Rare-earth Information Center NEWS

Ames Laboratory
Institute for Physical Research and Technology
Iowa State University / Ames, Iowa 50011-3020 / U.S.A.

Volume XXVII December 1, 1992 No. 4

1992 Shiokawa Award

The Shiokawa Award of the Rare Earth Society of Japan was presented in June to Professor Yuzo Fujiwara, Faculty of Engineering, Department of Applied Chemistry, Hiroshima University. He earned his B.S. and Ph.D. degrees from Osaka University and conducted post-doctoral research with G.M. Whitesides at The Massachusetts Institute of Technology, U.S.A.

Prof. Yuzo Fujiwara

The award was presented June 1st, at the Rare Earths '92 International Conference, held in Kyoto, for his contributions to rare earth chemistry, especially to the field of organic synthesis using rare earth compounds.

His work includes:

* R (rare earth)-Cl_3 catalyzed Friedel-Crafts reactions.
* Electrophilic addition to Yb-unpoled diaryl ketones to give unsymmetrical 1,2-diols, 1,3-diols, and ∝-hydroxycarboxylic acids, etc.
* Synthesis of amino acids from Yb-unpoled amines and CO_2.
* Regio- and stereoselective cyclodimerization of enones by Yb or RCl_3/Zn.
* $Sm(OR)_2$ catalyzed asymmetric aldol reactions.
* Coupling of isocyanates to oxyamides by SmI_2.
* Desulfurization of isothiocyanates to isonitriles by SmI_2.

He is currently working on synthetic reactions using transition metal complexes, including both *d*- and *f*-block elements, functionalization of alkanes, such as methane, via C-H bond activation, and utilizing unused substances such as CO, CO_2, methane, and propane as synthetic starting materials. ▲

New Magnetic Drives

UGIMAG, Inc., of Valparaiso, Indiana has announced the formation of a specialized Magnetic Drives Department (MDD). The facility will supply pump manufacturers with magnetic drive assemblies for use in sealless pumps. These pumps are seeing widespread use in industry because they are environmentally friendly by preventing leakage.

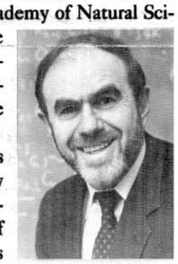
According to the company, the new department can: 1)provide complete magnetic assemblies ready to install in pumps; 2)take customer-supplied components and produce the magnetic assemblies; or 3)supply magnets customized for specific drive designs.

For further information on the new Magnetic Drives Department, contact: Dr. Umberto Ranzi, MDD, UGIMAG, Inc., 405 Elm Street, Valparaiso, IN 46383-3620 USA; Tel:(219)462-3131; Fax:(219)462-2569.

In addition, two papers on magnetic coupling design, "Applications of Nd-Fe-B Magnets in Couplings Above 150°C" by J.H. Wise and "Rare Earth Iron Alloys for Magnetic Couplings: A Tutorial Survey" by J.H. Wise and M.A. Phadke, are available from Dr. Ranzi at the above address. ▲

Academy Award

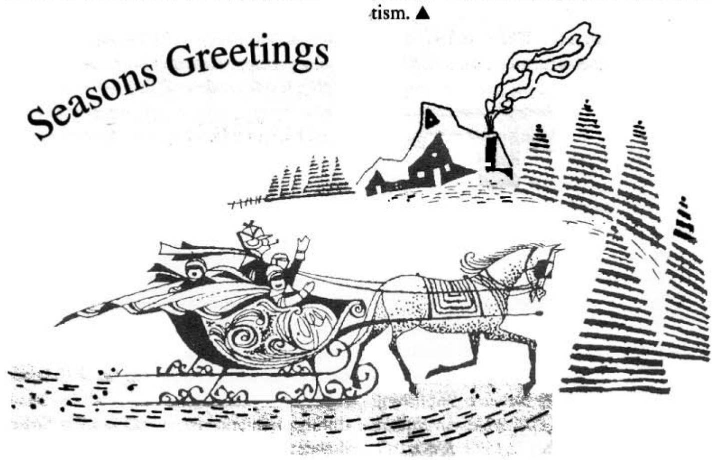
Dr. Arthur J. Freeman, Morrison Professor of Physics at Northwestern University, Evanston, Illinois, U.S.A., has been named a member of the Academy of Natural Sciences of Russia. He was honored in recognition of his achievements in solid state physics.



Dr. Arthur J. Freeman

Dr. Freeman is known internationally for his pioneering research in the field of magnetism, which has emphasized the innovative field of surface magnetism, interfaces, monolayers, ultrathin films, sandwiches and modulated structures. He is also responsible for the development of "novel computational techniques" used to carry out theoretical simulations of his research. Even though he is a theoretical physicist, his theoretical results are regarded as important to experimentalists who use them to create new experimental designs.

Dr. Freeman is editor-in-chief of the *Journal of Magnetism and Magnetic Materials*, the premier international journal of magnetism. ▲



Proceedings of the 7th Halide Glass Symposium

Sixty-five papers presented at the Seventh International Symposium on Halide Glasses, held March 17-21, 1991 in Lorne, Victoria, Australia, have been published in the *Journal of Non-Crystalline Solids*, Volume **140**, Nos. 1-3, January 11, 1992. This journal was edited by R.A. Weeks, D.L. Kinser and D.R. MacFarlane, and is published by North-Holland Amsterdam.

The Proceedings report on the research of 70 scientists and engineers from 11 countries. Both research and development in this field are driven by the promise of glass that is highly transparent in the mid-infrared region while providing ultra low losses for optical fibers. Progress towards the latter goal has been slow in the eighteen months since the previous conference, as the papers from the large research organizations in this volume indicate. However, systematic indentification and investigation of the problems confronting the field is continuing in many laboratories worldwide and are also reflected in these Proceedings.

The continued expansion of the halide family of glasses is highlighted by workers who have provided insights in yttria-stabilized divalent fluoride glasses, the preparation of high purity fluorides, and the effect of composition on the chemical durability of AlF_3-YF_3-ThF_4-BaF_2 (BATY) glass.

Other papers show that new systems, involving fluoride multicomponent glasses, as well as multihalide systems, are continuing to be discovered. The potential for application of these glasses in ultra low loss communication systems appear in a number of papers addressing ultra purification.

Another interesting aspect of these glasses is their ability as hosts for optically active dopant components. This interest alone produced a series of papers, some investigating the basic aspects of rare earth dopant ion fluorescence in the glass, others reporting the successful lasing of doped heavy metal fluoride optical fibers.

The fundamental properties of heavy metal fluoride glasses continue to attract attention and a series of papers considered aspects of their structure, electrochemistry, conductivity, relaxation, and spectroscopy.

For a copy of these Proceedings, send 396 Dfl (~$196.00 US) directly to Elsevier Science Publishers, P.O. Box 103, 1000 AC Amsterdam, The Netherlands; In the USA and Canada; Elsevier Science Publishing Co., Inc., P.O. Box 882, Madison Square Station, New York, NY 10159 USA. ▲

Conference Calendar

March '93
International Symposium on Radiation Protection in the Mining, Milling and Downstream Processing of Mineral Sands
Bunbury, Western Australia
March 18-20, 1993
RIC News, **XXVI**, [4] 2 (1991)
RIC News, **XXVII**, [2] 2 (1992)

April '93
Rare Earth Minerals: Chemistry, Origin, and Ore Deposits
London, England
April 1-2, 1993
RIC News, **XXVI**, [2] 2 (1991)
RIC News, **XXVII**, [2] 2 (1992)

Rare-Earth Doped Semiconductors
San Francisco, California USA
April 12-16, 1993
RIC News, **XXVII**, [3] 2 (1992)

August '93
European Magnetic Materials & Applications Conference (EMMA '93)
Kocise, CSFR
August 24-7, 1993
RIC News, **XXVII**, [3] 2 (1992)

September '93
20th Rare Earth Research Conference
Monterey, California
September 12-17, 1993
RIC News, **XXVII**, [1] 2 (1992)
RIC News, **XXVII**, [3] 2 (1992)

Santa Fe, New Mexico, USA
September 19-24, 1993
RIC News, **XXVI**, [3] 2 (1991)

Rare Earth-Steel Alloys

The addition of rare earths to steel improves the performance of low sulphur steel and has positive effects on hydrogen-induced cracking resistance in steel, according to Chen, Xi-Ying, *J. Rare Earths*, **10**, No.1, 61-5 (1992). The addition of rare earths to steel in China started in the 1950's, and after positive results, continued. Initially, nozzle blockage and macroscopic inclusion defects were problems, but these were eventually solved.

The addition of rare earths improves the properties of steel through cleaning and modifying molten steel and controlling sulphide morphology. The sulphide morphology controlling technique is used to decrease transverse cracking while improving low temperature toughness, cold punch formability, weldability and corrosion resistance. The rare earth addition also improves the casting characteristics, the hot-crack sensitivity for cast steel, high-temperature oxidation resistance, and strength. According to Chen, there seems to be a linear relationship between the amount of dissolved RE and hardness.

Although the actual composition of the material, nor the identity of the rare earths used in the process are mentioned, the current method of adding rare earths to steel during production is by feeding a RE-Si-Fe powder-cored wire into the melt. ▲

Smart Materials Facility

ETREMA (Edge Technologies Rare Earth Magnetostrictive Alloys) Products Inc., a subsidiary of Edge Technologies Inc., has started construction of a new smart materials research/development and manufacturing facility. This new facility will be located in Ames, Iowa, U.S.A. and is scheduled to be completed and operational by April of 1993.

The new highly automated facility will produce smart materials based on Terfenol-D ($Tb_xDy_{1-x}Fe_y$), which is used in actuators,

physical exploration, laser position control, medical sonics, and other applications.

Terfenol-D instantly changes shape in proportion to a magnetic field which can be varied by an electrical signal. It also produces an electrical pulse in response to external forces, making it a smart material.

Smart materials are said to be mission sensitive, meaning they sense and respond to changes in their environment. Lighter and faster than mechanical systems like hydraulics, smart structures provide motion or electrical signals in response to external variations such as load, vibration, turbulence and structural defects.

For more information contact: Mel J. Goodfriend, ETREMA Products, Inc., 306 South 16th St., Ames, IA 50010 U.S.A.; Tel:(515)232-0820; Fax:(515)232-1177. ▲

Professor Burkhanov Honored

Prof. G.S. Burkhanov was recently honored in Moscow, Russia, for his research accomplishments on metals and alloys. The ceremony was held during his 60th birthday celebration on September 18, 1992. After earning his degree from the Moscow Institute of Steel and Alloys in 1955, Prof. Burkhanov began his career as a research scientist at the Baikov Institute of Metallurgy, where he worked with Dr. E.M. Savitskii. He is now the Director of Savitskii's laboratory.

Prof. G.S. Burkhanov

Prof. Burkhanov has conducted research in the chemistry and technology of high-purity rare earth metals, their alloys and compounds, distillation processes, zone refining, single-crystal growth, recrystallization, and phase diagrams of intermetallics.

He has authored more than 250 journal articles, his work has appeared in nine books, and he holds over 20 patents for various metallurgical processes.

Prof. Burkanov will continue developing physical-chemical theories and the methods of purification and single crystal growth of metals with special emphasis on rare earth metals, rare earth high temperature intermetallic compounds and magnetic alloys. ▲

High-Tc Single Crystals

The Superconductivity Research Laboratory, Tokyo, Japan, recently used the Czochralski method to grow large 5 x 5 x 7 mm yttrium-based superconducting single crystals with a T_c of 92K [*Superconductor Industry*, **5**, No.3, 42 (1992)]. This discovery is expected to open the way for the development of devices such as superconductive circuit boards.

The growth was facilitated by a samarium-123 seed crystal, 1 x 1.5 mm square, which was lowered into a molten mixture of 5% yttrium, 30% barium and 65% copper, which was held at 970-1000°C. The seed crystal was then slowly removed from the melt at pull-up speeds of 0.1 to 0.5 mm per hour and a rotational speed of 10-120 rpm, producing the long single crystal. It was found that growth is possible only in the longitudinal direction. ▲

Improved Fluoride Glass

A new fluoride glass has been developed that could result in optical fibers capable of communicating over distances as great as 2000 km without needing a repeater [*Photonics Spectra*, **26**, [5], 46 (1992)]. The manufacturer, Cerem, of Grenoble, France, claims that the new fluoride glass is 100 times more transparent than the silica glass from which optical fibers are currently made. The first samples of the glass produced by the French center of materials research and development contain a few hundred impurities per cubic centimeter, which is 100 to 1000 times less than the best fluoride glass made today.

The new process of glass production eliminates contact between the glass and its container during cooling. The process uses a cushion of gas a few tens of microns thick that supports the glass during production and prevents it from touching the inner wall of the crucible. This "aerostatic lubrication" phenomenon can be maintained with gas entering the crucible at a rate of less than one liter per minute.

The first optical fiber produced by this method is to be tested by the end of this year, but it will take at least three years to commercialize a new fiber-optic product. ▲

Mag-Optical Memory From Recycled Terbium

Ames Specialty Metals, Inc. (ASM), a subsidiary of Edge Technologies, Inc., has developed a method for the recovery of terbium as one facet of their rare earth scrap reclamation capability. Terbium is a high value rare earth material which is used in rare earth-transition metal alloys in rewritable magneto-optical (M-O) data storage applications. The new recovery procedure saves 30 to 50% in the cost of terbium, making the manufacture of these disks more cost-efficient.

Optical discs are made by depositing, usually by sputtering, a thin magneto-optical film on to a glass or polymer substrate. Sputtering targets which contain rare earth-transition metal alloys such as terbium, gadolinium, or neodymium, in combination with transition elements such as iron and cobalt, are efficient materials for high density M-O data storage. Edge Technologies, Inc., is hoping that M-O data storage devices will claim an increasing market share currently held by compact disk-read only

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Lasers Cut Diamonds

It has been common knowledge in the diamond industry that the use of lasers, primarily Nd:YAG, can be used to cut, saw and kerf diamonds [*Photonics Spectra*, **26**, No.6, 40 (1992)]. Although these lasers have become standard equipment, laser sawing is not used frequently because approximately 5 percent of the diamond weight is lost in the process. This is about twice that lost using mechanical methods.

Recently, the Israel Diamond Institute initiated a research program at the Weizman Institute of Science in Rehovot, Israel, to study the optimal laser characteristics which would make laser sawing feasible. The research team, led by Professor Yehiam Prior, has managed to improve the efficiency of laser sawing, achieving a weight loss of only 2 percent. The team found, through experimentation, the optimum combination of laser power, spot size, focal distance, laser pulse length and repetition rate, temperature, and atmospheric conditions to saw the diamond with the least loss of weight.

It would seem that diamond, even with its high index of refraction, would be transparent to Nd:YAG laser light, and cutting would be impossible. However, once the laser pulse strikes the surface of diamond, graphitization takes place, which now absorbs the laser energy, enabling efficient ablation.

Not only can diamonds be cut with less loss than by mechanical methods, they can also be cut into shapes never before realized. This is because the laser causes no internal damage, and cuts can be made irrespective of the crystal structure.

As new miniature diode-pumped Nd:YAG lasers are developed with power levels of a few millijoules per pulse at several kilohertz, they will replace the industrial Nd:YAG lasers now in use. ▲

Mag-Op/*Continued from previous column* ➪
memory (CD-ROM) "write-once" devices. CD-ROM drives currently lead in volume, but by 1997, rewritable drives may account for 34.8% of the optical storage market, while the CD-ROM share could decrease from 75.7% to 63.0%. This growth will make the recovery of terbium from scrap increasingly important.

For more information contact: Michael Joyce, Ames Specialty Metals, Inc., 2625 N. Loop Drive, Suite 900, Ames, IA 50010 U.S.A.; Tel:(515)296-7139; Fax:(515)296-7703. ▲

New Trade Publication

Elements, The International Rare Earths & Specialty Metals Report, is being initialized by Concord Trading Corporation (CTC). Volume 1, Number 1 appears as the September 1992 issue. The new trade journal will be published monthly and should prove valuable to people active in the rare earth and specialty metal fields.

This new publication will provide the reader with access to a "wealth of information geared specifically to those who buy, sell, research, and produce rare earths and specialty metals," according to Thomas C. Pool, editor. "*Elements* is the first magazine of its kind, and is sure to become required reading for everyone in the rare earths and specialty metals industry". "There's nowhere else to obtain such valuable data in such a timely fashion."

Among the features to be included each month are: Exclusive reports on international market activities, the latest pricing trends, revealing feature articles, in-depth analyses of rare earth and specialty metals, metals calendar, and "Rumor Has It", a monthly column by Ray Rumer that will provide glimpses of who is doing what, to whom, in the industry.

The subscription price is $495.00 US. If you wish to subscribe, or receive a sample copy, contact Ms. Amy Lightner, Circulation Manager, Concord Trading Corporation, Three Park Central, Suite 1000, 1515 Arapahoe Street, Denver, CO 80202, USA. Tel:(303)899-4400; Fax:(303)899-4555; Telex:450202. ▲

Ceramic Scintillators for XCT

The use of X-ray Computed Tomography (XCT) in medical radiology has become an essential diagnostic tool because of its ability to generate cross-sectional images of the interior of the human body. In the past twenty years, considerable improvements have been made in image quality, and now, rare earth-doped ceramic scintillators with improved properties are being used in this application [*Phys. Stat. Sol.* (a) **130**, K183-7 (1992).

These ceramic scintillators are polycrystalline, inorganic-nonmetallic solids produced by sintering. B.C. Grabmaier, W. Rossner, and J. Leppert report that these luminescent ceramics are derivatives of known rare earth phosphor systems, such as europium-doped yttria-gadolinia, $(Y, Gd)_2O_3$:Eu and gadolinium oxysulphide doped with praseodymium and cerium, Gd_2O_2S:Pr,Ce. The x-ray excited emission spectra demonstrate the characteristic transition of $Eu^{3+}(^5D_j - ^7F_j)$ and $Pr^{3+}(^3P_j, ^1D_2 - ^3H_j)$. The basic luminescent properties of these ceramic scintillators do not differ much from those of related crystal or powder samples. These materials also offer the possibility of influencing the luminescent properties by multicomponent doping. For example, codoping $(Y,Gd)_2O_3$:Eu with other rare earths such as Ce, Pr, or Tb considerably reduces the afterglow intensity, even though this reduction often means a decrease in light output. An explanation for this behavior may be that afterglow related trapping-detrapping processes and the nature of the dominating trap states are affected. ▲

Future Demand for Yttrium

Regardless of the present market conditions for rare earth raw materials, there is still areas of growth and opportunity. R.K.A. Taylor presented "The Availability of Resources to Meet Future Demand for Yttrium" at the Joint TMS-AusIMM Rare Earths Symposium held in San Diego, California, March 2-5, 1992. However, it was not included in the proceedings: *Rare Earths Resources, Science, Technology and Applications.*

Of the many uses for yttrium, the applications in ceramics and phosphors are stimulating high rates of growth in demand, even though supplies from China have resulted in recent over-supply. In addition, there are three other major applications for yttrium which will tend to increase demand: specialty glasses, high performance alloys, and developing applications such as high T_c superconductors.

The consumption of yttrium by the year 2000 is expected to be in the range of 1,400-2,400 mt per year, with the most likely level at around 1,800 mt. This works out to be an average compound annual growth rate of 7%-8% for the remainder of the decade. The major area for growth will be in the ceramics industry where there is a wide range of applications where small quantities are currently used as dopants, but major expansion of applications are expected within the next ten years.

In 1991, 40% of the yttrium consumed was for CRT phosphors, nearly 35% for lamp phosphors, 17% in ceramics, and the remaining 8% for other applications. The extensive use of trichromatic yttrium lamp phosphors in Japan and developing coun-

sult in an annual growth rate of 15%, according to the author.

Last year, Japan consumed the largest share of yttrium, with over 45% of the total world market. Europe came in a distant second with 17.5% of the total, the United States with just over 14%, leaving the remaining 23% to the rest of the world.

The paper can be obtained by contacting the author, Mr. Richard Taylor, Dema Pty. Ltd., Suite U6, Chelsea Village, 145 Stirling Highway, Nedlands, WA, Australia; Tel:61 9 389 1700; Fax:61 9 389 1730. ▲

New Thermionic Emitter

A new thermionic emitter made of cerium hexaboride (CeB_6) has been developed by researchers at FEI Co., Beaverton, Oregon, as a replacement for lanthanum hexaboride (LaB_6) thermionic cathodes currently used in electron microscopes and electron-beam lithography systems [*R&D Magazine*, **34**, No.1, 56-7 (1992)]. Since CeB_6 has significantly lower volatility at the temperatures needed to achieve practical current densities, the service life of this emitter is over 500 operating hours longer than the LaB_6 material now widely used.

Operating at normal conditions of 1800K and under a residual pressure of 2×10^{-8} torr, CeB_6 emitters evaporate at a rate of 2.1×10^{-9} g/cm²sec compared to 2.9×10^{-9} g/cm²sec for similar emitters made of LaB_6 crystals.

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Emitter/*Continued from previous column* ⇨

Since evaporation of the emitting material during operation is the primary reason thermionic cathodes fail, this new material should greatly increase the service life of these cathodes used in e-beam applications. The work function of CeB_6 is reported to be 2.4 eV as compared to 2.6 eV for LaB_6. Another advantage of CeB_6 emitters is their ability to recover more completely from carbon contamination than LaB_6. When CeB_6 cathodes are heated in scanning electron microscope (SEM) environments, for example, contaminants on the crystal surface are quickly desorbed. It is this higher tolerance to contamination that may be the key to a longer cathode service life since lower filament temperatures can be maintained during emission.

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Emitter/*Continued from previous column* ⇨

For the 35-40% of all e-beam instruments that now use LaB_6, CeB_6 can be used as a replacement with no change in brightness or total available beam current. ▲

Magnetism of Surfaces, Thin Films, and Multilayers

Materials Research Society (MRS) Symposium Proceedings Volume **231** is entitled *Magnetic Surfaces, Thin Films, and Multilayers* and was edited by S.S.P. Parkin, H. Hopster, J.-P. Renard, T. Shinjo, and W. Zinn. It contains 13 of the invited papers and 53 of the contributed papers presented at a symposium held April 29 to May 2, 1991 in Anaheim, California, USA, in conjunction with the MRS Spring Meeting. The papers detail recent developments in the magnetism of surfaces, thin films, and multilayers. The book contains 525 pages and was published in 1992.

In recent years the study of magnetic surfaces, thin films, and multi-layers has undergone a renaissance, partly motivated by the development of new growth and characterization techniques, but perhaps more so by the discovery of many exciting new properties, some quite unanticipated. These include, most recently, the discovery of enormous values of magnetoresistance in magnetic multilayers far exceeding those found in magnetic single layer films, and the discovery of oscillatory interlayer coupling in transition metal multilayers. These experimental studies have motivated much theoretical work. However these developments are to a large extent powered by "materials engineering" and the ability to control and understand the growth of thin layers only a few atoms thick. It is quite remarkable that the magnetic and transport properties of certain thin film and multilayered structures are sensitive to thickness variations on the scale of one atomic layer but even more remarkable is the fact that such structures can actually be created.

Part IV of the Proceedings, "Rare-Earth Thin Films and Multilayers", provides insight to the various properties of epitaxial rare earth superlattices and thin films, including ferrimagnetism, magnetoresistance and structure of these materials.

This book can be ordered from the MRS, Publications Department, 9800 McKnight Road, Pittsburgh, Pennsylvania 15237, USA; Tel: (412)367-3012 Fax:(412)367-4373. It is available in hardcover or microfiche for $47.00 US to MRS members. For nonmembers it lists at $54.00 US in the United States and $60.00 US elsewhere. In Europe, Africa, and the Middle East, please direct book inquiries to Clarke Associates - Europe Limited, 13a Small Street, Bristol, BS1 1DE England; Tel:0272-268864 Fax:0272-226437. ▲

Studies of High T_c Superconductors

Studies of High Temperature Superconductors, Volume 8, was published in 1991 by Nova Science Publishers, Inc., and continues the pattern of the earlier seven volumes. The topics discussed are from the frontal areas of research and applications of high T_c materials. J. Spalek and J.M. Honig in chapter 1 consider the problem of the mechanism of high T_c in terms of real space pairing through exchange interactions, while D.K. Ray (chapter 9) discusses the strong coupling theory. Clearly, the magnetism of rare earth-doped high T_c cuprates presents several challenging problems in understanding the superconductivity mechanism. Z. Fisk, et al. in chapter 2 report on the magnetic properties of R_2CuO_4 compounds, (where R= Pr, Nd, Sm, Eu and Gd) while A.J. Zaleski and J. Klamut (chapter 6) review magnetic ordering in the $YBa_2Cu_3O_{6+x}$ system. V.I. Anisimov, M.A. Korotin, and E.Z. Kurmaev in chapter 7 describe the electronic structure and correlation effects in high T_c systems. Anomalous magnetic behaviors of these materials are explained by M. Naito, Y. Tomioka, and K. Kitazawa (chapter 11) and the fluctuation effects on transport properties are discussed by M. Akinaga (chapter 8). As for applications, the progress using the Chemical Vapor Deposition (CVD) route in realizing large J_c tapes for high field magnets is treated by K. Watanabe, H. Yamane, N. Kobayashi, T. Hirai, and Y. Muto (chapter 3), while A. Bailey, G.J. Russell, and K.N.R. Taylor (chapter 4) describe the processing of thick films of HTSC suitable for high-sensitivity electronic devices. Characterization techniques for HTSC are described as T. Nagarajan (chapter 10) presents the potential of positron annihilation studies for revealing the Fermi surface properties and P. Esquinazi, A. Gupta, and H.F. Braun (chapter 5) discuss the powerful vibrating reed technique. Each chapter contains a complete bibliography.

The book, edited by Anant Narlikar, contains 434 pages and may be ordered from Nova Science Publishers, Inc., 283 Commack Road, Suite 300, Commack, New York 11725-3401, USA, Tel:(516)499-3103/3106. The cost is $74.00 US (US/Canada) and $87.00 US elsewhere, including air delivery. ▲

Tm^{170} is utilized as a radioisotope heat source, nondestructive testing of materials, and blood irradiation. ▲

REagents in Organic Synthesis

The application of lanthanide reagents to the preparation of organic compounds has caused an explosive growth in synthetic chemistry. Prof. G.A. Molander in ***Chem. Rev.***, **92**, 29-68 (1992) reviews material, published through mid-1991, that is the greatest value to synthetic organic chemists. The organization of the paper follows along traditional lines in synthetic organic chemistry and includes a bibliography of 241 references which should prove of value to interested scientists.

The utilization of lanthanide reagents for simple functional group transformations such as oxidation-reduction processes, is first outlined, then followed by more comprehensive descriptions of the application of lanthanides in selective carbon-carbon bond forming reactions. Synthetic transformations (e.g. oxidation or reduction reactions or processes) are emphasized to the near exclusion of kinetic and mechanistic studies. Even with this limitation, the author reminds us, a truly comprehensive interpretation is impossible. Thus, the concentration is on those processes occurring in a highly selective manner or that cannot be carried out efficiently using currently available technologies.

Since cerium(IV) compounds represent the most notable oxidants among all the lanthanides, they have been used extensively for many oxidative reactions. These reactions include; aromatic systems, hydroquinones, catechols, and their derivatives, arenes, alcohols, ethers, olefins, vicinal diols and -hydroxy ketones, ketones and aldehydes, carboxylic acids, oxidative halogenation, nitroalkanes, and organosulfur compounds. Other lanthanide compounds used as catalysts in oxidation include ytterbium nitrate, lanthanum(III) acetate and a variety of samarium alkoxides.

The section dealing with carbon-carbon bond forming reactions covers: substitution and carbonyl addition reactions; addition to carbon-nitrogen multiple bonded functional groups; nucleophilic acyl substitutions; reductive-oxidative coupling and cyclopropanation reactions; lanthanides as Lewis Acid catalysts; and miscellaneous reactions.

Throughout the paper, molecular diagrams of many reactions are included which serve as quick-and-easy guides to the reactions. ▲

Actinides Handbook Six

Actinide research presents unique challenges, both for experimentalists and theorists. This uniqueness stems not only from their nuclear properties, which since the 1940's has led to their important role in nuclear energy and technology, but also from their unusual chemical and physical properties. These properties led to the publication of the *Handbook on the Physics and Chemistry of the Actinides* by North-Holland Publishing Company.

Volume 6 of this series completes the set. It, like volumes 3 and 4, emphasizes the unique chemistry of the actinides, though physical aspects, such as self-radiation and electron paramagnetic resonance are also treated. The chapter titles and their authors are as follows: 1. Characterization of selected solid-state actinide (and related) compounds via Raman and absorption spectrophotometry, by W.R. Wilmarth and J.R Peterson; 2A. The actinide borides, by P.E. Potter; 2B. The ternary and higher order systems with actinide elements and boron, by P. Rogl; 3. Phase relations and thermodynamic and magnetic properties of fluorite-type solid solutions $M_yU_{1-y}O_{2+x}$ ($M = M^{4+}$, M^{3+} or M^{2+}) as a modification of UO_2 by the addition of M metal ions, by T.Fujino and C. Miyake; 4. Molten-salt chemistry of actinides, by L. Martinot; 5. Chemistry of tervalent uranium, by J. Drozdzynski; 6. Magnetochemistry of U(V) complexes and compounds, by C. Miyake; 7. Chemical aspects of actinide Mossbauer studies, by A. Tabuteau; 8. Electron paramagnetic resonance (EPR) and thermally stimulated luminescence (TSL) studies on actinide doped solids, by M.D. Sastry and A.G.I. Dalvi; 9.Hydrolysis of the actinide ions, by S. Ahrland; 10. Behavior of transuranium elements in the Purex process, by Z. Kolarik; 11. Acceleration of the natural rate of elimination of transuranium elements from the mammalian body, by D.M.Taylor; 12. Analytical chemistry of transuranium elements, by B.F. Myasoedov and I.A. Lebedev; 13. Radiation chemistry of actinide solutions, by P.K. Bhattacharyya and P.R. Natarajan; and 14. Self-radiation effects in the actinides and their compounds: basic studies and practical implications, by J. Fuger and Hj. Matzke.

Chapters 1, 2B, 3, 4, and 8 contain subject matter that deals with the rare earths and actinides. The other chapters are of interest only because of the similarities between the

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Handbook/*Continued from previous column* ⇨

actinides and the rare earths. Volume 6 also includes a cumulative subject index of volumes 1-6, as well as a contributor index for the entire six volume set.

Volume 6 of *Handbook on the Physics and Chemistry of The Actinides* contains 752 pages and was edited by A.J. Freeman and C. Keller and was published in 1991.

The *Handbook* is available for Dfl. 500.00 ($286.00 US) from Elsevier Science Publishers, P.O. Box 211, 1000 AE Amsterdam, The Netherlands, or from Elsevier Science Publishing Company, Inc., P.O. Box 882, Madison Square Station, New York, NY 10159, USA. ▲

Divalent Rare Earth Ions in Halide Crystals

A review written by J. Rubio O. [J. Phys. Chem. Solids, 52, No. 1, 101-74 (1991)] reports on the results of the extensive research into the properties of divalent rare earth ions in halide crystals. The paper primarily relies on the research of the past 20 years and concentrates on the spectroscopic properties of divalent rare earth ions doped into alkaline earth and alkali halides, and other halide crystals. The author gives special emphasis on the most-studied divalent rare earth species: Eu^{2+}, Sm^{2+} and Yb^{2+}.

The rare earth ions can be present in solids, either in their divalent or trivalent state, but by far the most common valence state of these ions in solids is the trivalent one. Since the absorption and emission spectra of the divalent ions differs considerably from the trivalent ions, this review is a welcome addition to the literature that is currently available.

The spectra are mainly composed of two types of electronic transitions: weak $4f$ - $4f$ at low energies and strong $4f$ - $5d$ at higher energies. In order to understand these transitions, a reasonable knowledge of the energy levels of the $4f^{n-1}5d$ configuration is required.

The author reports on the optical and physical properties of Eu^{2+}, Sm^{2+} and Yb^{2+}, which include absorption and emission spectra, fluorescence, photoionization energies, binding energies, quantum efficiencies and energy levels. The 73-page review effectively uses 68 figures, 39 tables, and 324 references to summarize the most significant information concerning the spectroscopic properties of halide crystals doped with divalent rare earth ions, mainly Eu^{2+}, Sm^{2+} and Yb^{2+}. ▲

Landolt-Börnstein Series e1

Landolt-Börnstein:Numerical Data and Functional Relationships in Science and Technology-New Series, Subvolume e1, *Compounds of Rare Earth Elements with Main Group Elements Part 1*, is a continuation of Volume 19 (Magnetic Properties of Metals, of Group III:*Crystal and Solid State Physics*). Subvolume e1, compiled by T. Kaneko and edited by H.P.J. Wijn, was published in 1990. The earlier editions of *Landolt-Börnstein* (6th Edition), Vol. **II**, part 9, dealt with the magnetic properties of a wide variety of substances. Naturally, the amount of published data has since grown considerably and thus a new compilation was necessary.

This volume specifically deals with the magnetic properties of metallic compounds of rare earth elements with elements of the main groups of the periodic system. Section 2 of this subvolume reviews the literature containing information on rare earth (R) compounds with group 1B elements, (RCu_x, R_3Ag_2, RAu_x and $(R_{1-x}R')_mN_n$, where N=Cu, Ag, and Au), and other intermetallic compounds containing $3d$ elements. The final few pages of the section deals with the magnetic properties of rare earth and rare earth-substituted ternary and quaternary U and Th compounds.

The volume is complete with crystal and magnetic structure diagrams, electrical resistivity measurements, magnetic moment, magnetoresistance, magnetostriction, and other magnetic properties of these compounds. These properties are displayed by using many tables, graphs and diagrams. All of the information is arranged in a logical format and is easy to locate for quick reference. This feature alone makes these series a premier source for this type of information.

The 519-page *Compounds of Rare Earth Elements with Main Group Elements Part 1* contains 1,115 figures and nearly a thousand references. It can be ordered from Springer-Verlag GmbH & Co. KG, Postfach D-1000, Berlin 33, Germany for 1,620DM (~$1,100US). ▲

Another High T_c Record

Kobe Steel, Ltd., of Kobe, Japan, has succeeded in using the sol-gel process to produce an yttrium-barium-copper oxide superconducting thick film which reached a critical current density (J_c) of 12,000 A/cm² [*Japan New Materials Report*, 7, No. 3, 6

Continued on page 7 ⇨

Permanent Magnet Patent Update

Improving the Properties of Permanent Magnets: A Study of Patents, Patent Applications, and Other Literature, compiled and edited by G.H.M. Koper and M. Terpstra, was published in 1991 by Elsevier Science Publishers Limited.

Improving the Properties of Permanent Magnets emphasizes the improvements in various magnetic, chemical, physical, and mechanical characteristics of the magnets by various alloys and methods of production. The book is arranged in sections that provide information on industrial economics including methods to lower production costs of rare earth magnets and magnetic materials. The final section provides methods to prevent risks, including explosions, during the production of rare earth magnets and magnetic materials. Patent information on 47 companies and research organizations is also presented. The book provides a valuable guide to the most recent developments in the use of metal alloys for permanent magnets and should be of interest to metallurgists and electronic and mechanical engineers, particularly those working in the robotics and transport industries.

The 156-page book costs £65.00 (~$130.00 US), and may be ordered from Elsevier Science Publishing Inc., P.O. Box 8832, Madison Square Station, New York, NY 10159, USA or from Elsevier Applied Science Publishers Ltd., Crown House, Linton Road, Essex, IG11 8JU, United Kingdom. ▲

RIC News

Vol. XXVII, No. 4 December 1, 1992

Published quarterly in March, June, September, and December by Rare-earth Information Center, Ames Laboratory, Institute for Physical Research and Technology, Iowa State University, Ames, Iowa 50011-3020

Postmaster: Send address changes to: *RIC News*, Rare-earth Information Center, Ames Laboratory, Institute for Physical Research and Technology, Iowa State University, Ames, IA 50011-3020

Telephone: (515)294-2272

Telex: 283359

Facsimile: (515)294-3709

BITNET: RIC@ALISUVAX

K. A. Gschneidner, Jr. .... Editor

Joel Calhoun .... Staff Writer

Jennings Capellen .... Staff Writer

Superconducting Electrical Current Lead

Workers at Argonne National Laboratory, Argonne, Illinois, have invented an electrical current lead made of a proprietary blend of high-temperature (High T_c) superconductors and other materials. The superconducting material has been licensed nonexclusively to Illinois Superconducting Corp. (ISC), Evanston, Illinois.

The new current lead could help researchers and hospitals save energy and liquid helium in conventional superconducting devices that operate at temperatures near absolute zero, such as magnetic resonance imaging equipment in hospitals, and magnets used in physics research at high energies and low temperatures.

The new high-T_c lead would carry electrical current between normal conducting materials at room temperature and low temperature superconductors, which are first cooled by liquid helium, at the super-cold temperature of 4K. The new lead is aimed at minimizing loss of helium due to resistive heating, which, in conventional superconducting systems, is continually boiled off by heat transferred from non-superconducting metals. High-T_c superconductors lose all resistance to electricity when cooled to much warmer temperatures of about 90K, but are still unsuitable for many applications, such as magnets, because they are too brittle and do not carry large amounts of current well.

The use of high-T_c superconductors would eliminate this resistive heating over that portion of the lead, and with the new proprietary design, also add strength and flexibility, in addition to providing a shunt to carry current in case superconductivity is temporarily lost.

According to John Hull, an Argonne scientist and one of the concept's originators, the best material for use in this application may be the yttrium-barium-copper-oxide high-T_c superconductor.

The largest potential market for this new material is the Superconducting Super Collider being built in Texas, according to Ora Smith, president of ISC. ▲

***Record**/Continued from page 6* ⇨

(1992)]. The superconductor was formed on a silver substrate and became superconducting (T_c) at 90K.

According to company officials, this could be a step towards developing practical superconducting tape and shielding materials. ▲

Dieter Wohlleben (1935-1992)

RIC has learned of the death of Professor Dieter Wohlleben of the Department of Applied Physics at the University of Köln in Germany. He was born April 23, 1935. He died, in an automobile accident, July 13, 1992.

Dieter Wohlleben attended the Technische Universität in Berlin from 1955-1961 and received a diplomingenieur in physics. He received his MS (1964) and his PhD (1968) in Physics from the University of California at La Jolla. Dieter was with the University of California at San Diego from 1968 until 1974, when he went to the University of Köln (Cologne).

His most recent work involved the magnetic and thermal behavior of rare earth alloys, high temperature ceramic superconductors, and the mixed valency and phase transitions of rare earth compounds and alloys, especially those containing Ce, Eu, and Yb. The scientific community lost a brilliant scholar whose loss will be keenly felt. ▲

Remy Lemaire (1937-1992)

On September 1, 1992, Dr. and Mrs. Remy Lemaire, and their son, Pierre, died as a result of an automobile accident in Namibia. Dr. Lemaire was born April 30, 1937 in St-Mihiel, Lorraine, France. Dr. Lemaire earned his undergraduate degree as an Electrotechnic Engineer in 1960 and then a year later in Atomic Engineering at the National Polytechnic Institute of Grenoble. In 1966, he earned a Ph.D. at Grenoble University, while under the supervision of E.F. Bertaut and L. Néel, studying the preparation and magnetic properties of rare earth or yttrium-cobalt compounds.

Dr. Lemaire received the silver medal from CNRS (National Center for Scientific Research) in 1974, and in 1977 earned the Blondel Medal for the industrial process for the elaboration of rare earth-cobalt permanent magnets. He served as President of the Magnetic Commission of IUPAP (International Union of Pure and Applied Physics) from 1986-90, and headed the Laboratoire Louis Néel, CNRS, Grenoble, from 1988-92. He has been a co-editor of the ***Journal of Magnetism & Magnetic Materials*** since 1987.

Dr. Lemaire published more than 200 papers in international journals, supervised 40 theses, and was a member of the organizing committee of 15 international conferences. ▲

Laser Fibers

A new line of rare earth-doped optical glass fibers are now available from the French company, Le Verre Fluore. The new fluoride glass, doped with rare earths at a concentration between 100 and 2,000 ppm, has far better light transmission properties than traditional silica glass fibers. The optical properties of the glass are changed when small amounts of rare earths are added, with each element adding a unique capability and different range of optimal frequencies of light transmission. When the rare earth ion in the glass is stimulated by laser light, a 4f electron jumps from its ground state (base) energy level to a higher energy level, and then returns to its original level through a series of jumps, emitting photons in the process.

The rare earths doped in the standard glass fibers offered by the company are Er^{3+}, Nd^{3+}, Ho^{3+}, Tm^{3+}, Pr^{3+}, Sm^{3+}, and Dy^{3+}. A variety of fiber glasses are available. For example, with the Nd-doped fiber, there are four standard fiber types available, ranging from a dopant concentration of 100 ppm and with a core diameter of 6.5 microns and a cut-off wavelength of 0.98 microns, to one with 2,000 ppm dopant, a diameter of 4 microns, and a cut-off frequency of 1.22 microns. The company can also produce specialty fluoride glasses upon request, including those fibers which operate within specific spectral bands.

The new fluoride glass laser fibers have core diameters of 3.4, 6.5, and 11 microns. They are available in any desired length, but standard lengths are 10, 20, and 50 meters.

Applications for these fibers include remote infrared spectrometers, infrared imagers, optical amplifiers, diode pumped solid-state lasers ranging from ultraviolet to visible to mid-infrared, fiberoptic sensors, and remote control/monitoring of industrial processes. These fibers are also well suited to fiberoptic telecommunication networks operating in the 850, 1300, and 1500 nm wavelength ranges.

For additional information on applications, or on the company's products and services, contact: Mr. Gwenael Mazè, President, Le Verre Fluore, Z.I. du Champ Martin, 35770 Vern-sur-Seiche, France; Tel:99 62 79 22; Fax:99 00 42 96. ▲

Gd_2O_3 is used in microwave garnets, ferromagnetic garnets, and bubble memory substrates in gadolinium gallium garnet (GGG). ▲

Supporters 1993

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Since the September issue of the RIC News went to press, RIC has received financial support from six new family members, and renewed support from 29 other organizations. The supporters from the second quarter of fiscal year 1993 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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For more information contact: Bjørn

Gaustadalléen 21, N-0371, Oslo, Norway; Tel:47 2 95 88 91; Fax:47 2 60 44 27. ▲

Rare-earth Information Center
Ames Laboratory
Institute for Physical Research and Technology
Iowa State University
Ames, Iowa 50011-3020