Rare-earth Information Center NEWS

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Iowa State University / Ames, Iowa 50011-3020 / U.S.A.

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Belgium 1990

The First International Conference on *f* Elements was held at the Katholieke Universiteit of Leuven, Belgium on September 4-7, 1990. The Conference was divided into six themes, in which there were plenary lectures (PL), session lectures (SL) and posters (P). (The number(s) preceding these letters indicate the number of such presentations in the topical area.) These are: Theory and Spectrocopy 3-PL, 5-SL and 60-P; Coordination Chemistry 2-PL, 6-SL and 39-P; Analytical and Environmental Chemistry and Geochemistry 2-PL, 4-SL and 13-P; Reactivity, Catalysis and Organometallic Chemistry 2-PL, 5-SL and 30-P; Solid State Chemistry and Physics 2-PL, 7-SL and 53-P; and High Temperature Superconductors no-PL, 4-SL and 12-P. In addition there were six conference lectures and two opening addresses. The six conference lectures were generally broad overviews (2), or were concerned with applications (2), or subjects which covered two or more of the six major themes (2). The first opening address was given by Nobel Prize winner J. G. Bednorz, who naturally spoke on superconductivity and presented an overview of developments of the past few years. The second opening address was given by J. G. Wurm, who is a scientific administrator for the Commission of the European Communities (EC), spoke on "advanced materials research activities of the EC Commission."

C. W. (Paul) Chu of the University of Houston, who gave one of the Conference lectures, presented an excellent address on the state-of-the-art of high temperature superconductivity. All of the lectures were well presented and quite informative. The plenary lectures were given by B. R. Judd -- "Mysteries of the *f* shell"; L. Eyring -- "Atomic âctors on television: oxides from colloidal gels", and included 15 minute time lapse video of chemical reactions and transformations taking place in situ in an electron microscope; G. R. Choppin -- "*f*-Elements and environmental behaviors"; B. Fegley, Jr. -- "Chemistry of the lanthanides and actinides in the solar nebula"; C. F. Meares -- "Conjugation of antibodies with metal chelates"; B. G. Wybourne -- "Atomic physics and the properties of rare earths and actinides"; J. D. Corbett -- "Octahedral lanthanide clusters centered by heterometal atoms"; R. G. Denning -- "Two-photon spectroscopy of *f*-block elements"; A. Streitwieser -- "Lanthanide catalysis of a Mukaiyama addition reaction"; T. J. Marks -- "Metal-ligand bond enthalpies as a guide to understanding bonding and designing new reactions in organo-*f*-element chemistry"; and K. N. Raymond -- "Template synthesis and ligand design for *f*-metal ligands".

Most of the posters were well done and were quite informative. Most of the invited presentations and posters will be published in the conference proceedings. RIC will announce the availability as soon as the proceedings are published.

The opportunity to discuss rare earth science and technology with others and being brought up to date on new experimental data and ideas was the most profitable as-

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RE on Postage Stamps

As part of its 25th Anniversary Celebration, RIC is pleased to announce that Prof. Emer. Foil A. Miller, Department of Chemistry, University of Pittsburgh is the winner of our Rare Earths on Postage Stamps Contest. Prof. Miller correctly named 23 stamps of 53 stamps which are known to RIC to have a clearly definable relationship to the rare earths. It was an extremely close contest with the other two contestants each naming 22 stamps. The editor was disappointed in the number of persons participating, since he personally knows two other rare earth scientists/philatelists who did not submit entries.

Prof. Miller has chosen as his first place prize *SCANDIUM - its Occurrence, Chemistry, Physics, Metallurgy, Biology, and Technology*, Academic Press (1975). Prof. Miller is quite active in the Chemistry-Physics Study Unit of the American Topical Association and he has contributed several articles about science on postage stamps to *Philatelia Chimica et Physica* and the *J. Chemical Education.*

Personalities dominated the list of rare earths on postage stamps, headed by Dmitri

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I. Mendeleev (12 stamps from 4 countries) and Jöns Jakob Berzelius (5 stamps from 2 countries). Many of the scientists are Nobel Prize winners (8). Also found were minerals, buildings and miscellaneous items, such as formulas and chemical symbols. The list of these 53 stamps may be obtained by writing RIC. ▲

Permanent Magnets

Advances in Permanent Magnetism is the title of a book specifically written for anyone confronted with design problems involving permanent magnets. Written by R.J. Parker, this all-in-one guide is an essential tool for engineers that will save hours of legwork that is usually spent locating data scattered throughout the many specialized texts and journals. The book covers the entire field, from the origin of permanent magnet behavior, to the use of magnetic components in energy conversion devices. It also offers new information on high-energy rare earth magnets. This book would be a welcome addition to the working library of electrical engineers, electromagnetic design engineers, physicists, chemists, and material scientists.

The 334-page book contains 9 chapters and 4 appendices which cover a glossary of terms, magnetic and physical property tables, demagnetization curves for design analysis, and a chronology of discovery of permanent magnets. It was published in 1990 and may be obtained for U.S.$54.95 from John Wiley & Sons, 605 Third Avenue, New York, NY 10158, U.S.A. ▲

Better Superconductors

The problems encountered in making bulk high temperature superconductors for uses in power transmission of sizable currents appear to be diminishing [*C&EN*, 68,24-7,(1990)]. The difficulty is that the superconductors are unable to carry large currents in a magnetic field - a requirement for many large-scale applications such as generators. The bulk superconductors can handle 10^4A/cm^2, while the thin films are able to carry 10^6 A/cm^2.

The problem appears to be caused when an outside magnetic field penetrates a superconductor, forming eddies of magnetic flux, or "vortices". These eddies create resistance to the flow of current unless they are "pinned" in place by defects known as pinning sites. The defects that occur naturally in $YBa_2Cu_3O_7$ do not pin the vortices strongly enough to prevent them from being shoved aside by the current. Because energy is consumed in moving the vortices, the current eventually dissipates. This problem can be controlled by creating pinning centers, thus preventing the lines of flux from shifting. One way to produce these pinning centers is to create a fine dispersion of nonsuperconducting particles within a superconducting matrix. These particles should then serve as pinning centers, preventing the vortices from being shifted and creating resistance.

In another method, R. Bruce van Dover and coworkers of AT&T Bell Laboratories found that by irradiating a crystal of $YBa_2Cu_3O_7$ (1-2-3 superconductor) with fast neutrons, they could produce structural defects in the crystal which serve as pinning centers. These irradiated crystals conducted 100 times the current as in unirradiated crystals. The problem with irradiated crystals is that they need a week or more of "cool down" time before they can be handled.

More practical methods of raising the critical current in high-temperature superconductors includes "hybridizing" thin films of superconducting $YBa_2Cu_3O_7$ and nonsuperconducting $PrBa_2Cu_3O_7$. These two materials have the same orthorhombic crystalline structure which enables one to be grown on the other epitaxially. Heterostructures of $YBa_2Cu_3O_7/PrBa_2Cu_3O_7$ have been grown forming superlattices of up to 40 layers by D.H. Lowndes and coworkers at Oak Ridge National Laboratory.

In yet another procedure, X.D. Wu and coworkers at Los Alamos National Laboratory in New Mexico have shown that it is possible to grow thin films of intermediate composition, that is, $Y_{1-x}Pr_xBa_2Cu_3O_7$ using laser deposition. The beauty of preparing the material in this fashion is that as yttrium is gradually replaced with praseodymium, the material loses its superconducting properties to become a semiconductor, enabling the hybrid yttrium/praseodymium material to be "fine tuned" from superconducting to semiconducting.

The advance of making electronic components from layered films has already been accomplished by C. Rogers and T. Venkatesan of Bellcore, while working with their colleagues at Rutgers. Using a combination of photolithography and argon ion

Conference Calendar

* A NEWS STORY THIS ISSUE

January '91

International Conference on Rare Earth Minerals and Minerals for Electronic Uses
Hat Yai, Thailand
January 23-25, 1991
RIC News, XXV, [2] 2 (1990)

March '91

The Magnetic Bearings and Dry Gas Seals Conference and Exhibition (ROMAG'91)
Washington, D.C., U.S.A.
March 13-15, 1991
RIC News, XXV, [2] 2 (1990)

April '91

Journees des Actinides
Lagos, Algarve, Portugal
April 28-May 1, 1991
RIC News, XXV, [2] 2 (1990)

May '91

2nd Workshop on the Basic and Applied Aspects of the Rare Earths
Venezia, Italy
May 10-11, 1991
RIC News, XXV, [3] 2 (1990)

Second International Conference on Rare Earth Development and Applications (2nd ICRE)
Beijing, China
May 27-31, 1991
**RIC News*, XXV, [2] 2 (1990)
(see page 5)

July '91

19th Rare Earth Research Conference (19th RERC)
Lexington, Kentucky, U.S.A.
July 14-19, 1991
RIC News, XXV, [1] 2 (1990)

June '92

Rare Earths '92 in Kyoto
Kyoto, Japan
June 1-5, 1992
RIC News, XXV, [3] 2 (1990)

beam etching, they have produced tiny $YBa_2Cu_3O_7/PrBa_2Cu_3O_7/YBa_2Cu_3O_7$ devices on gold. These devices, called Josephson weak-links, behave much like traditional junctions consisting of a superconductor/normal metal/superconductor sandwich. "We've seen the basic physics of the Josephson effect" in these junctions, Rogers says, referring to the same behavior in microwave detectors and magnetometers based on superconducting quantum interference devices (SQUIDS). This increasing materials sophistication will help us to better understand high-temperature superconductivity. ▲

Ultrashort Light Pulses

A Review by J. Simon entitled "Ultrashort Light Pulses" has been published in *Rev.Sci. Instrum.*, 60, [12], (1989). Recent advances in laser technology now enable the generation of ultrashort laser pulses from infrared through the ultraviolet regions of the spectrum. The current techniques for the generation and amplification of laser beams that are pulsed on the order of picoseconds ($\leq 10^{-12}$ sec) are examined. The review not only treats the devices based on mode-locking and various novel methods for ultrashort laser pulses such as switches and electro-optic sampling, but also presents recent advances in the use of fiber optics to shape and compress optical pulses. The advent of these technologies allows the study of dynamics processes in real-time with femtosecond (10^{-15} sec) time resolution.

Section 1, "General Considerations", covers the technique employed by the majority of devices, active and passive mode locking. This method has been used in producing short pulses from flash-lamp-pumped Nd:glass, Nd:$LiYF_4$, and Nd:YAG lasers. For example, mode-locking of a miniature diode pumped Nd:YAG laser can produce ultrashort laser pulses at a frequency of 245.7 MHz. Group-velocity dispersion and self-phase modulation deals with the compensation for the pulse broadening of the femtosecond laser as well as optical components used in constructing ultrafast dye lasers and amplifiers. Section 2, "Short-Pulse Generation Using Mode-Locked Lasers", gives attention to the techniques of generating picosecond and subpicosecond laser pulses. Section 3, "Other Devices for the Generation of Ultrashort Pulses", explains the four different approaches of mode-locking: traveling-wave excitation (TWE), distributed feedback lasers (DFL), free-electron lasers and semiconductor lasers. Section 4, "Amplification of Picosecond and Femtosecond Dye-Laser Pulses", the most comprehensive of all the sections, describes the approaches to increasing the output pulse energies of lasers from a few nanojoules to levels as required for the application. Section 5, "Extension of Wavelengths", examines the techniques that are used to extend the ultrashort laser pulses into the ultraviolet and infrared spectral regions.

The author points out that these laser pulses are currently being used to study a wide variety of fundamental problems in the physical sciences. In medicine and dentistry, there have been considerable advances in the applications of ultrashort pulsed Nd:YAG lasers. As more is learned about the ability to modify the capability of these devices, new and exciting applications are sure to follow. ▲

RE Metal Properties Available

A paper with the latest and best values of the physical properties of the rare earth metals is available from RIC. The paper, written by K. A. Gschneidner, Jr., [*Bull. Alloy Phase Diagrams* 11, 216-24 (1990)], is a critical evaluation of the properties of the rare earth metals. Included are: crystal structure (at various temperatures), metallic radius, atomic volume, density, transition temperatures, melting points, boiling points, heat capacity (and other thermodynamic values), vapor pressure, heats of sublimation, magnetic properties, thermal properties, electronic specific heat constant, Debye temperature, superconducting transition temperature, and mechanical properties. Other tables list information about the liquid metals, ionization potentials and effective ionic radii for various coordination numbers. The 9-page paper contains 14 tables with references. ▲

Magnesium Alloys

A review of the importance of rare earth metals in the development of magnesium alloys and their effect on mechanical properties and corrosion resistance appeared in *Int. J. Mater. Product Tech.* 4, 366-78 (1989). "The Role of Rare Earth Elements in the Development of Magnesium Base Alloys" gives examples of commercial as well as some experimental alloys and discusses their advantages and limitations. The author, W. Unsworth, covers the uses and properties of casting alloys, wrought alloys, and the applications in the extrusion and forging fields in the use of rapidly solidified alloys.

The author points out that the present range of rare earth-containing alloys for sand, permanent mold and investment casting offer a sufficiently wide range of properties to meet requirements for the forseeable future. However, new alloys have been developed using a number of heavier RE metals. Thus, alloys are now becoming available commercially which should be capable, with suitable heat treatment, to produce temperature-stable precipitates. The possibility of improving the properties of the simpler and cheaper alloys by particle or chopped fiber dispersion would appear to be worthy of examination.

The author suggests that the development of creep resistant and elevated-temperature strength (up to 200 °C) alloys prepared by pressure die casting methods is an area which is worthwhile pursuing, in particular, the cheaper Mg-RE-Mn and Mg-RE-Zn-Mn alloys. The use of magnesium alloys has been suppressed in the past by the fear of corrosion failure. The conventional alloy systems, Mg-RE-Zr, Mg-Zn-RE-Mn, and Mg-RE-Y-Zr now offer corrosion resistance on par with aluminum base alloys. ▲

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pect of being at the Conference. At the Conference the International Steering Committee on *f* Conferences met and finalized decisions on the locations and approximate times for future broad based conferences through 1994 and for 1996 and 1997. The Conference in 1995 will be held in Asia or South America, but details are being worked out. The schedule is as follows:

1991	Lexington, KY USA	
	July 14-19, 1991: RERC (19th)	
1992	Japan	June 1-5, 1992
1993	California, USA	RERC (20th)
1994	Finland	ICFE (2nd)
1995	Asia or South America	
1996	Paris	ICFE (3rd)
1997	USA	RERC (21st)

Paul Caro delivered a humorous but serious address at the conference banquet -- how to explain the rare earths to your friends and the public. Since the banquet was held in a building which formerly housed monks, the rare earths must have a religious connection and sure enough, Paul who is the director of a museum in Paris (Citie de Sciences) claimed to have found an early Gregorian chant about the rare earths -- which he

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promptly sang the first few measures -- La, Ce, [Pra-seo-dym-i-um....]. And here we all thought the rare earths were discovered a little over two hundred years ago, but now we learn that the monks knew about them hundreds of years earlier (the first Gregorian chants were written about 600 AD) a very well kept secret. Looks like we will have to rewrite the history of the discovery of the rare earths. Paul Caro also pointed out that these elements also permeate our modern society -- in our music (look at all of the people walking or running around with those funny things over their ears -- rare earth permanent magnets), the color TV in our homes (europium phosphors) etc., etc. Thank you, Paul. We hope your speech ends up in the Conference proceedings. ▲

Terfenol-D Notes

A newsletter is now being produced by the ETREMA Products Division of Edge Technologies, Ames, Iowa. The 4-page newsletter reports on new literature concerning Terfenol-D and the state of research on this amazing material. *Terfenol-D Notes* also chronicles applications, users clubs, conferences, markets and pricing, designs, engineering data, and other applicable items as appropriate. For more information contact: Mel Goodfriend, Edge Technologies, Inc., 306 South 16th Street, Ames, IA 50010, Tel:1-800-327-7291 Fax:(515)232-1177. ▲

Lanthanide Probes

The application of lanthanides in studies of organic and biochemical systems by use of their NMR and spectroscopic properties has led to growing interest in the physics and chemistry of these elements. Because the lanthanides are used as industrial catalysts, electrical and optical components, high-temperature superconductors, x-ray intensifying materials, relaxation agents for imaging techniques, and radioisotopes for pharmaceutical applications, their utilization as probes of a wide variety of phenomena give them a prominent place in modern science.

The book *Lanthanide Probes in Life, Chemical and Earth Sciences*, edited by J.-C.G. Bunzli and G.R. Choppin, contains eleven chapters written by leading experts who describe the various facets of the application of lanthanides as probes in life, chemical and earth sciences. The aim of these authors is to provide guidance to scientists who may wish to use the unique advantages of lanthanides in their own fields. The topics cover the areas of: chemistry, spectroscopy, geochemistry, medical imaging, environmental chemistry, biochemistry, and biology.

All 432 pages are presented in an easy-to-read format and the chapters are complete with diagrams and illustrations. *Lanthanide Probes in Life, Chemical and Earth Sciences* was published in 1989 and is available for US$142.00 from Elsevier Science Publishers, P.O. Box 211, 1000 AE Amsterdam, The Netherlands. ▲

Gmelin Handbook

The first portion of volume C11 of the *Gmelin Handbook* on the *Rare Earth Elements* which deals with the compounds and systems of the rare earth elements with boron, i.e. borides, borates, and associated alkali double compounds has been published. As in all earlier volumes of the *Gmelin Handbook*, the comparative data are presented in sections preceding the treatment of the individual compounds and systems. Topics of Volume C11a are the comparative data on all of the borides and the individual sections on the systems and borides containing Sc, Y, and La.

In this volume, the most extensively studied borides treated in the comparative sections are of the type MB_6. These rare earth hexaborides are refractory compounds, good thermionic emitters, and exhibit other interesting physical properties. The most comprehensive chapter in the individual sections of Volume C11a deals with LaB_6, which is a well-known thermionic emitter of great practical importance with high electron emission efficiency and an excellent stability in the surface composition at high temperatures. The effects of preparation conditions, composition, temperature, surface structures, surface treatment, and of the atmosphere on the thermionic emission are thoroughly reviewed. Another important item of the LaB_6 chapter is the electronic structure, which often serves as an example for the other rare earth hexaborides.

The price of Volume C11a, which was published in 1990, is DM1265 (US$794.00) and contains 275 pages and 88 figures. For orders/inquiries contact Springer-Verlag, Heidelberger Platz 3, D-1000 Berlin 33. ▲

Ferromagnetic Materials

Volume 5 of *Ferromagnetic Materials - A Handbook on the Properties of Magnetically Ordered Substances*, 1990, is the latest edition of collected reviews of the modern trends in magnetism and the new achievements in this area. The handbook has a dual purpose. As a textbook it is intended to help those who wish to be introduced to a given topic in the field of magnetism without the need to read the vast amount of literature published. As a work of reference it is intended for scientists active in magnetism research and therefore consists of topical review articles written by leading authorities. In each of the articles an extensive description is given of material properties in graphical and tabular form and emphasis is placed on the discussion of the experimental material in the framework of physics, chemistry, and materials science.

The topics dealt with in Volume 5 include the magnetism of magnetic superconductors, the magnetic properties of hydrides, first-order magnetic processes, quadrupolar interactions in 4*f* systems and their role in magnetic ordering and magneto-elastic effects, the magnetism of strongly enhanced itinerant alloys and compounds, and the magnetism of INVAR alloys. The book has many figures and diagrams, and not only comes complete with author and subject indices, but also includes a materials index which lists the most important rare earth compounds currently used in magnetically ordered substances.

The 604-page book costs US$167.00 and is available from Elsevier Science Publishers, P.O. Box 211, 1000 AE Amsterdam, The Netherlands. In the U.S.A. and Canada contact: Elsevier Science Publishing Co., Inc., Box 882, Madison Square Station, New York, NY 10159 U.S.A. ▲

Carbon Fiber Reinforcement Improves Superconductors

A composite developed by Dr. D. Chung at the State University of New York at Buffalo may improve the mechanical strength of high-temperature ceramic superconductors. She has developed a composite material of carbon fibers, tin and a high-temperature superconductor that exhibits good mechanical and electrical properties. Fabricated by sandwiching the ceramic superconductor between two layers of carbon-fiber reinforced tin, the composite may be applied to magnets, thick films, cables and other uses where mechanical strength is important.

"The brittleness and mechanical fragility of ceramic superconductors make them not practical, even if the superconductor prop-

erties are super," Chung said. She added that "The composite is a method of improving the mechanical properties without disturbing the electrical properties."

The carbon-reinforced tin composite dramatically improves the tensile strength of ceramic superconductors, which tend to be particularly weak under tension. In the composite, the materials' tensile strength is improved 26 times. The composite also improves the thermal conductivity of the material and provides resistance to thermal fatigue. Tin acts as an adhesive, plus it is a good electrical as well as a thermal conductor.

At room temperature, electrical resistance is high in ceramic superconductors, but the composite shows lower resistance. The critical temperature of about 90 K and current density of the superconductor are not changed by the fabrication process. ▲

ICRE '91

The second circular for the 2nd International Conference on Rare Earth Development & Applications (ICRE '91) is now available. As mentioned in the June 1, 1990 issue of the *RIC News*, the conference will be held at the Beijing International Convention Center, May 27-31, 1991 and will include all areas of basic and applied sciences related to rare earths. The three sections of the conference include: RE Chemistry; RE Resources and RE Metallurgy; and RE New Materials and RE Applications. As a reminder to participants, the deadlines are as follows: December 31, 1990, return of preregistration forms; February 1, 1991, arrival of submitted manuscripts; May 1, 1991, all payments due.

If you or your company needs information regarding exhibition at ICRE '91, please contact: Rare Earth Office of the Chinese National Council, Yue Tan Nan Street 38, Beijing, P.R. China, 100824. ▲

ASC Award

The Applied Superconductivity Conference, Inc. broke a 24-year-old policy and gave awards to Dr. Ellen O. Feinberg and Professor John R. Clem, Distinguished Professor in Liberal Arts and Sciences at Iowa State University, Ames, Iowa, in appreciation for their contributions to the superconductivity community. Feinberg is project director and editor of *High-T_c Update*; Clem is science editor of the newsletter and reports on nearly 100 papers in each issue.

According to ASC '90 chairman, Dr. Alan F. Clark, "The ASC has a long-standing policy of *not* giving awards to individuals. However, the ASC board decided to make an exception in this instance. We felt that their extraordinary service to the community should be recognized for developing an information-handling tool which we all use, rely on, and, most importantly, trust."

Engraved plaques were presented to Feinberg and Clem at the biennial ASC conference, held in Snowmass, Colorado, September 24-28, 1990.

For more information on *High-T_c Update*, contact: Dr. Ellen O. Feinberg, 12 Physics, Ames Laboratory, Iowa State University, Ames, IA 50011-3020 Tel:(515)294-3877 Fax:(515)294-0689 Bitnet:FEINBERG@ALISUVAX. ▲

Data Base Expands

Information inquiries received at the Center now arrive at the rate of nearly two per day. The good news to those who use our services is that our data base has set a record in the number of references that we keep on file. We currently have over 50,500 documents on site and we are increasing that number by over 10 per day! This allows us to provide a comprehensive resource base that improves the quality of services that we offer to rare earthers worldwide. ▲

Readership Grows

The circulation of the *RIC News* is at an all-time high. The number of quarterly issues being sent to readers now exceeds 10,100. As interest in the rare earths increases world-wide, so does the size of our mailing list. Since the number of our readers increases daily, we find it necessary to make improvements in the way rare earth news is presented to you. If you like the *subtle* changes we have made for this issue, or you have ideas that would improve our image, we would be glad to hear from you. ▲

ASM Historical Landmark

The Ytterby Mine, located on Resaro Island, Stockholm, Sweden, was recently designated an ASM Historical Landmark. The mine was nominated to receive the prestigious award by the Sweden Chapter of ASM International. The award recognizes the mine where several rare earth elements were discovered.

Excavation of minerals from Ytterby Mine began around 1600. In 1787, the mineral gadolinite was discovered at the Mine, which is also known as "the world record holder" in the number of elements in the periodic table named after the site: yttrium, ytterbium, erbium, and terbium. The Mine was in operation until 1933.

A plaque was presented to Mr. Bjorn Korlof, director general, Royal Swedish Fortifications Administration. The inscription on the plaque reads, "Four periodic elements - Yttrium, Terbium, Erbium, and Ytterbium - were isolated from the black stone gadolinite mined here, and were named after the Ytterby Mine".

The ASM Historical Landmark award was established in 1969 to "preserve our engineered materials heritage while at the same time providing a means to increase the awareness of pioneering milestones in engineering materials technology". This was the 76th Historical Landmark award to be presented by ASM International and the first in Sweden. ▲

25 *The Rare Earths and I* 25

During our 25th year celebration, readers have sent us personal accounts of their experiences in the field of rare earths. Since we have several interesting stories yet to be published, we have decided to continue "The Rare Earths and I" as a regular feature in the *RIC News*. We are hoping that readers continue to send us their stories so that we may eventually publish a booklet containing all those received.

This issue we bring you a story sent to us by J.P. Liu, now doing work at the University of Amsterdam, The Netherlands.

I HAVE A DREAM

I remember how surprised I was when I first saw a magnet. This was 25 years ago (the same year RIC started), when I was a little boy. One day I found a magnet from a damaged loudspeaker. This fantastic substance could pick up a nail by itself! That night I had a dream, I dreamed that I had many magnets, and shared them with everyone.

This dream was finally realized in 1986. Since Nd-Fe-B magnets were among the strongest types, I chose this material as the subject of my Master's degree thesis even though the conditions at our university were not good for magnetic materials research. After many failures, I succeeded in making the sintered Nd-Fe-B type magnets. I used the mixed rare earths as a substitute for neodymium, and was able to obtain sample

with a maximum energy product of 27 MG·Oe. I observed and analyzed the coarsening to spheres of the Nd-rich phase, and developed a new explanation of the coercivity mechanism making use of the wetting theory.

By reading journals and books, I learned more about the importance of the rare earths, and became extremely interested in these 17 elements, much the same way that I was attracted by the magnets as a child. I then decided to continue my studies as a doctorate student at a materials research institute.

As my interest in the rare earths grew, I felt a responsibility to promote the use of the rare earth elements. Since China has the largest known deposits of rare earth minerals, I think that the Chinese should do more work in this field. The work that was done in our country was not satisfactory. For example, in Xunwu county, South China, much of the ionic type deposit was wasted by abusive mining procedures resulting in losses of 90% in some mines. In order to draw attention to the importance of our resources, I wrote an essay "Rare earth valley -- a new high technology industry in the 21st century", to a newspaper. I stated that the rare earths will become more useful,and that with better coordination between materials production and device production, and with an increased demand for more complex materials, will make the rare earths industry into a high technology industry, similar to "silicon valley" in the U.S.A.

Taking into account the difficulty in separating the elements, one can easily see that an assembly production system, including the separation of the elements, the synthesis and the processing of the materials, and the production of devices, need to be more efficient. I called this high technology system a "rare earth valley". I concluded that we must treasure the deposit and work toward a "rare earth valley".

The special meeting, "The Rare Earth Valley Symposium" was held in Baotou at the end of last year, after my essay was published. Baotou is a "rare earth city". More than thirty experts discussed my opinions for two days. They said that their "rare earth city" should be enlarged into a "rare earth valley".

Recently I read in a Japanese journal that there is an exploitable deposit of rare earths in my hometown. I became very excited! That night I had a dream, I dreamed that my hometown became a "rare earth valley", and that many rare earth valleys appear in China and the world, making our world more prosperous and more colorful! ▲

Rare and Earthly Goofs

On page 3 of our September issue we regrettably misspelled the name of the recipient of the first Bernd Matthias Memorial Award, Dr. Theodore H. Geballe. We apologize to our readers for this oversight.

On page 4 of the September issue in our story on SHARE the address for Drs. Michele Faucher and Denis Garcia, CNRS, MEUDON Bellevue, should read: UTSB001@FRORS12.BITNET. We also omitted the address of Dr. Michael F. Reid, Department of Physics, University of Hong Kong, MFREID@HKUCC.BITNET. ▲

Magnetic Superconductors

The discovery of superconductivity in a number of rare earth compounds has made a strong impact on the field of superconductors. These compounds have provided a unique opportunity for studying the interplay between magnetism and superconductivity in the same system. The book *Magnetic Superconductors*, edited by K. P. Sinha and S. L. Kakani, is a collection of recent papers covering the interaction between the magnetic moments of *f*-electrons and the 3*d*, 4*d*, and 5*d* superconducting electrons.

The book is presented as a monograph which may serve as a base for scientists working in this field. It is divided into eight chapters: Introduction (theoretical background), Survey of Experimental Results, Reentrant Superconductivity:Ferromagnetic Superconductors, Antiferromagnetic Superconductors, Magnetic Field Induced Superconductivity, Itinerant Ferromagnetic Superconductivity, Heavy Fermion Superconductivity, and High Temperature Superconductivity. Of interest to rare earthers in this field is the observation of "very weak itinerant ferromagnetic superconductivity" (VWIFS) in Y_9Co_7.

The 218-page book was published in 1989 and is available from Nova Sciences Publishers, Inc., 283 Commack Road, Suite 300, Commack, NY 11725-3401. The cost of the book is US$62.00. ▲

Rare Earth Geology

Geologists, geochemists, petrologists, economic geologists as well as advanced students studying early earth evolution and planetary development will be interested in a new book edited by R.P. Hall and D.J. Hughes. *Early Precambrian Basic Magmatism* is a 486-page book which discusses the occurrence and distribution of rare earths in rock formations over 1700 million years old. It is a comprehensive review of the basic rocks produced during the first half of the Precambrian period.

The book addresses basic magmatism and crustal evolution and is divided into two parts. Part I deals with the general aspects of the geochemical characteristics of certain rock types and includes their relationship to rare earth occurrence in these systems. Part II focuses on regional synthesis of Early Precambrian rock types of the U.S.A., the Canadian Shield, Greenland and Scotland, the Baltic Shield, China, Australia, India, Africa, and South America.

This 1990 book includes previously unpublished references on the relationship of the rare earths and Precambrian rocks. The book is available from Routledge, Chapman, & Hall, 29 West 35th Street, New York, NY 10001, Tel:212-244-3336. The cost is US$141.00. ▲

Disordered Systems

Dynamical Processes in Disordered Systems is the title of a new book edited by W.M. Yen. It is published as Volume 51 (1990) of Materials Science Forum by Trans Tech Publications, Ltd.

In the past decade, the physics of disordered systems has been an extremely active and fruitful research area and it is likely that this will continue well into the forseeable future. This trend is encouraging to both materials scientists and rare earthers since rare earths have played an important role in this field.

"Dynamical Processes in Disordered Systems" sums up the current situation and future research tendency in disordered systems. It presents a series of up-to-date reviews of the effects that dynamical processes exert on the structure and properties of disordered or amorphous solid state systems of various types. The dynamical processes include: optical energy transfer and diffusion in organic and inorganic glasses, inclusive of processes in systems with restricted dimensionality, and relaxation processes in glasses which implicate disorder modes. The titles of the eight reviews with the number of references in parentheses are: Introduction and Overview (33), Relaxation and Critical Dynamics in Spin Glasses (168), Optical Dephasing in Glasses (36), Two Level Tunneling Centers in Glass (61), Laser-Induced Gratings in Rare Earth-Doped Glasses (24), Optical Energy Transfer in Activated Glasses (81), Migration-Accelerated Quenching of Lu-

minescence in Glasses Activated by Rare-Earth Ions (58), and Computer Simulation Studies of Dynamical Processes in Disordered Systems (74).

The book has 243 pages and is available from Trans Tech Publications, Ltd., for SFr110.00(US$86.00). For further information contact the publishers: in the U.S.A., Old Post Road, Brookfield, VT 05036, USA, fax (802)276-3837, outside the U.S.A., contact Trans Tech Publications, Ltd., Segantinistrasse 216, CH-8049 Zurich, Switzerland, fax(41)13 42 05 29. ▲

Aspects of Superconductivity

Many international conferences have been held on the subject of high-T_c oxides, but these have been intended mainly for those already involved in high-T_c research. The 18th course of the International School of Materials Science and Technology which was held at the Ettore Majorana Centre for Scientific Culture in Erice, Sicily, Italy, July 4-16, 1989, was designed to give students and young scientists a broad perspective of the field of superconductivity. The proceedings of that meeting, entitled *Earlier and Recent Aspects of Superconductivity*, contains lectures that are grouped into four parts: fundamental properties of superconductors; coherence-length- related properties, electronic and magnetic properties, and theoretical models. It is Volume 90 in the *Springer Series in Solid State Sciences* and was published in 1990.

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The book was edited by the two famous scientists who have done landmark studies in the field of superconductivity, J.G. Bednorz and K.A. Muller. Its 528 pages will be useful to newcomers to the field who seek an overall picture of research in superconductivity and of the relationships between the various branches. The cost of the book is DM 59 (U.S.$39.00) and can be ordered from Springer-Verlag, Heidelberger Platz 3, D-1000 Berlin 33. ▲

Rare Earth Stockpile Available

RIC has learned that the rare earth inventory from the Kerr-McGee Chemical Corporation, West Chicago Facility, is now available. After the thorium and rare earths plant ceased operating in 1973, several hundred tons of rare earth intermediates remained. These materials have recently been sampled and repackaged in drums.

Rare earth oxide content of the inventory ranges from 40-70 percent. If reprocessing the intermediate products is feasible for a currently operating rare earth producer, Kerr-McGee would consider providing the materials as feedstock.

Plant Manager Mark Krippel informed RIC that these materials can be obtained only for the cost of shipping. To receive the results of the analysis, the materials summary, and bulk composition of the available rare earths, contact: Mark Krippel, Kerr-McGee Chemical Corporation, 798 Factory Street, West Chicago, IL 60185 Tel:(708)231-0762 Fax:(708)231-3990. ▲

Radioactive Waste

Radioactive waste will be generated as long as nuclear reactors are in operation. The safe isolation of this waste from the biosphere requires immobilization of the radionuclides in a chemically and mechanically durable, heat and radiation resistant solid matrix. *Radioactive Waste Forms for the Future* presents a compilation of important information on the full range of radioactive waste forms that have been developed, or at least suggested, for the incorporation of high-level nuclear waste. Many of the results were formerly published in the "gray literature" of final reports of national laboratories or in various, generally less available proceedings volumes. This is the first publication to draw information on nuclear waste forms for high-level wastes together in a single volume.

The 712-page book contains 12 chapters in 5 parts: Non-crystalline Waste Forms, Crystalline Waste Forms, Novel Waste Forms, Spent Fuel, and Summary and Evaluation of Waste Forms. The book includes reports on monazite, xenotime, rare earth ions, lanthanide orthophosphates, and the research that has been done with these materials. Each of these chapters has been written by an expert and includes a current compilation of waste form properties with an extensive list of references.

Radioactive Waste Forms for the Future will provide a stimulus for future research as well as useful reference material for scientists working in the field of nuclear waste disposal and materials science. The book was compiled and edited by W. Lutze and R.C. Ewing. It was published in 1988 and is available from Elsevier Science Publishers, P.O. Box 211, 1000 AE Amsterdam, The Netherlands, or from Elsevier Science Publishing Co., Inc., P.O. Box 1663 Grand Central Station, New York, NY 10163 U.S.A. The cost of the book is US$247.00. ▲

25 *Highlights From Past RIC News* 25

The last of the series of selected articles from past issues of the *RIC News* addresses the increasing popularity of cubic zirconia used as imitation diamonds in jewelry. This article appeared in the December 1, 1980 issue of the *RIC News*.

CAUGHT IN THE ACT

Since the mid 1970's, yttrium-stabilized, cubic zirconium oxide has been widely accepted as a diamond substitute. This is very easy to understand when one compares the index of refraction, dispersion, and hardness of each. For yttrium-doped zirconia they are 2.15-2.18, 0.060-0.063, and 7.5-8.5 (the range of values corresponds to different compositions) while for diamonds they are 2.42, 0.044, and 10, respectively. These values are so close that it has become very difficult for even some of the experts to tell the difference if the stone is small and mounted in jewelry. Science and Ceres Electronics Corporation have come to the rescue according to P. Read [*Canadian Jeweller* (November, 1979)]. The Ceres diamond probe distinguishes real diamonds from the imitations by comparing the thermal conductivity of the gems. Cubic zirconia is a poor heat conductor and so it shows up obviously in the imitation column.

An interesting side note is that different rare earths add striking color when added to the yttrium-doped zirconia. Praseodymium

Continued on page 8 ➪

imparts a yellow hue, erbium gives a pink color, and adding neodymium results in the color blue. Dysprosium, thulium, holmium, and gadolinium additions result in little or no color at all. ▲

Rare Earth-Iron Nitride Permanent Magnets

A new series of interstitial rare-earth iron compounds ($R_2Fe_{17}N_{3-x}$) with promising magnetic properties has been discovered by J.M.D. Coey and his group at Trinity College, Dublin [*J. Magn. Magn. Mater.* **87**, L251-254 (1990), *J. Phyd. Cond. Mater.* **2**, 6465-70 (1990)]. The alloys are produced by treating R_2Fe_{17} in nitrogen or ammonia gas at a relatively low temperature (about 500 °C). Their structures are expanded versions of the Th_2Zn_{17} or Th_2Ni_{17} structures of the parent compounds. Curie temperatures are increased by approximately 400 °C on nitrogenation, and the intrinsic magnetic applications (Curie temperature 470 °C, magnetization 1.54 T and anisotropy field 15 T).

The new materials have potential for polymer or metal-bonded oriented magnets, and for isotropic magnets made by melt spinning or mechanical alloying (MA). Coercivities of up to 3 T have already been developed by L. Schultz and colleagues at Siemens Central Research Laboratory, Erlangen, Germany, using MA. Other members of CEAM, the *C*oncerted *E*uropean *A*ction on *M*agnets, are actively engaged in research on this exciting new family of compounds. ▲

New High-Sensitivity Phosphor

Thermoluminescence is now extensively used for dosimetry of ionizing radiations. Among the phosphors in common use, $CaSO_4$:Dy has good sensitivity but poor "tissue equivalence", or the ability to compensate for different tissue densities. In addition, the shape of the glow curve also changes with exposure, causing a degradation in quality with respect to time. Other important factors in thermoluminescence dosimetry is response time and reusability.

A recent paper by P.D. Sahare and S.V. Moharil which appeared in *J. Phys.D: Appl. Phys.* **23**, 567-570 (1990) and entitled "A New High-sensitivity Phosphor for Thermoluminescence Dosimetry", details the preparation and properties of $K_2Ca_2(SO_4)_3$ doped with europium. The new phosphor, $K_2Ca_2(SO_4)$:Eu is about five times more sensitive than $CaSO_4$:Dy, has a better signal-to-noise ratio, a simple glow curve structure, and excellent reusability. The phosphor also exhibits negligible fading even after storage periods lasting several days.

Experimental results show that preannealing temperatures used while preparing the samples have a pronounced effect on the intensity of the glow curve. The intensity of the glow curve decreases nominally with increasing preannealing temperatures up to 500 K and then increases by a factor of 100 with an increase in the preanneal temperature up to 900 K. No change in intensity is observed for a further increase in the preannealing temperature. Apparently, impurity aggregates are formed up to 500 K then disperse at higher temperatures, making more luminescence centers available. The best results were obtained when the phosphor was preannealed at and quenched from 950 K.

The new phosphor, $K_2Ca_2(SO_4)_3$ doped with Eu (0.1 mol%), is easily prepared and should be an excellent replacement for phosphors presently used in the dosimetry of ionizing radiations using thermoluminescence. ▲

Supporters

Since the beginning of the second quarter of the fiscal year beginning October 1, 1990, RIC has received support from 6 new family members, and renewed support from 12 of our regular members. Thus, 18 pledges of support have been received during the second quarter.

The supporters for the second quarter 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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