



RARE-EARTH INFORMATION CENTER NEWS

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PYROCHLORES

M. A. Subramanian, G. Aravamudan, and G. V. Subba Rao have authored a 89 page treatise entitled "Oxide Pyrochlores—A Review." The review containing 260 references appears in *Progress in Solid State Chemistry*, 15, [2] 55-143 (1983).

About 150 ternary metallic oxides that have the general formula $A_2B_2O_7$ (A and B are metals) and are isostructural with the mineral pyrochlore are known to exist. These compounds are predominantly cubic and ionic in nature but are capable of possessing a wide variety of interesting physical properties. They can exhibit insulating through semiconducting to metallic behavior with some even having a semiconductor-to-metal transition point. Many show interesting di-, piezo-, and ferro-electric properties. When a rare earth is present as an A atom, magnetic behavior may range from simple paramagnetism to ferro- or antiferro-magnetism with ordering at or below 77K. Some rare earth containing pyrochlore structures exhibit fluorescent and phosphorescent behavior and are possible laser host materials. Many "defect" pyrochlores ($A_2B_2O_6$ or AB_2O_6), some containing scandium or yttrium, possess good cationic conductivity, can be considered solid electrolytes, and are found to behave as oxygen electrodes. In many cases the A and/or B atoms may be different metals giving a quaternary or quintinary oxide, e.g. La_2ScNbO_7 and $LaCdNbTiO_7$.

The review includes five main sections besides the introduction and conclusion. The first deals with the crystallography of pyrochlores and the various crystal parameters. The second discusses the $A_2^{3+}B_2^{4+}O_7$ or $(3+, 4+)$ pyrochlores. Included are pyrochlores containing 3d, 4d, 5d and group IVA metals as B atoms. In

Rare Earthers Rhone-Poulenc Vice-President

C. Richard Tevebaugh has been elected a vice president of Rhone-Poulenc, Inc. He will continue to serve as general manager of the company's Special Products Division in addition to his new duties as vice president. The Special Products Division markets rare earths, aluminas, gallium, and inorganic salts. Rhone-Poulenc, Inc. of Monmouth Junction, New Jersey is the United States subsidiary of Rhone-Poulenc S.A. of France, a leading supplier of separated high-purity rare earths. The RIC wishes to congratulate Richard on his promotion and wish him every success.



Appointment

The Special Products Division of Rhone-Poulenc, Inc. has appointed Paul Lange as product development manager. He will be involved in the development of new business areas for cerium, lanthanum, and neodymium and a member of the Commercial Development Department. Paul previously worked in sales and marketing with Diaguide, Inc.

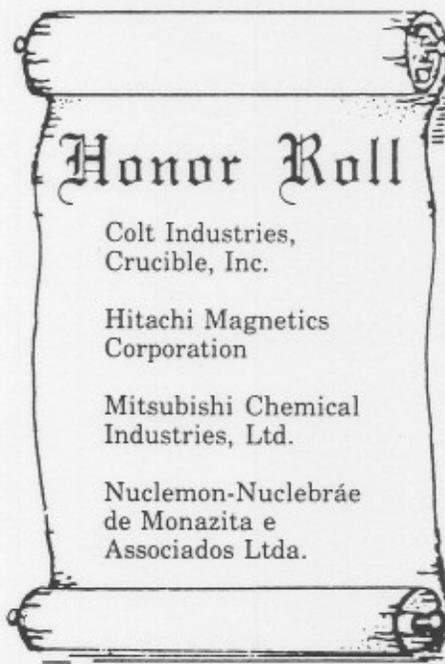
many cases a rare earth element is the A atom.

The $A_2^{2+}B_2^{5+}O_7$ or $(2+, 5+)$ pyrochlores are discussed in the third section. In this case most of the A atoms are divalent and the B atoms are pentavalent. One must remember that this is a general rule and as long as the ionic radius and charge neutrality criteria are satisfied, a wide variety of elemental substitution can occur at the A, B, and/or O sites. This

(Continued on page 4)

** THANKS **

Four companies joined our select list of sponsors who have supported the Center for at least 10 years. We wish to express our deepest appreciation to all of our sponsors, but especially the 26 companies who have been with us for 10 years plus. The companies reaching the 10 year plateau and thus earning a spot on our honor roll are listed below.



RE's in the News

World Record 45MGOe

Crucible Research Center has produced a permanent magnet with a world record energy product of 45 mega gauss oersteds (MGOe). The magnetic material, developed under the direction of Dr. K.S. Narasimhan, technical director, Magnetics Section, is an alloy of neodymium, iron, and boron. [See *RIC News* XIX [1] (1984) and XVIII [1] 2 (1983)].

(Continued on page 3)

CONFERENCE CALENDAR

- Intl. Conf. on Luminescence—1984
Madison, Wisconsin U.S.A.
August 13-17, 1984
RIC News XVIII [3] 5 (1983)
- 4th Intl. Conf. on Valence Fluctuations
Köln, West Germany
August 27-30, 1984
RIC News XVIII [3] 5 (1983)
- REACIM-84 Electron Structure and
Properties of Rare Earth and Actinide
Intermetallics
St. Pölten, Austria
September 3-6, 1984
RIC News XVIII [2] 2 (1983)
- Intl. Symp. on Rare Earth Spectroscopy
Wrocław, Poland
September 10-15, 1984
RIC News XVIII [4] 4 (1983)
- NATO Advanced Study Institute:
Fundamental and Technological Aspects of
Organo-*f*-Element Chemistry
Acquafredda di Maratea, Italy
September 10-21, 1984
RIC News XVIII [4] 3 (1983)
- 2nd Intl. Conf. on Physics of Magnetic
Materials
Warsaw, Poland
September 17-22, 1984
RIC News XVIII [4] 4 (1983)
- Intl. Symp. on Actinide/Lanthanide
Separations
Honolulu, Hawaii USA
December 16-22, 1984
RIC News XVIII [2] 2 (1983)
- Intl. Rare Earth Conf.: Materials and
Chemistry
Zürich, Switzerland
March 18-22, 1985
RIC News XVIII [3] 3 (1983)
- 5th Intl. Conf. on Crystalline Field
and Anomalous Mixing Effects in
f-Electron Systems
Sendai, Japan
April 16-19, 1985
This Issue
- 1985 InterMag Conference
St. Paul, Minnesota USA
April 28-May 2, 1985
RIC News XIX [1] 3 (1984)
- 8th Intl. Workshop on Rare Earth-
Cobalt Permanent Magnets and
Their Applications
Dayton, Ohio USA
May 6-9, 1985
RIC News XIX [1] 3 (1984)
- Intl. Conf. on Rare Earth Developments and
Applications and Intl. Fair for Rare
Earths and Their Application Products
Beijing, People's Republic of China
September 10-14, 1985
This Issue
- 17th Rare Earth Research Conference
Hamilton, Ontario, Canada
June 8-12, 1986
This Issue

\$ Good Fourth Quarter \$

The 1984 fiscal year is coming to a close and, as usual, the fourth quarter has been the big one. Eighteen sponsors sent in their support, bringing to 46 the number for the year. This is 1 less than last year's record.

We wish to thank all companies that contributed their support last year and invite any company that has business connected in any way with the rare earths to inquire about the benefits of sponsoring the RIC. We appreciate industry's support, which allows us to serve the public and spread the news about developments in the rare earth field.

Fourteen companies renewed their support during the fourth quarter of the 1984 fiscal year and we gained the support of 4 new organizations. These 18 companies are listed below with the number of years of sponsorship in parentheses.

- Aldrich Chemical Company, Inc.,
USA (5)
- Allied Chemical Corporation,
USA (12)
- BOSE Corporation, USA (7)
- General Electric Company, USA (9)
- GTE Laboratories, Inc., USA (12)
- GTE Products Corporation, USA (12)
- Hitachi Magnetics Corporation,
USA (10)
- Inland Motor Division, Kollmorgan
Corporation, USA (8)
- Kolon Trading Company, USA (11)
- Rare Earth Products, A Division of
Johnson Matthey Chemicals,
Limited, England (12)
- Rare Earth Trading, Hong Kong (1)
- Storage Technology Corporation,
USA (1)
- Trans-Tech, Inc., USA (3)
- United Technologies Research
Center, USA (1)
- V/O Techsnabexport, USA (7)
- Western Mining Corporation
Limited, Australia (1)
- Williams Strategic Metals, Inc.,
USA (2)
- Yue Long Chemical Plant, People's
Republic of China (4)

MEETINGS

China Conference and Trade Fair

The Chinese Society of Rare Earth is sponsoring an International Conference on Rare Earth Development and Applications to be held in Beijing, September 10-14, 1985. At the same time, in conjunction with the State Council for the Promotion of International Trade, they are also planning an International Fair for Rare Earths and Their Application Products.

For information about the fair or conference contact Mr. Tang Kefeng, 2 Xinjiekou Wai Dajie, Beijing, People's Republic of China, Telephone 657215 or Telex 22604 MIEC CN. Preliminary information can be obtained from the RIC.

The conference will cover the entire field of interest in the rare earths from geochemistry to final applications, with emphasis on the practical applications and chemical and physical characterization. The fair will have items arranged in the following sections: (1) rare earth research and production technology transfer; (2) rare earth products; (3) rare earth application products; and (4) reagent chemicals, instruments and equipment for use in research and production.

Mixing Electrons

Sendai, Japan will host the 5th International Conference on Crystalline Field and Anomalous Mixing Effects in *f*-Electron Systems on April 16-19, 1985. The deadline for submission of an abstract is November 1984 with the complete paper to be submitted at the conference.

Anisotropic mixing effects between *f*- and conduction electrons or band states are important in the crystalline field mechanism. Recently, higher order effects, including anisotropic mutual interactions, and their relationship to dense Kondo effects and valence instabilities have attracted much interest in the scientific community. Papers dealing with these problems involving either 4*f* or 5*f* electrons are encouraged. The program will include invited as well as contributed papers and a poster session. For more information contact Professor O. Sakai, Secretary, Department of Physics, Faculty of Science, Tohoku University, Sendai 980, Japan.

RE's in the News

(Continued from page 1)

ble Magnetics Division of Colt Industries intends to market this alloy under the trade name Crumax[®]. Crumax 35 will be the first of a planned family of permanent magnet materials to be marketed and will have a BH_{max} of 35 MGOe.

Narasimhan says the alloy system exhibits remarkable flexibility that has yet to be fully explored. One shortcoming of the alloy system is its Curie temperature of 150°C, but he calls the prospect for raising the Curie point extremely promising.

Crucible Research Center has developed a bulk sintering manufacturing process for these alloys that avoids the use of spin-quenching techniques used by others. The sintering process also produces an anisotropic material in which magnetic domains are oriented in one direction as compared to the omni-directional orientation found in spin-quenched material. Crumax 35[®] will be produced at Elizabethtown, Kentucky, with an expected output of 3,000 pounds per month to be reached during the fourth quarter of 1984.

New Journal

The Chinese Rare Earth Society has begun sponsorship of a new journal entitled, appropriately enough, *Journal of the Chinese Rare Earth Society*. The first issue was in June 1983 and it is to be published twice a year. The text is in Chinese but each article has an English abstract and

(Continued on page 4)

Second Rare-Earth Chemistry Symposium University of São Paulo, Brazil



Left to right, first row: A. Vaillati, L. C. Garla, A. C. N. Souza, M. Ionashiro, L. B. Zinner, G. R. Choppin, L. Niinistö. Second row: E. Scoralick, J. E. X. Matos, L. R. F. Carvalho, E. C. Silva, R. Miotti, R. Najjar, J. M. Dantas, M. J. Campos, L. S. Marques, M. S. M. Mantovani. Third row: G. Lüders Neto, A. O. Silva, H. F. Brito, J. R. Matos, V. M. De Bellis, L. T. Atalla, A. Abrão, L. Federgrün, C. R. Modenesi. Fourth row: S. Nardo, S. M. Melo, A. B. Nascimento, E. C. Boica, V. Blatt, M. T. Carlos. Fifth row: T. Tatuma, M. G. Silva, M. A. Silva.

Photo courtesy of G. Vicentini

As part of the 8th Annual Meeting of the São Paulo Academy of Science, the 2nd Rare-Earth Chemistry Symposium was held at the University of São Paulo, Brazil, in October 1983. Some of the participants are pictured above as they enjoyed the beautiful spring weather. The proceedings of the symposium, entitled *Rare Earth Chemistry*, is available from the Academia de Ciências do Estado de São Paulo, Caixa Postal 22.297-CEP 01498, São Paulo, Brazil. The 230-page, soft-cover book costs U.S. \$15.00, which includes air postage. The proceedings were edited by G. Vicentini and L. B. Zinner. The plenary lectures by L. Niinistö, "Preparation and Characterization of Rare Earth Luminescent Compounds," and G. R. Choppin, "Solution Chemistry of the Lanthanide Elements," are in English. Nine of the remaining papers are also in English, with six in Portuguese with English abstracts.

Dmitri I. Mendeleev

This is the 150th year since the birth of Russia's most famous chemist, Dmitri I. Mendeleev. He was born February 8, 1834 in the Siberian town of Tobolsk. Mendeleev made his most important contribution to science with his discovery in 1869 of the periodicity of the chemical properties of the elements. He spent the next 20 years developing a periodic table based on his findings. In June 1889 he presented his ideas in a lecture to the London Chemical Society and they have been a cornerstone in teaching chemistry and research on the chemical properties of the elements ever since. Elements missing in his table, including scandium, have been found and their properties have matched those predicted by Mendeleev.

17th Rare Earth Research Conference

The tentative dates for the 17th Rare Earth Research Conference (RERC) have been set. The 17th RERC will be held at McMaster University, Hamilton, Ontario, Canada, on June 8-12, 1986. Originally scheduled for August 1985, the dates were changed to eliminate overlap with the International Rare Earth Conference: Materials and Chemistry, to be held in Zürich, Switzerland, in March 1985. According to the organizers of the two conferences, a meeting will be held in odd numbered years in Europe and one in the United States or Canada in even numbered years. Further information on the 17th RERC will be published in the *RIC News* when it is received from the organizing committee.

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Pyrochlores

(Continued from page 1)

is true for all the pyrochlores.

In the fourth section the authors discuss the defect pyrochlores where vacancies can occur as part of the structure. These defects occur at the A or O sites. The special structures and properties of the defect compounds are given in this section.

The last of the major sections deals with some of the applications of the many compounds with the pyrochlore structure. Since the electronic behavior of pyrochlore and related oxides vary widely they have a wide range of applications. In solid state devices they can be used as high permittivity ceramics, thermistors, thick film resistors, and switching elements. Other uses for these adaptable materials are (1) electrodes in MHD power generators, (2) heating elements in furnaces, (3) oxygen electrodes, (4) semiconductor electrodes for solar energy conversion, and (5) solid electrolytes.

As the authors point out, no single description can bring out all the interesting and unique features of the pyrochlores. Since the structure is amendable to substitutions at the A, B, or O sites, there are innumerable possibilities for synthesizing new compounds and therefore fabrication of tailor-made materials to meet certain application requirements. Good theoretical models and detailed band structure calculations are needed to not only quantify the experimental data but to allow the prediction of new and unique physical properties for the many pyrochlore compounds known and yet to be discovered.

(Continued from page 3)

each issue contains an English table of contents. In future issues some important theses will be published in both Chinese and English. Its coverage will run the gamut from rare earth geology and ore processing to solid state physics and chemistry to applications of the rare earths and their products.

The journal is available on a subscription basis or in exchange for other publications. For subscriptions contact: The Subscription Section, China National Publishing Industry Trading Corporation, P.O. Box 614, Beijing, The People's Republic of

(Continued in next column)

Rare Earth Survey

Joyce Griffiths, deputy editor, has compiled a survey of the rare earth industry in *Industrial Minerals*, No. 199, 19-37, April 1984. It covers the producers and processors of raw materials world wide, except for Russia, as well as the producers of the rare earths and rare earth products. The review includes the minerals and their composition, processing of the minerals and concentrates, separation of the rare earths, imports and exports, and uses of the rare earths. It also discusses new developments and looks at the future. The April issue can be obtained for 6.50 (~\$9.00 U.S.A.) surface mail or 8.00 (~\$11.00 U.S.A.) air mail from Metal Bulletin PLC., Subscription Fulfillment Department, Park House, 3 Park Terrace, Worcester Park, Surrey KT4 7HY, England.

RE's in the News

(Continued from previous column)

China. To inquire about exchange of publications contact the Editorial Office of the *Journal of the Chinese Rare Earth Society*, No. 2 Xijiekou Wai Dajie, Beijing, The People's Republic of China.

New Alloy

Cabot alloy no. 214 is described as "a nickel base, high temperature alloy with excellent resistance to oxidation, carburization, and chlorination." Its nominal composition is 16.0 Cr, 2.5 Fe, 4.5 Al, and the balance Ni plus a small amount of yttrium. Potential applications include furnace parts, high temperature test racks, heating elements, radiant tubes, gas turbine parts, brazing fixtures, roller hearths, retorts, and support systems for ceramics.

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Ames, Iowa 50011

Allen Whitfield

Allen Whitfield died March 12, 1984, at the age of 80. A lawyer by training, he had a keen sense of civic pride and dedication to the American way of life. He served willingly, enthusiastically, and ably in various capacities in politics, business clubs, and as national president of the Jaycees. He worked with the National Fund for Medical Education and was a member of the Board of Governors for the Iowa State University Foundation. He graduated from Iowa State University in 1924.

He believed that the health of the economy depended upon the development of new materials and applications through research. In the past five years he had developed an intense interest in the rare earth elements and was a strong booster of the Rare-Earth Information Center. His contributions to family, city, state, and nation will be missed.

John C. Jamieson

The RIC has learned of the death of John C. Jamieson on June 26, 1983, in Chicago after an extended illness. Jamieson's experimental research included the determination of the crystal structure and elastic moduli of minerals and metals under high pressures and temperatures. He first worked with tungsten carbide anvils and later developed and introduced the diamond anvil. He studied several rare earth materials including cerium and dysprosium.