RARE-EARTH INFORMATION CENTER NEWS

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AIME Alloy Theory Conference

Eight papers on the "Alloy Theory of the Rare-Earth Metals" were presented at the Fall Meeting of the Metallurgical Society of the Amer. Inst. of Mining Met. and Pet. Engr. The first paper, "Band Structures" by J. O. Dimmock, Massachusetts Institute of Technology, discussed the theoretical calculations of the electronic structures of the rare-earth metals. Several different methods for calculating the band structures were discussed and the usefulness and limitations of each were summarized.

"Transport and Magnetic Properties" by Sam Legvold, Iowa State University, dealt with rare-earth metal single crystals. The influence of the magnetic structures and band overlap on some of the properties were clearly demonstrated in several instances.

The results of neutron inelastic scattering experiments being carried out in several different laboratories were summarized by S. K. Sinha of Iowa State University in his talk, "Neutron Scattering." He noted that the phonon dispersion curves for the normal hexagonal rare-earth metals were similar to one another and that the number of 4*f* electrons does not affect these curves. Furthermore, he pointed out that they have strong long-range forces within the basal plane but not between layers.

The results of "Mossbauer and Nuclear Magnetic Resonance" studies on the rare-earths was reviewed by G. M. Kalvius, Argonne National Laboratory. The similarities and differences between these two techniques were briefly summarized. The experimental difficulties in using these techniques to study rare earths and some of the significant and important results were noted.

C. C. Koch, Oak Ridge National Laboratory, spoke on "Solid Solution Intra-Rare-Earth Alloys." The results from different laboratories were summarized, and several diverse explanations dealing with the existence of the various phases observed in these alloys were discussed.

"Solid Solutions with Non-Rare-Earth Metals" was presented by K. A. Gschneidner, Jr., Iowa State University. He stated that information gleaned from these studies has shed new light on the factors which influence the formation of solid solution alloys.

Hugo Steinfink, University of Texas, delivered a paper entitled "Crystal Chemistry of Semi-Metallic-Rare-Earth Compounds." The major portion of his talk was concerned with the sulfides, selenides and tellurides, especially the R_3X_4-R_3X_2 region in the rare-earth(R)-chalcogenide(X) systems.

The final paper was presented by W. B. Pearson, University of

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New Service from RIC

The Rare-Earth Information Center is now in a position to offer an additional service to the scientific and technological community. RIC is providing extensive surveys or searches and in-depth analyses on a cost basis. However, we will continue to answer most inquiries on a no charge basis as in the past, except for those which require a large amount of staff time to answer. We will inform the requester beforehand if there will be a charge made for our services.

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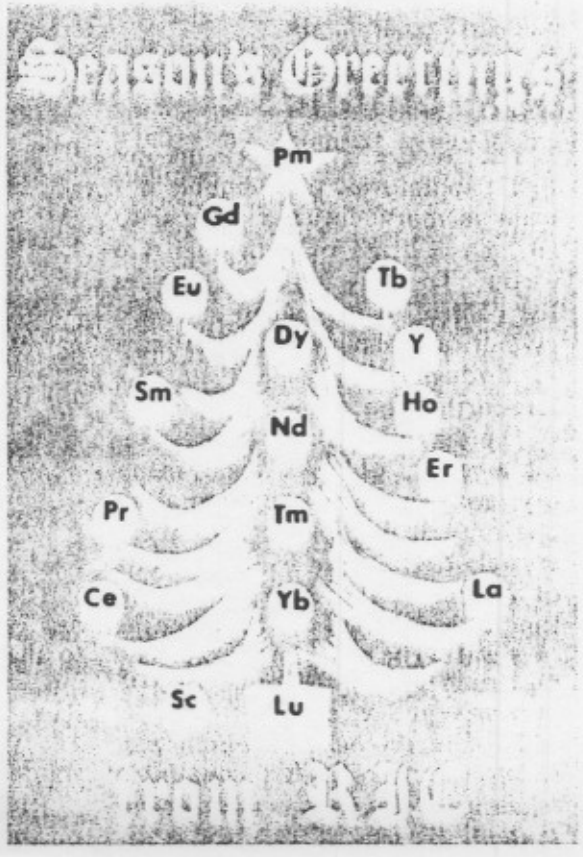

More RIC Support

Two more rare-earth producers, Forskningsgruppe for Sjeldne Jordarter (Rare Earth Research Group) of Oslo, Norway and Nippon Yttrium Company, Ltd. of Tokyo have joined the other 15 leading companies which are now supporting RIC.

Rare Earth Pioneer, Spedding, is Honored

Rare-earth pioneer Frank H. Spedding has been honored for his scientific contributions by both the Society for Applied Spectroscopy and the Franklin Institute of Philadelphia.

The Franklin Institute awarded Spedding its Francis J. Clamer medal for his "many important contributions to the science of extractive metallurgy . . . and for his pioneering contributions to rare-earth metallurgy." The Society for Applied Spectroscopy named Spedding to honorary membership citing him for his continuing studies on the nature of solids by means of spectroscopy, with major work on rare-earth compounds.

Bell Bubbles

The recent announcement by Bell Laboratories of a bubble domain memory device may lead to an increased use of individual rare earths. The development involves the control of very small magnetic cylindrical domains (bubbles) moving through a thin single crystal of a rare-earth orthoferrite.

The device is capable of performing a variety of tasks; logic, memory, switching and counting, all in one crystal. A cubic inch of these crystals could store 15 million bits of information with a power consumption of a few ten thousandths of a watt. The space and power savings each are of the order of 10^5 over present devices.

To date the most promising materials are orthoferrites containing samarium, terbium, dysprosium and thulium.

REactive in Certain Media

The Spex Mixer/Mill pictured at right was demolished and a technician was injured as a result of an explosion which occurred when an attempt was made to grind 20 g of samarium powder in approximately 20 cc of Freon 113 (1,1,2-trichlorotrifluoroethane). It was reported that detonation was almost instantaneous. Subsequent investigation revealed that the explosion was caused by the generation of fresh metal surface in the presence of the chlorinated halocarbon as a result of the grinding operation. It is thought that other RE's will react in the same manner when ground in the presence of chlorinated halocarbons.

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RIC has just published *25 Years of Rare Earths -- A Bibliography of Rare-Earth Research Papers and Reports Published by the Ames Laboratory from Its Founding to Its 25th Anniversary,* by Joan E. Smith, Charla C. Bertrand, and Karl Gschneidner, Jr., August 1968, 241 pages.

This report is divided into three sections: papers published in journals, conference proceedings, and books; university theses and U. S. Atomic Energy Commission reports; and patents on rare-earth processes. Subject, materials, and author indexes are included. *To obtain a copy, order USAEC Report IS-RIC-2 from the Clearinghouse for Federal and Scientific Technical Information, Springfield, Virginia 22151, U.S.A.; the price is $3.00.*

Trademark Protection For RIC Symbol

The United States Patent Office has granted trademark protection to the U. S. Atomic Energy Commission for the symbol used by the Rare-Earth Information Center. The trademark is only the second granted to the AEC.

RIC's trademark which appears on all RIC publications consists of a large triangle enclosing a smaller, inverted triangle. The chemical symbols for the rare earths are printed in the outer triangle from the apex down according to decreasing number of unpaired $4f$ electrons. The inner triangle with the cross bar is the alchemist's symbol for earth, and this combined with the Latin word for rare (rarus) gives "rare earth."

In addition to using the trademark on the heading of *RIC News,* the Center uses it on brochures concerning the Center, and on the covers of its technical reports. And that, sharp-eyed readers, is why the ® appears next to the symbol on this issue.

Magnetic Review

The 1967 technical literature covering the magnetic properties of rare-earth materials is summarized in *Magnetism and Magnetic Materials, 1968 Digest,* H. Chang and T. R. McGuire, eds. (Academic Press, New York, 1968) 315 pp., 2000 references.

The chapters on rare earths cover work on magnetic moment, paramagnetic susceptibility, ordering temperature and structure, exchange mechanism, and anisotropy for the metals, alloys, and com-

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Indian Institute of Technology --

Kanpur Rare-Earth Research Group

RARE-EARTH RESEARCH GROUP – Pictured from left are Dr. S. N. Bhat, Dr. G. V. Subba Rao, Mr. M. Natarajan, Dr. A. S. N. Murthy, Professor C. N. R. Rao, Mr. S. Ramdas, G. Rama Rao, Mr. G. C. Chaturvedi, Dr. M. S. Tomar and Miss Abha Goel.

Professor C. N. R. Rao and his research group are actively engaged in research in the areas of solid state chemistry, chemical spectroscopy and molecular structure. Much of research work in solid state chemistry is related to rare earths. The specific problems in rare earths are the following:

1. This group has been interested in the phase transformations and equilibria in rare-earth oxides for some years. They have studied the phase transformations of the sesquioxides and the formation of PrO_2 and TbO_2 by acid leaching of the non-stoichiometric oxides. Recently, they have examined the origin of the anomalously high entropy changes associated with the oxidation of Pr_2O_3 and Tb_2O_3 to non-stoichiometric oxides.

2. The mechanism of electrical transport in rare-earth oxides has been examined in the light of the polaron model. Mixed conduction in oxides of the type TiO_2-Y_2O_3 and CeO_2-Y_2O_3 has been studied with a view to understanding defect structures.

3. Electrical, optical (I. R. and U. V. spectra) and dielectric properties of rare earth perovskites of the general formula, $LnZO_3$ (Z = ion of the first transition metal series) are being studied extensively. These properties are interpreted in terms of the localized and collective be-

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EUROPIUM STAIN

A europium chelate has been reported as a fluorescent stain for microorganisms by W. L. Schaff, Jr., D. L. Dyer, and K. Mori, *J. Bacteriol.* 98, 246 (1969).

One of the best chelates was found to be tris (4,4,4-trifluoro-1-(2-thienyl)-1,3-butanediono) europium, Eu(TTA)3, which is formed by the reaction of europium salts (acetate, chloride, or nitrate) with the organic ligand.

Eu (TTA)3 has widely separated activation and emission lines and is easily activated by the 365 nm mercury line. The organic portion of the molecule absorbs ultraviolet light, and transfers the energy to the europium ion which emits light in a narrow band at 613 nm.

Apparently one or more components of the cell binds europium firmly giving a bright and uniform stain. The best results were obtained using 10^{-3}M Eu(TTA) in 50% ethanol, although a number of organic solvents or buffered aqueous solutions also gave good results.

Superconducting Rare Earths

Recently scientists at the University of California's Los Alamos Scientific Laboratory reported the preparation of a new high-temperature yttrium-thorium sesquicarbide superconductor. Krupka, Giorgi, Krikorian and Szklarz state in their *J. Less-Common Metals* (19, 113, 1969) paper that the maximum temperature, 17°K, was found for an alloy of the composition $Y_{0.7}Th_{0.3}C_{1.55}$.

This compound has the body-centered cubic Pu_2C_3-type structure and must be prepared by high-pressure high-temperature techniques.

Does this study open the door to a new class of high-temperature superconductors much like the class based on the cubic W_3O(β-W) type structure? We at RIC believe it does – but only time will tell.

Review

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pounds. There are additional references to rare-earth work under the chapters on theory, dilute systems, nuclear magnetism, and magnetoelastic phenomena. A material index by chemical symbols is included.

The digest is published annually, surveying the literature, books, and conferences of the preceding year; the price of the 1968 volume is $13.00.

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Telephone: Area Code 515 294-2272
K.A. Gschneidner, Jr. . . . . Editor
Nancy Kippenhan and W.H. Smith
Staff Writers

Rare Earths In the News

RONSON ACQUISITION

Ronson Corporation has acquired British Flint & Cerium Manufacturers, Ltd., which now becomes a division of Ronson Products, Ltd. The mischmetal manufactured by British Flint & Cerium will be primarily used in the United Kingdom for lighter flints and alloy additives.

LANTHANUM ELECTRON GUN

A patent for an improved electron gun which utilizes LaB_6 as the cathode from which electrons are emitted has been granted to the International Business Machines Corporation. The improved gun is the invention of Dr. Alec N. Broers. The gun is said to have five times the "brightness" of those made with the usual tungsten hairpin-shaped filaments.

Kanpur

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haviour of the d-electrons. Detailed studies on ortho-chromites, -manganites and -ferrites have been completed and presently cobaltites, nickelites and titanites are being examined.

4. Optical spectra of rare-earth ions doped in CaF_2 are being examined to understand the defect equilibria and energetics.

5. Infrared spectra and thermal decompositions of a number of rare-earth compounds (carbonates, nitrates, nitrites, acetates, formates etc.,) have been investigated to establish the reaction modes and the nature of metal-anion bonding. Heavier rare-earth compounds generally decompose at lower temperatures due to the greater covalency of the metal-oxygen bonds; in these compounds distinct bands are seen in the infrared spectra due to the metal-oxygen stretching vibrations.

Rare! Earthly Goofs

Vol. IV, No. 3, September 1969.

In the story on the June 1969 issue of *Goldschmidt informiert*, articles 3, 4 and 5 were written by W. Bungardt and not by W. Brugger as reported.

AIME

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Waterloo (Canada) on "Crystal Chemistry of Metallic-Rare-Earth Compounds." He noted that the rare-earth-metallic compounds form most of the common-type structures found for metallic compounds, except in the cases where the large size of the rare-earth metal atom prevents their formation – such as sigma and related phases.

The papers presented at this symposium will not be published as a conference proceedings. However, most of the information presented at the conference has been or will be published in the usual journals.

Service

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In keeping with our previous tradition, all information inquiries and our new services are kept confidential unless otherwise directed by the requester. For further information write the Director of RIC, Dr. Karl A. Gschneidner, Jr.

RE Lubricants

CeF_3 and LaF_3 have been found to be effective in reducing metallic wear in air or argon atmospheres at temperatures up to 1000°C, according to H. E. Sliney of National Aeronautics and Space Administration's (NASA) Lewis Research Center, Cleveland, NASA TN D-5301, July 1969.

During wear experiments the flouride particles coalesced and flowed plastically in the contact areas forming a thin adherent film on Inconel sliding surfaces used in the study. Friction coefficients ranged from 0.1 to 0.4 and were fairly constant over a large temperature range. CeF_3 and LaF_3 were also found to be useful in lubricating nickel-base superalloys.

The lubricating properties of CeF_3 and LaF_3 combined with their chemical stability and high melting points make them attractive lubricants for special applications such as power transmission devices, especially at high temperatures.

The oxides of La and Ce were also investigated under the same conditions and found to be poor lubricants below 700°C, although there was some indication that they might have lubricating ability at very high temperatures (see *RIC News* Vol II, No. 4, p. 2, December 1967).

TROMBE NAMED TO C.N.R.S. BOARD

Felix Trombe, formerly director of the Rare Earth Laboratory of the French National Center for Scientific Research (C.N.R.S.), has been named to a three-year term as president of the Laboratory's board of directors. His appointment was effective in October 1969.

J. Loriers has succeeded Prof. Trombe as director of the Rare Earth Laboratory, and P. Caro has been appointed assistant director. Prof. Trombe will continue his research interests in rare-earth metallurgy in his new post with C.N.R.S.

Rare-Earth Information Center
Institute for Atomic Research
Iowa State University
Ames, Iowa 50010