000, Berlin 33, Germany, for 1,660DM ($1100US). ▲

MONAZITE is the name selected by Breithamp in 1829 from a Greek verb meaning "to be solitary" in recognition of the rarity of the mineral at the site of its recovery near Miask in the Ilmen Mountains of Russia.

RarE Opportunity

ETiBANK, a state owned mining, metallurgy and banking company of Turkey has opened its thorium bearing barite-fluorite-bastnasite deposit to foreign participation for evaluation, mining, processing and marketing activities.

The ore body is located in midwestern Turkey and is characterized by two different types of bastnasite mineralizations. One of the deposits is a fluorite-barite-rare earth ore in the form of lenses and layers, while the other deposit is composed of carbonatitic dikes and veins. The mineral deposit is calculated to have reserves of 30,358,000 tons with an assay of 3.14% rare earth oxide. Mining by open pit should yield 11,500 tons rare earth oxide per year.

If interested, contact: Taskin Akdeniz, Sihhiye Cihan Sok. No.:2, 06443, Ankara, Turkey; Tel:4-231 70 20; Fax:4-229 21 32; Telex:42207 eti tr. ▲

The Extraction & Processing Technology Award

The Extraction & Processing Technology Award was recently presented to R.A. Sharma and R.N. Seefurth for their paper entitled "A Molten Salt process for Producing Neodymium and Neodymium Iron Alloys" which appeared in the December 1989 issue of *Metallurgical Transactions B*, pp.805-13. The award recognizes a paper (or series of closely related papers with at least one common author) that represents a notable contribution to the advancement of extraction and processing technology, particularly to nonferrous metals.

R.A. Sharma is a senior staff scientist, and R.N. Seefurth is a staff research scientist in the physical chemistry department at the General Motors Research Laboratories. Their work involves reduction of neodymium oxide or halides with calcium or sodium in a molten-salt medium and separation of the metal product in either neodymium-iron or neodymium-zinc extraction pools. ▲

New Telex Number

The telex number to the Center was changed August 1, 1992. For messages sent via telex, the new number will be: 283359 (verification IASU UR). Our telephone and fax numbers remain (515)294-2272 and (515)294-3709, respectively. ▲

Buckyball, Anyone?

Chemists are continuing to experiment with the new polymorphic form of carbon, carbon clusters. The most common one, C_{60}, is basically a carbon cage shaped like a soccer ball [*RIC News*, **21** [1],2 (March, 1986)]. One of the first buckyballs to be discovered contained a lanthanum atom encapsulated in a C_{60} cage. Lanthanum and yttrium clusters so far discovered include $La@C_{44}$, $La@C_{60}$, $La@C_{82}$, $Y@C_{60}$, and $Y_2@C_{82}$ where @ indicates that the preceeding element(s), either La or Y, is encapsulated in the carbon cage. Three other buckyballs, $La_2@C_{66}$, $La_3@C_{88}$ and $La_4@C_{110}$, are really not "balls" at all because they appear to be tube-shaped with the lanthanum atoms being held in place like peas in a pod.

These C_{60} clusters, called buckyballs or buckminsterfullerenes (also known as "fullerenes"), were named by Prof. Richard E. Smalley, Rice University, Houston, Texas, and Harry W. Kroto, of the University of Sussex, England, because they resembled some of the structures designed by the famous architect, Buckminster Fuller.

Buckyballs, because of their stability, were thought to be inert due to their icosahedral framework [*C&EN*, **69**, No.50, 17-20 (1991)] but actually they are chemically reactive, particularly with free radicals. Fullerenes have shown promise in growing diamond films, and one of the startling early discoveries was that C_{60} is a relatively high-temperature superconductor when it is doped with a number of alkali metals.

The ability of fullerenes to readily accept free radicals makes for exciting chemistry because of the increased chances of discovering new complexes. This "radical sponge" effect is attracting many scientists to attempt to synthesize many new compounds with wide-ranging properties.

Recently, the first mixed fullerene-metal endohedral complex, $LaY@C_{80}$ was synthesized at the Naval Research Laboratory [*C&EN*, **70**, No.18, 6 (1992)] and is soluble in water under certain conditions. Other interesting complexes are the scandium-fullerene complexes $Sc@C_{82}$ and $Sc_3@C_{82}$. Solid-state electron paramagnetic resonance spectra of $Sc_3@C_{82}$ indicate that the three scandium atoms are holding hands to form an equilateral triangle inside the fullerene cage. According to R.D. Johnson of the I.B.M. Almaden research Center, neither the oxidation state of the metals nor of the fullerene cage have been determined in this complex. ▲

Mount Weld

Fifteen years after the discovery of a geologic anomaly in Western Australia, Mt Weld was recognized as one of the richest rare earth resources in the world. Mt Weld is a circular volcanic plug approximately 3km in diameter and is buried under an ancient lake bed located in the Eastern Goldfields of Western Australia. The carbonatite contains 1.3 million mt of rare earth oxides (REO) at an average grade of 23.6%, with lanthanum, cerium, praseodymium and neodymium making up 93% of the the recoverable REO.

Ashton Rare Earths Limited, a member of the Ashton Mining Group, has teamed up with two Japanese companies, Mitsui Mining and Smelting Co. which is providing rare earth separation technology, and Marubeni Corp. which will play a key role in marketing, especially for sales to Japan [*RIC News*, **XXVII**, No.2, 7 (1992)]. Once production begins, 50,000 mt per year REO ore will be beneficiated on-site, producing 10,000 mt REO concentrate. Ashton will use the hydrometallurgical method to process the rare earths which involves: pre-leach; calcination; caustic conversion; caustic regeneration/concentration; drying/oxidation; hydrochloric acid leaching; removal of impurities; sulfuric acid leaching/dissolution; and solvent extraction.

Ashton believes that by the year 2000 the world demand for rare earths could total 70,000 mt, with up to 50,000 mt going to the developed nations. The total value is forecast to be US$1 billion. The company is counting on cashing in on the expected high growth in the 1990's for rare earths in: glass applications; permanent magnets; phosphors; and electronic uses. ▲

Superior Service Award

The Refractories Division of Ferro Corp. received the Superior Service Award during the Ceramic Manufacturers Association spring meeting held in Pittsburgh, Pennsylvania, U.S.A. [*Ceramic Industry*, **133**, No.5, 47-9 (1992)]. Donald J. Donewirth, president of Ferro Corp., accepted the award in behalf of the Refractories Division. The company was one of twelve companies chosen by *Ceramic Industry* readers from seven categories: Raw Materials, Manufactured Materials, Process Equipment, Equipment/Machinery, Kilns & Furnaces, Refractories, Test/Inspect/Measure/Evaluate and Contract Services. ▲

Andries R. Meidema (1933-1992)

On May 28, 1992, Dr. Andries R. Meidema, Director of the Philips Research Laboratories, Eindhoven, The Netherlands, died unexpectedly. Dr. Meidema is probably best known for his method for estimating the heats of formation of binary intermetallic compounds. For a semi-empirical method, the estimated values, when they can be verified experimentally, are quite reliable. Indeed, many theorists accept the Meidema values as if they were determined experimentally. Needless to say, other practitioners, i.e. engineers and applied scientists, have found his method extremely valuable in designing new alloys and materials, conceiving new processes, and making devices and products. He also made other valuable contributions to solid state physics.

Dr. Meidema was born November 15, 1933. He received his Ph.D in low temperature physics in 1960 and became a full professor in experimental physics in 1965 at the University of Amsterdam. He started working for Philips Research Laboratories in 1971 and became director in 1980. He was awarded the 1981 Hume-Rothery Award, the Hewlett Packard EPS Physics Prize in 1982, and was elected to the Royal Academy of Sciences in 1985.

Andries was a fine gentleman, an outstanding scientist, and a technological leader. He was also a strong supporter of the Rare-earth Information Center. His death will be a great loss to the scientific, technological and commercial communities. ▲

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Karl Strnat (1929-1992)

Karl J. Strnat, the father of rare earth permanent magnets, died unexpectedly from a heart attack on May 1, 1992. Dr. Strnat was born in Vienna, Austria, March 29, 1929. He began his career at Wright-Patterson Air Force Base near Dayton, Ohio which continued until his retirement in 1968. He then served as Professor of Engineering at the University of Dayton for 22 years until his retirement there in 1990. In the intervening 25 years he made many valuable contributions to the science and technology of rare earth permanent magnets. It was in 1966 that he and G.I. Hoffer found that YCo_5 exhibited extremely large uniaxial magnetocrystalline anisotropy and a theoretical energy product which was unheard of, and suggested it would make an excellent permanent magnet. A year later, several groups, including Strnat and co-workers showed that $SmCo_5$ was the best permanent magnet of the RCo_5 family. Dr. Strnat is also well known for organizing the first few International Workshops on Rare Earth Magnets and Their Applications. ▲

Welch Foundation Award

Richard E. Smalley of Rice University, one of the discoverers of fullerenes, the family of carbon-cage molecules commonly referred to as buckyballs, has won the 1992 Robert A. Welch Award in Chemistry. The award is given annually to a chemist who has made significant chemical research contributions. The award consists of a $225,000 US grant, a gold medallion, and certificate. Professor Smalley joined Rice University in 1977 where he has dual appointments in the departments of chemistry and physics.

Smalley has studied the structure and energy transfer of molecules in cooled supersonic jets by observing their high-resolution spectra. He invented a method for producing cold molecular beams of refractory material by pulsed laser vaporization, and described the hextuple bond in Cr_2. He most recently has developed methods for synthesizing and chacterizing clusters, work that led to the discovery of fullerenes, soccer ball-like carbon clusters. These clusters may have a metal atom enclosed inside the structure. The first buckyball he had prepared was $La@C_{60}$ [*RIC News*, **21** [1],2 (March, 1986)], where the @ sign denotes the La is trapped inside the carbon cage. See also the article entitled "Buckyball, Anyone?" on page 6 of this issue. ▲

Nominations Open for 7th Spedding Award

The 7th Frank H. Spedding Award will be presented at the 20th Rare Earth Research Conference, September 12-17, 1993, in Monterey, California U.S.A. This prestigious award is given in recognition of distinguished contributions to the basic science and/or technology of rare earth materials. The award is presented by the Rare Earth Research Conference, Incorporated, with the financial support of Rhone-Poulenc Industries.

Nominations are sought from the rare earth community, world-wide. An individual may nominate more than one person for the Award, or may propose a joint-Award for a group of leaders in a particular subfield. Seconding letters are encouraged, especially if they cover information complementary to the nominating letter.

Further information and nominating forms may be obtained from: Professor Lance E. DeLong, Chair, Spedding Award Committee, Department of Physics and Astronomy, University of Kentucky, Lexington, KY 40506-0055, U.S.A.; Fax:(606)258-2846. The deadline for admission of nominations and seconding letters is December 31, 1992. ▲

Bernard J. Beaudry

After 38 years at the Ames Laboratory, Iowa State University, Ames, Iowa, Senior Metallurgist Bernard J. Beaudry retired as head of the Rare Earth section of the Materials Preparation Center in June. During his tenure, Bernie authored or co-authored over 170 publications mostly dealing with the preparation, production and properties of ultra-high purity rare earth metals and materials. He was instrumental in maintaining Ames Laboratory's reputation for producing ultra-high purity rare earths.

Bernie will stay active during his retirement by providing much needed community service to disadvantaged youth and young adults in the Ames Area. He will provide this service with the same dedication that he gave to his scientific research.

The Rare Earths section of the Materials Preparation Center is now being directed by Mr. Timothy W. Ellis. The Center continues to provide ultra-high purity rare earth metals and materials for research.

For Service and materials, contact Mr. Ellis at: Materials Preparation Center, 242 Spedding Hall, Ames Laboratory, Iowa State University, Ames, IA 50011-3020 USA; Tel:(515)294-1366; Fax:(515)294-3709. ▲

Fourth Quarter 1992 Supporters

The following companies provided financial support to the Center in the fourth quarter, 1992. We wish to acknowledge these companies for supporting us in 1992. They are grouped according to their appropriate category with the number of years they have supported us in parentheses.

Sustaining ($400 to $999)
- Arnold Engineering Co., U.S.A. (7)
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- Bard Critical care Division of C. R. Bard, Inc., U.S.A. (3)
- Huron Valley Steel Corp., U.S.A. (2)
- Sassoon Metals Co., Inc., Belgium (7)

Rare-Earth Doped Semiconductors

The First International Workshop on Rare Earth Doped Group IV and III-V Semiconductors, Symposium E, will be held at the 1993 Spring Meeting of the Materials Research Society, San Francisco, California, U.S.A. 12-16 April 1993. The interest in the properties of rare earth ions in semiconductor hosts has been driven by the possibility of producing efficient, room temperature, electrically excited intracenter emission for optoelectronic applications. Recent work also includes electronic issues associated with ohmic contacts, metallization, magnetic field sensors and improved transport properties through rare earth doping.

The purpose of the symposium is to investigate and discuss in depth the fundamental properties of rare earth doped III-V, II-VI, and group IV semiconductors and to identify their potential for current and future electronic and electro-optical applications. Emphasis will be on addressing materials issues, fundamental physical characteristics and novel device concepts.

This symposium will be coordinated with the symposium on Silicon-Based Optoelectronic Materials. For more information contact: Gernot S. Pomrenke, Air Force Office of Scientific Research, AFOSR/NE Bldg 410, Bolling AFB, DC 20332-6448 USA; Tel:(202)767-4931 Fax:(202)767-4986.▲

TMS-AusIMM/*Continued from page 4* ⟲
conductors, and alloys; electrochemistry; corrosion protection; and emerging technologies. The papers have a wide range of topics so that most rare earthers should find something of interest. ▲

Supporters 1993

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Since the June issue of the RIC News went to press, RIC has received financial support from six new family members, and renewed support from 27 other organizations. The supporters from the first quarter of fiscal year 1993 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 parentheses, are listed below.

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- Stone Ltd., U.S.A. (1)
- Sumitomo 3M Ltd., Japan (1)
- Wheeler Associates, U.S.A. (7)

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- Department of Industry, Technology and Commerce, Australia (5)

Errata

The seventh volume of *Handbook of Magnetic Materials* will soon be published by Elsevier Science Publishers. On page 8 of the June issue of *RIC News*, we reported in error that volume 6, edited by K.H.J. Buschow, was the final volume of the series. We regret any inconvenience this may have caused our readers, or Elsevier Science Publishers and the editor, Dr. Buschow. ▲

SAMARIUM, atomic number 62, was discovered by Lecoq de Boisbaudran in 1879 and was named after a Russian mine official, Colonel M. Samarski.

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