RARE-EARTH INFORMATION CENTER NEWS

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Institute of Metallurgy, USSR–

Rare Metals and Alloys Laboratory

RARE EARTH RESEARCH GROUP–Seated from left are E. M. Savitskii, V. F. Terekhova and V. F. Gribula. Standing from left are U. A. Kulakov, I. G. Shelkova, M. M. Kuchinov, O. D. Chistiakov, I. A., Markova, R. S. Torchinova and A. V. Novikov.

The rare earth research group of the Laboratory of Rare Metals and Alloys at the Institute of Metallurgy of the Academy of Sciences of the USSR in Moscow has been studying the rare earth metals since 1955.

A wide variety of work is being conducted, ranging from the purification of the metals by distillation and zone-refining to the utilization of rare earth metals and alloys. Single crystals of Sc, Y, Nd, Gd, Dy, Ho, and Er have been produced and their physical properties, such as thermoelectric power, work function, electrical resistivity, coefficient of thermal expansion, microhardness, etc., have been investigated. This group has determined about 70 binary and ternary phase diagrams of the rare earth metals with Mg, Al, Ca, V, Fe, Co, Cu, Nb, Pd, Hf, and Pt. Those alloys having interesting magnetic, emissive or gas absorption properties were more extensively studied.

The work of the group is closely connected with industrial laboratories which are concerned with the use of the rare earth additions for producing cast iron and high strength alloy steels.

Twelve different mechanisms of the influence of the rare earths on other materials have been elucidated. The rules governing rare earth alloy formation between the cerium and yttrium group metals, and the influence of the electronic structure on the formation of the alloys and compounds are under study. For the last three years much of this work has been carried out by means of computers, utilizing the electronic structure of the components and a certain number of examples for training the computer.

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We're Five Years Old

The loud noises which you may have heard from 93°37′ W, 42°1′ N on January 14 were the words to a refrain sung by the RIC staff celebrating our fifth birthday. There were times of doubt that there would even be a third anniversary, but thanks to our five initial benefactors, the 20 in 1969-70, and the present 26, we are still here writing and publishing the *RIC News* and helping the scientific and technological community by answering their requests for information.

At the end of the first year our family consisted of 560 subscribers and they have been joined by another 1110 during the succeeding four years. In addition to sending you the *RIC News*, we have attempted to answer, as best we could, 1111 information inquiries. An interesting statistic is, that of the 842 persons who have requested information, 18.5% of them have been repeat users of the Center's resources -one of you has asked for help 10 times. We are glad we can be of service.

In an effort to keep informed of the latest developments we acquire annually about 600 journal articles, reports and books in our field of specialization–physical metallurgy and solid state physics of the metals and alloys–and another 100 of a more general and review nature in the chemistry, technology, ceramics, geochemistry and toxicity of the rare earths. We estimate that we

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Rare Earths In the News

RARE EARTH ENGINES

A rare earth-Mg alloy, ZE41A which contains 1.2% mischmetal, is finding its way into the automotive field after being used successfully for more than 15 years in aircraft applications. Porsche has replaced aluminum alloys in the engines and transmissions of its racing cars with the ZE41A alloy. It is used because it provides better castability, a lower scrap rate, and better weldability.

BRIGHTER X-RAYS

A new phosphor made from oxysulfides of lanthanum and gadolinium containing small amounts of terbium has been developed by Lockheed Missiles & Space Co. for use in an improved x-ray image intensifier tube. Successful development of the intensifier tube will mean brighter x-ray pictures (both industrial and medical) with corresponding lower x-ray dosage levels.

MEETING

NINTH RE CONFERENCE

The Committee for the Ninth Rare Earth Research Conference which is to be held at Blacksburg, Va., Oct. 10-14, 1971, has announced the topics of the technical sessions and issued a call for papers.

Fourteen sessions in seven meeting periods will cover metallurgy, industrial applications, Mössbauer spectroscopy, biochemical applications, solid state, and chemistry.

Conferees who plan to present papers should submit abstracts by March 15, 1971, to Dr. Paul E. Field, Department of Chemistry, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, *USA*.

RE Forecast

By 1995 the National Materials Advisory Board projects that the yearly consumption of rare earths will be more than 49 million pounds (rare earth oxide equivalents) as compared to the current consumption of slightly over 15 million pounds per year.

The status of rare earth materials as to sources, consumption, and applications is discussed in the Advisory Board's report, "Trends in the Usage of Rare Earths." The current price and availability of both the mixed and the individual rare earths are presented as well as their present uses. Taking into consideration new developments and anticipating future technology the panel has projected future requirements in the rare earth field for both the near future (5 years) and the distant future (25 years).

This report, NMAB-266, is for sale by the National Technical Information Service, Department A, Springfield, VA 22151, U.S.A. for $3.00.

Elixir of Life

During the past 80 years the Superstition Mountains of Arizona have claimed about 50 lives as prospectors continue the search for one of the American West's most persistent legends—the fabled Lost Dutchman gold mine. The mine was claimed to have been found by a Dutchman, Jacob Waltz, although when he died in 1891 he had never revealed the mine's location.

Even today, prospectors enter the Superstition Mountains armed and some even claim that too much time spent in the mountains can drive a man insane. One unsupported, but altogether fascinating, theory about the unsettling effect of the mountains was advanced by a miner who told a *Los Angeles Times* reporter, "...There is a rare earth deposit running through here which gives off static electricity. This affects your mentality and sexual desires, just like in the South Seas."

RIC NEWS INDEX

An eight-page index of the first five volumes of the *RIC News* is available and may be obtained by writing the Information Center.

ATOMIC PIONEER, CORYELL, DIES

Charles D. Coryell, professor of chemistry, Massachusetts Institute of Technology, and a pioneer in the field of nuclear chemistry, died Jan. 7, 1971, in Cambridge, Mass. He was 58.

Coryell was the co-discoverer of promethium, the last rare earth to be separated and identified. In 1970 he was awarded a U. S. Atomic Energy Commission Citation for his work in the field of fission products research and radiation chemistry (*RIC News* 5 [3]2, 1970)

RE's are Tops

Rare earths again demonstrated their increasing use in industry when *Industrial Research*, in naming the top new 100 products for 1970, picked three that made use of the fraternal fifteen.

Continued use of rare-earth phosphors in color television picture tubes was evident in the Chromacolor television picture tube developed by Zenith Radio Corp. Zenith's new picture tube attains increased brightness by black-surrounding each picture-producing phosphor and employs an even brighter rare earth red phosphor.

A monolithic numeric display device which is capable of multicolor emission, developed by General Electric Co., depends heavily on rare earth-doped phosphors. The phosphors convert infrared light emitted from p-n junction bars to green, yellow or red.

A YAG crystal is incorporated into a continuous wave (CW) laser built by Holobeam, Inc. This laser whose principal use is in high-speed metal cutting, is said to produce four times the CW power output of any other YAG system.

Laser Welding

Laser welding is undergoing intensive studies ranging from industrial processes to dentistry. One reason for the interest in laser welding is that lower costs are envisioned in certain types of metal joining operations.

A neodymium-doped YAG laser with 1100 W of continuous wave (CW) power has been developed by Holobeam, Inc., Paramus, N.J. Experimental welds on Type 304 stainless steel and AISI 1030 steel, ¼-in. thick were made at rates of about 15 in. per minute. Weld depth was 0.020 in. Work with much higher power lasers in the range 10,000 to 100,000 W is needed before practical, industrial applications in heavy metalworking are realized.

Dental patients who need bridgework may realize benefits from laser welding much sooner. A neodymium-doped glass laser head is the heart of a prototype dental laser welder, a cooperative venture by J. M. Ney Co., Bloomfield, Conn., and International Laser Systems, Inc., Orlando, Fla. This pulsed laser, 2.5 and 5.0 J, has been tested for the past two years in the clinical welding of dental bridgework and desk-top size welders are available.

French Proceedings

The Proceedings of the French International Rare Earth Conference held May 5-10, 1969, in Paris and Grenoble, France, are now available in two volumes.

Les Élements des Terres Rares, Tome I, includes those papers presented at the Paris sessions, while *Tome II* contains the Grenoble section. Both volumes are available from Bureau 3A-Service de Presse, Centre National de la Recherche Scientifique, 15 Quai Anatole France, Paris 7e, France. The price of Tome I was not available at press time; the price of Tome II is 107 F 50 ($19.35).

The complete program of the French Conference was printed in *RIC News* IV [3] 2-3 (1969).

Rare Distribution

RIC has available about 300 free copies of the English translation of *Rare Metals* by O. A. Songina (Moscow, 1964). RIC received these books from the U.S. Bureau of Mines on the condition that we distribute them to anyone interested in receiving a copy.

This volume discusses, besides the rare earths, Re, Mo, W, V, Nb, Ta, Zr, Hf, Ge, U, the actinides, Ga, In, Tl, Be, Li, Rb, Cs, Se, and Te. *Rare Metals* is a compact handbook of the properties and compounds of these metals, their occurrence in nature, preparation, use and analytical determination.

To obtain a copy please write to RIC. The volumes will be distributed on a first-come, first-served basis.

Crystal Structure Monograph Published

A survey of the structure of solids which have properties of considerable contemporary interest has been published by F. S. Galasso in *Structure and Properties of Inorganic Solids* (Pergamon Press, New York, 1970) $13.50.

In his discussion the author has divided the different crystal structures into related groups. The simple structures are presented first, followed by the more complex. The description of each structure type includes a figure, a typical compound, space group, and unit cell data. This is followed by a discussion of the properties of the more important materials in each group. Background information on crystallography and properties is included in the introduction.

A number of rare earth intermetallic and inorganic compounds are described in this volume and are easily located from the comprehensive formula index. Compounds of interest for their ferromagnetic, laser, ferroelectric, superconducting, and semiconducting properties are among those described in this text.

NEUTRON RADIOGRAPHY

The rare earths play an important role in neutron radiography, an important new tool complementing x-ray radiography in nondestructive testing. Because neutron absorption and transmission are dependent upon the nuclear nature of a material and x-rays on the number of electrons, many substances which are opaque to x-rays are transparent to neutrons and *vice-versa*.

The rare earths such as gadolinium and dysprosium serve as the detectors for the neutron beams. The gadolinium and dysprosium absorb neutrons and emit secondary radiation (β- and γ-rays) which are allowed to strike an x-ray film upon which the image is recorded.

Gadolinium is used *in situ* to expose the x-ray film, but dysprosium, which continues to emit β- and γ-rays after the neutron beam is turned off, can be transported to another site to expose the x-ray film. Lithium and boron are competitors for gadolinium, and rhodium, silver, gold and indium for dysprosium.

More Contributors

Two more companies have contributed to the support of RIC for the current year. They are Sawyer-Adecor International, Inc., Los Angeles, Calif., and Reactor Experiments, Inc., San Carlos, Calif. Twenty-six firms from throughout the world now provide financial support for RIC.

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K. A. Gschneidner, Jr. . . . . Editor
Nancy Kippenhan and W. H. Smith
Staff Writers

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We're Five Years Old

acquire only about half of all the articles published on rare earths. *Do you have a feeling of knowing less today than you did yesterday? Now you know why.*

The U.S. which, in terms of papers published, accounted for more than half of the rare earth research a few years ago, last year published less than 45% of the papers. This shift in the worldwide distribution of rare earth research is a healthy trend which we welcome. We believe these figures do not reflect the reduced funding for science in the United States (the effect of that will be seen in the next few years, starting in 1971) but rather the expansion of science activities in the other leading scientifically and technologically advanced countries in the World.

When RIC came into being rare earth phosphors and hosts in color TV were the "greatest" and the use of rare earths in cracking catalysts and ductile iron was established and making steady gains yearly. During our first five years there have been a number of disappointments and one large technological advance—the discovery and development of the rare earth-cobalt magnets. There are a number of other interesting developments just over the horizon, and these should provide another exciting five years. And *RIC News* aims to keep you abreast of these advances. With 1300 to 1400 papers being published yearly on the rare earths, we cannot help but be optimistic about their future. We must, however, await developments with patience since it takes 5 to 10 years from the time of discovery until utilization in commercial applications—*a la* rare earth-cobalt magnets.

Commercial cobalt superalloys AiResist-13, AiResist-213, and AiResist-215 contain 0.1-0.2% Y and HA-188 contains 0.08% La. These rare earths are added to increase the oxidation resistance.

Permanent Magnets

An excellent review article by J. J. Becker on the rare earth-cobalt magnets was published in the December 1970, issue of *Scientific American* 223 [6] 92-100. We recommend it highly for those of you who are nonexperts in magnetism.

The superior properties of the rare earth-cobalt permanent magnets are vividly displayed. Becker presents an accurate history of the discovery and development of these materials which could not have been gleaned from the news releases issued to the general and trade press 18 to 24 months ago.

A number of potential uses of these materials are described—miniaturization of electric motors, microwave amplifiers, frictionless magnetic bearings, and magnetically suspended railroad transport.

More on Gd Molybdate

In the September 1970 issue of *RIC News* we reported on the interesting ferroelectric-ferroelastic compound $Gd_2(MoO_4)_3$. Since then we have obtained additional information. $Gd_2(MoO_4)_3$, which is transparent to visible and infrared light, was discovered by Dr. H. J. Borchardt of Du Pont in the mid-1960's. A list of references which contain additional technical information on this unusual material is available from RIC.

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Rare Metals and Alloys Laboratory

These Moscow scientists hope that before the end of the 20th Century the physical metallurgy of all individual rare earth metals can be calculated and alloys with predictable physical properites can be obtained as easily as a ticket for the Metro (Moscow subway train).

Two monographs by the research workers of this Laboratory have been translated into English: *Rare Earth Alloys* by E. M. Savitskii, V. F. Terekhova, I. V. Burov, I. A. Markova, and O. P. Naumkin, and *Yttrium* by V. F. Terekhova and E. M. Savitskii.

V. F. Terekhova supervises the rare earth metals research program. The general leadership is provided by E. M. Savitskii, Corresponding Member of the Academy of Sciences of the USSR. He is quite enthusiastic about these metals, and his motto, "The future belongs to the rare earth metals," is the guiding principle under which the work of this group is carried out.

MOLYCORP PROMOTES TWO

Molycorp has formed two new divisions. Thomas A. Wilson, a former Molycorp sales manager, has been named as Vice President and General Manager of the new Chemicals & Rare Earth Division, while Frank P. Kristoff, formerly assistant to the president of Molycorp, will head the newly-formed Metallurgical Division.

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

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