



# RARE-EARTH INFORMATION CENTER NEWS

ENERGY AND MINERAL RESOURCES RESEARCH INSTITUTE  
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No. 2

## Rare Earth Notes Atomergic Chemetals

Atomergic Chemetals Corporation has moved into new, larger facilities. They have moved from Plainview, New York, to 91 Carolyn Boulevard, Farmingdale, New York 11735. Telephone (516) 694-9000.

### Oxide Push

Rhone-Poulenc Inc. of Monmouth Junction, New Jersey, has announced a new major development effort to produce ready-to-use rare earth/copper/alkaline earth oxides as raw materials for the production of high  $T_c$  superconductors.

### 1986 Vaaler Award

Haynes® alloy 230, developed by D. L. Klarstrom, has won the 1986 Vaaler Award. The award is given biennially by *Chemical Processing* in recognition of outstanding developments which are believed to offer improvements in the efficiency of chemical processing operations. Alloy 230 is a nickel base alloy with 22 percent chromium, 14 percent tungsten, 2 percent molybdenum, plus boron, silicon, lanthanum, and manganese. It is said to have outstanding resistance to oxidation, nitriding and carburization, and superior longtime thermal stability.

### SO<sub>2</sub> Detector

N. Imanaka, Y. Yamaguchi, G. Adachi, and J. Shiokawa have developed a detector for measuring SO<sub>2</sub> gas in hot stack gases [*J. Electrochem. Soc.*, 133, 1757-8 (1986)]. A metal sulfate-metal oxide solid reference electrode is used. The sulfate electrode contains 13.8 percent Y<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

### Galfan Markets Growing

Galfan, a zinc galvanizing coating containing aluminum and misch-

## PATTERSON AWARD



Professor David Templeton and his wife Dr. Lieselotte Templeton were awarded the A. L. Patterson Award for 1987 by the American Crystallographic Association (ACA) at its annual meeting. The award is the highest honor given by the ACA and is awarded every three years. The citation, read at the award ceremony, states in part, "... in recognition of your significant achievements in the accurate measurement of anomalous scattering terms at wavelengths near absorption edges using synchrotron radiation and your pioneering contributions to our understanding of anomalous scattering of x-rays."

David Templeton, professor of chemistry at the University of California at Berkeley, and his wife, a research scientist, have been associated with the university and the Lawrence Berkeley Laboratory for many years. They found astonishingly large anomalous scattering from lanthanides and studied the crystal structures of many rare earth compounds, both organic and inorganic.

metal, [*RIC News*, XX [4] 2 (1985)] has had a solid market growth since being introduced in 1985. Weirton Steel Corporation, which produces galvanized sheets up to 48 inches wide, has increased their production by more than 50 percent. They report that the fuel tank for the 1989 Thun-

(Continued on page 3)

## T<sub>c</sub> NEWS

It has been 50 years since K. Mendelssohn and J. G. Daunt discovered superconductivity in lanthanum [*Nature*, 139, 473 (1937)]. Since then the rare earths have played an important part in the study of superconductivity, but the most exciting role is occurring now with the discovery of, and subsequent worldwide push to develop, the new ceramic superconductors with proven  $T_c$ 's of over 90 K. The general formula is  $RBa_2Cu_3O_{6-y}$ , where R is a rare earth metal.  $T_c$  is essentially independent of R, indicating that R plays only a minor role in the superconductivity. The rare earths that have higher oxidation states (cerium, praseodymium, and terbium) do not form this superconducting phase. The copper is present in a mixed valent state with the oxygen stoichiometry playing an important part in the ability of the ceramic to become superconducting.

The scientific and technological world have gone absolutely wild in their efforts to find the "best" ratio of ingredients, the "best" method of preparation, and the "best" theory to explain what is going on. Scores of researchers around the world have dropped everything to pursue the ultimate dream of getting these new materials ready for practical applications. They have been working days, nights, and weekends; packing scientific meetings; flooding editorial offices of scientific journals with manuscripts; and have taken to sending preprints to each other by express mail to establish priority of discovery. Many new publications and services have begun to help spread the knowledge and bibliographic references. Among the services are the following.

### High $T_c$ Update

May 1, 1987, was the publication  
(Continued on page 3)

## RE—BYC 1787—1987

### Luminescence Applications

Mel Tecotzky  
Matrix

One of the most significant discoveries in rare earth technology is the commercial and medical applications of rare earth luminescence.

Even though Urbain reported on the cathodoluminescent properties of  $Gd_2O_3:Eu$  in 1907, no significant applications appeared until the middle 1960s when  $YVO_4:Eu$ ,  $YVO_4:Eu,Bi$ ,  $Y_2O_3:Eu$ ,  $Gd_2O_3:Eu$ , and  $Y_2O_3S:Eu$  were introduced as red phosphors for color television. These technological advances had a profound influence on the rare earth industry as there was now commercial justification to build large separation plants to prepare large quantities of high purity, rare earth oxides. The TV industry has now settled on  $Y_2O_3S:Eu$  as the red phosphor of choice. Other important rare earth phosphors for specialty CRTs followed:  $Gd_2O_3S:Tb$  for avionics;  $Y_2O_3S:Tb$  a one component black and white phosphor for special displays; and terbium and cerium activated rare earth garnets, for high current density and rapid decay displays.

The luminescent properties of the rare earths have also improved the quality of fluorescent lamps. There are now blue, green, and red rare earth phosphors used in fluorescent lamps to improve energy efficiency and natural color rendition.

While CRT and fluorescent lamp applications of rare earth phosphors are important, the most significant application of rare earth luminescence is in medicine. Calcium tungstate was the only significant x-ray phosphor for 70 years. In the early 1970s rare earth phosphors were introduced as x-ray phosphors for intensifying screens. Through the use of these phosphors, which have excellent conversion efficiency, and x-ray photon absorption in the medical range, it is possible for a patient to get an x-ray of equivalent image quality with half the dose. Since medical x-rays are the greatest source of radiation a person receives we have been able to decrease the total amount of radiation a patient

(Continued in next column)



### \*\* THANKS \*\*

Two more companies, BOSE Corporation and Eastman Kodak Company, have become eligible to have their names listed on our honor roll for 10 years of support. They join 29 others who have had their names in the honored spot in the *RIC News*. We are appreciative of all our sponsors but wish to express a special thanks to the 31 companies who have had their names listed in this special place of honor.

(Continued from previous column) receives. In addition decreased exposure time reduces loss of image detail or blurring due to patient motion, reducing the need for retakes, especially for children. The rare earth x-ray phosphors in current commercial use are:  $Gd_2O_3S:Tb$ ,  $LaOBr:Tb$ ,  $LaOBr:Tm$ ,  $Y_2O_3S:Tb$ ,  $BaFCl:Eu$ , yttrium tantalate:Nb, and yttrium tantalate:Tm. These phosphors are used in general diagnostic radiology for many types of examinations. In addition,  $Gd_2O_3S:Tb$  is used for mammography.

Futhermore, the rare earth x-ray phosphors have reduced the exposure of the staff and led to new developments in the x-ray field. Medical costs have also been reduced by saving time, extending the life of equipment, and by reducing the amount of silver in the x-ray film.

**Editor's Note:** Since the last issue several readers have taken up the editor's challenge and submitted brief write-ups concerning historical events that have occurred in the last 200 years. We would like to hear from more of you since there are still many important events, discoveries, etc., some fairly current, which have not been described or discussed. All entries received will be published in a booklet early in 1988 and made available to our *RIC* subscribers.

## MEETINGS HTSC-M<sup>2</sup>S

A conference to bring together the new and exciting field of High-Temperature Superconductors with the long-standing interests in Materials and Mechanisms of Superconductivity will be held from February 29 to March 4, 1988 in Interlaken, Switzerland. The program will include plenary sessions, symposia, and poster sessions covering basic research, solid state chemistry, potential applications, theoretical models, etc. For more information, address your inquiries to Secretariat HTSC-M<sup>2</sup>S, Physics Department, ETH-Hönggerberg, CH-8093 Zürich, Switzerland.

### Crystal Field Effects and Heavy Fermion Physics

The 6th International Conference on Crystal Field Effects and Heavy Fermion Physics will be held July 18-21, 1988, in Frankfurt, West Germany. It will be held one week before the International Conference on Magnetism (ICM 88). The program will consist of invited and contributed papers as well as posters and the proceedings are to be published. At least one session will be devoted to high T<sub>c</sub> superconductors. The deadline for abstracts is March of 1988 with full papers due in June. For more information contact W. Assmus, conference secretary, Physikalisches Institut, University of Frankfurt, P.O.B. 11 19 32, 6000 Frankfurt 11, Federal Republic of Germany.

### Rare Earth Symposium

A Rare Earth Symposium is being organized as part of the 1989 TMS-AIME Annual Meeting to be held February 27 to March 3, 1989, in Las Vegas, Nevada, U.S.A. The symposium will consist of six sessions—extraction, separation, purification, preparation, production, and applications. The objective is to highlight the current state of the art and advances in each session area for the rare earth metals and their alloys and compounds. It is being planned for research and development scientists and engineers, industrial plant supervisors and operators, materials scientists, and designers of en-

(Continued on page 3)

## PROCEEDINGS 17th RERC

The proceedings of the Seventeenth Rare Earth Research Conference held June 9-12, 1986, in Hamilton, Ontario, Canada, have been published in the *Journal of the Less Common Metals*, Volumes 126 and 127. The hard cover books are also entitled *Rare Earths 1986* and were edited by H. B. Silber, L. R. Morss, and L. E. DeLong. The first volume is 434 pages and contains sections on science and technology of intermetallics, lasers in rare earth spectroscopy, coordination chemistry, and organometallic chemistry. The second volume is 404 pages and contains sections on solid state structures and bonding, heavy fermion metals, and mixed valence compounds. The two volumes are available for U.S. \$351.50 from Elsevier Sequoia S.A., P.O. Box 564, 1001 Lausanne, Switzerland.

### MEETINGS

(Continued from page 2)  
gineered materials. The proceedings, according to plans, will be published and available at the meeting. Abstracts are due February 1, 1988, with manuscripts due June 1, 1988. To receive further information contact either Renato G. Bautista, Mackay School of Mines, University of Nevada-Reno, Reno, Nevada 89557-0046, U.S.A., or Morton M. Wong, Union Oil of California, 376 South Valencia Avenue, Brea, California 92621, U.S.A.

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K. A. Gschneidner, Jr. . . . Editor  
Jennings Capellen . . . Staff Writer

## Minerals Availability

Bureau of Mines Information Circular 9111, published in 1986, and entitled *Availability of Rare-Earth, Yttrium, and Related Thorium Oxides—Market Economy Countries, A Minerals Availability Appraisal* is available. This 19-page circular can be obtained from the Division of Minerals Availability, Bureau of Mines, 2401 E Street, N.W., Washington, D.C. 20241, U.S.A. The report discusses the general rare earth field and then addresses the availability of rare earth oxides in concentrated form from 29 foreign and 9 domestic properties.

### T<sub>c</sub> News

(Continued from page 1)

date of a new bulletin entitled *High T<sub>c</sub> Update*, which is sponsored by the Division of Materials Sciences, Office of Basic Energy Sciences, United States Department of Energy (USDOE). The bulletin is being produced and published for the USDOE by the Ames Laboratory at Iowa State University. To get more information on the content and availability of *High T<sub>c</sub> Update* contact the editor, Ellen Feinberg, Ames Laboratory, Iowa State University, Ames, Iowa 50011, U.S.A. [Telephone (515) 294-3675].

### Video Tapes

The American Physical Society (APS) and American Chemical Society (ACS) have both announced the availability of video tapes on high temperature superconductors. The APS tapes are of the historic March 18, 1987, session in New York. The ACS tapes were made April 7, 1987, at the Denver, Colorado, meeting. For more information write High Temperature Superconductivity Tapes, American Physical Society, 335 E. 45th Street, New York, N.Y. 10017, U.S.A. or Department of Nontraditional Education, American Chemical Society, 1155 16th Street, N.W., Washington, D.C. 20036, U.S.A.

### Superconductors Update

*Superconductors Update*, a new printed current awareness service, is being published by STN International. The *Update*, according to a news release, contains all the abstracts of superconductor research published in the scientific literature

(Continued in next column)

## CONFERENCE CALENDAR

9th Intl. Workshop on Rare-earth Magnets and Their Applications and 5th Intl. Symposium on Magnetic Anisotropy and Coercivity in Rare Earth-Transition Metal Alloys

Bad Soden, West Germany  
August 31-September 3, 1987  
RIC News, XXI, [1] 4 (1986).

Intl. Conference on High-Temperature Superconductors and Materials and Mechanisms of Superconductivity (HTSC-M<sup>3</sup>S)

Interlaken, Switzerland  
February 29-March 4, 1988  
\*This Issue

6th Intl. Conference on Crystal Field Effects and Heavy Fermion Physics

Frankfurt, West Germany  
July 18-21, 1988  
\*This Issue.

18th Rare Earth Research Conference (RERC)  
Interlaken, Lake Geneva, Wisconsin, U.S.A.  
September 11-15, 1988  
RIC News, XXI, [3] (1986).

TMS-AIME Rare Earth Symposium  
Las Vegas, Nevada, U.S.A.  
February 27 - March 3, 1989  
\*This Issue

### \*New Listing

### RE Notes

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derbird will use this material and that it is being considered for floor pans, door interpanels, exhaust system clamps, etc. Other users include the appliance industry, construction companies, agricultural equipment builders, various marine industries, and electrical equipment manufacturers. Underwriters Laboratory has certified that 0.6 ounce of Galfan per square feet is equal to or better than 0.9 ounces of normal galvanizing material.

(Continued from previous column)

and available on-line in two STN files, the PHYS FILE, produced by Fachinformationszentrum Energie, Physik, Mathematik GmbH, and the CA FILE produced by Chemical Abstracts Services. The journal is published every two weeks and the subscription price for all of 1987 is U.S. \$650 before June 30 and U.S. \$750 thereafter. A separate 650-page book entitled *Superconductors Update, January-March 1987* is available for U.S. \$150. For more information contact STN Information®, % Chemical Abstracts Service, P.O. Box 02228, Columbus, Ohio 43202, U.S.A.

## MAGNET MATERIALS

Although the eyes of the world are focused on the newest developments in superconductivity, other fields are still generating materials of interest. Two reviews and a bibliography on rare earth permanent magnet materials have been received by the RIC and are reviewed below.

W. E. Wallace is the author of "Rare Earth-Transition Metal Permanent Magnet Materials," published in *Progress in Solid State Chemistry*, **16**, 127-162 (1985). The paper is divided into seven sections with one section on  $RNi_5$  and  $RCo_5$  systems, one on  $R_2T_{17}$  ( $T = Fe, Co, or Ni$ ) systems and one on the  $R_2Fe_{14}B$  systems. The other sections present the general magnetic characteristics of rare earth intermetallics, the reasons why rare earths are prime materials for magnets, and the applications of these magnets.

"New Permanent Magnet Materials" is the title of a review by K. H. J. Buschow published in a brand new journal, *Materials Science Reports*, **1**, [1], 1-63, (1986). This review, while mentioning other magnets, is mainly concerned with the  $R_2Fe_{14}B$  materials. Means of preparation and its effect on their mechanical properties, applications, and magnetic properties are discussed thoroughly. The publishers of this journal will send interested scientists a free introductory copy of this first issue, if you write Ms. A. Broekgaarden, North-Holland Physics Publishing, P. O. Box 103, 1000 AC Amsterdam, The Netherlands.

A bibliography has been compiled by E. M. T. Velu and E. C. Subbarao. Entitled "Bibliography Rare Earth-Transition Metal Permanent Magnet Materials: 1960-1985", it can be found in the *Journal of Materials Science*, **21**, 3387-3412 (1986). The bibliography has 848 citations. The papers are divided into year of publication with individual papers listed alphabetically using the first author. This section is followed by a subject index, a material index, and an author index. This published bibliography is a condensed version of an unpublished one the authors compiled with over 1,400 entries.

These three articles, along with our report IS-RIC-9 [*RIC News*, **XXI**, [2] 1 (1986)] should give any scientist a clearer picture of the rare earth permanent magnet field.

## \*\* SPONSOR RECORD \*\*

Our family of sponsors now has 113 members, 23 more than last year's record of 90. Our heartfelt thanks to each of our sponsors for their wonderful support. During the last quarter of fiscal 1987 we received support from 36 sponsors, with 8 being new additions to our family. The companies are listed below, with the number of years they have been supporting the RIC in parentheses.

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 BOSE Corporation, U.S.A. (10)  
 Ceradyne Incorporated, U.S.A. (2)  
 The Chinese Society of Rare Earth, People's Republic of China (2)  
 Cia Vale Do Rio Doce, Brazil (1)  
 Delco Remy, Division of General Motors Corporation, U.S.A. (3)  
 Dow Chemical U.S.A., Texas Division, U.S.A. (1)  
 Eastman Kodak Company, U.S.A. (10)  
 Electro-Craft Corporation, U.S.A. (1)  
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 F. G. Jones Associates, U.S.A. (3)  
 London & Scandinavian Metallurgical Company, Limited, England (3)

(Continued in next column)

## EDWARD MORRICE, JR.

Edward Morrice, Jr., passed away December 22, 1986, after battling pancreatic cancer for a year. He was born June 13, 1924, and spent half of his 62 years working with the U.S. Bureau of Mines at Reno, Nevada. His main interests were the preparation and purification of rare earth metals and alloys by electrowinning and electrorefining. His recent efforts were devoted to establishment of the minerals processing laboratory in the Mackay School of Mines at the University of Nevada, Reno, from which he had earlier received his Geological and Metallurgical Engineering degrees. The university has now named the laboratory the Edward Morrice Minerals Processing Laboratory.

(Continued from previous column)

LTV Aerospace and Defense Company, U.S.A. (3)  
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