Rare-earth Information Center NEWS

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Handbook Volume 18

Volume 18 of the *Handbook on the Physics and Chemistry of Rare Earths* "Lanthanides/Actinides: Chemistry" is the second of a three-volume set of reviews that are devoted to the interrelationships, similarities, differences, and contrasts of the lanthanide and actinide series of elements. This book devotes, in more detail than any previous *Handbook*, particular attention to the comparisons of the chemistry of the lanthanide and actinide elements. The lanthanide and actinide elements present a multitude of challenging physical and chemical problems that result from the involvement of open *f*-shell configurations.

The first chapter of the book, "Origin of the Actinide Concept", by Glenn T. Seaborg, is a concise history of the groundwork for determining placement of those elements which occur beyond uranium on the periodic chart. Students and researchers of the actinides will appreciate the background information and comprehensive nature of the history of these important elements, provided by one of the world's leading authorities on the subject. This chapter, in our opinion, is alone worth the price of admission.

The remaining ten chapters cover the topics of: relativistic effects and electronic structure of lanthanide and actinide molecules; similarities and differences in trivalent lanthanide- and actinide-ion solution absorption spectra and luminescence; separation chemistry for lanthanides and trivalent actinides; comparative thermochemical and oxidation-reduction properties of lanthanides and actinides; comparison of 4*f* and 5*f* element hydride properties; lanthanide and actinide halides; comparisons of the binary oxides; *f*-element speciation in strongly acidic media; and solution chemistry and hydration/hydrolysis of the lanthanides and actinides. The final chapter deals with the biochemistry of the *f*-ele-

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High-Temperature Superconductors

The amount of literature published in the field of high temperature superconductors is both tremendous as well as diverse. To keep up-to-date in all aspects of this area of study requires reading many journal articles, professional papers, and other publications. *Synthesis and Characterization of High-Temperature Superconductors* appears as Volumes **130-132** in Materials Science Forum and attempts to collect the most important research on these materials in one bound section. Volumes **130-132** were edited by J.J. Pouch, S.A. Alterovitz, R.R. Romanofsky and A.F. Hepp, and was published in 1993.

The book contains 30 invited papers on a wide variety of topics dealing with primarily $YBa_2Cu_3O_{7-x}$, as well as other rare earth and non-rare earth oxide superconductors. The book is divided into three parts: Preparation of Materials; Properties; and Applications of high-T_c Superconductors. Part I is made up

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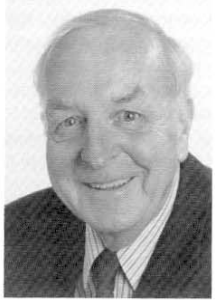
Handbook*/Continued from previous column* ➪

ments which should be required reading for workers who handle these materials in their day-to-day routines, as well as those supervisory personnel in charge of scientific research.

The 674-page Volume **18**: "Lanthanides/Actinides: Chemistry" of the *Handbook on the Physics and Chemistry of Rare Earths* was published in 1994 and includes subject and author indices. The volume was edited by K.A. Gschneidner, Jr., L. Eyring, G.R. Choppin, and G.H. Lander and is available for $300.00 US (Dfl. 525.00). Customers in the USA and Canada should send their orders to: Elsevier Science Inc., P.O. Box 945, Madison Square Station, New York, NY 10159-0945 USA; Tel:212 633 3650; Fax:212 633 3680; elsewhere: Elsevier Science B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands; Tel:31 20 5803 642; Fax:31 20 5803 598. ▲

Taylor Honored
Foreign Associate of US Academy of Sciences
1993 V.M. Goldschmidt Award

Dr. Ross Taylor, a Visiting Fellow at the Department of Nuclear Physics in the Research School of Physical Sciences & Engineering, Australian National University, Canberra, has been selected to join the elite group of foreign associates of the National Academy of Sciences of the USA. The Academy has only 1600 members with 260 Foreign Associates. He was also selected for the 1993 V.M. Goldschmidt Award. Dr. Taylor is a geochemist with an international reputation for his research into the continental crust and into the chemistry of the moon and other planets. He has written over six books and 210 publications, and his work has been cited at an average rate of 250 times per year over the past five years. He is currently working on a popular version of his 1992 book entitled *Solar System Evolution; a New Perspective* that is scheduled to be released in 1996. Rare earthers will recall his contribution to the *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 11, Chapter 79, "The Significance of the Rare Earths in Geochemistry and Cosmochemistry". RIC Congratulates Dr. Taylor for receiving these two well-deserved honors. ▲



Dr. Ross Taylor

HOLMIUM, atomic number 67, was discovered independently by P.T. Cleve and J.L. Soret in 1879. The name holmium is derived from the Latinized word for the city of Stockholm, Holmia.

ISPMM 95

The Third International Symposium on Physics of Magnetic Materials (ISPMM 95) will be held August 21-25, 1995, in Seoul, Korea. The symposium is intended for scientists and engineers involved in the field of magnetism, and will cover all aspects, from physics to applications. Some of the topics that will be included in the symposium are: basic magnetism, magnetization processes, artificially structured materials, soft magnetic materials and applications, hard magnetic materials and applications, magnetic recording, and miscellaneous topics.

The symposium will offer the attendees an opportunity to visit and tour industrial sites immediately following the technical programs. The sites include Samsung Electro-Mechanics, Samsung Advanced Institute of Technology, Pohang Steel & Iron Company (POSCO), and Ssangyong Cement Industrial Co. (at their hard ferrite plant).

For more information, contact Dr. H.J. Kim, Secretary, ISPMM 95, Korea Institute of Science & Technology, P.O. Box 131, Cheongryang, Seoul 130-650, Korea; Tel:82 2 968 2320; Fax:82 2 959 8381. ▲

MAG '95

MAG '95 is the fourth international conference on applications of magnetic bearings, magnetic drives, and dry gas seals. The conference is presented by the Center for Magnetic Bearings and will be held August 8-11, 1995 in Alexandria, Virginia. MAG '95 will provide an opportunity for manufacturers, users, and engineers of magnetic bearings to exchange ideas about these devices. Magnetic bearings are starting to be used widely in industry for the support of rotating shafts that are subject to forces. These bearings provide the advantages of oil free operation, low friction losses, long life, and enhanced vibration control. The conference will also feature an exhibition for manufacturers who wish to provide information to the participants about their products and services.

The conference will also include a Magnetic Bearing Short Course that will be held August 8-9, 1995. The short course will cover the following topics: magnetic bearing design, automatic controls, rotor dynamics, applications, electronics, power losses, and installation and maintenance. For more

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Conference Calendar

*** A NEWS STORY THIS ISSUE**

March '95
The Twelfth International Seminar on Primary and Secondary Battery Technology and Application
Deerfield Beach, Florida, USA
March 6-9, 1995
RIC News, **XXIX**, [4] 2 (1994)

April '95
25ièmes Journées des Actinides
L'Aquila, Italy
April 7-11, 1995
RIC News, **XXIX**, [4] 2 (1994)

August '95
MAG '95
Alexandria, Virginia, USA
August 8-11, 1995
*This issue

The Third International Conference on Rare Earths Development & Application
Baotou, Inner Mongolia, China
August 21-25, 1995
RIC News, **XXIX**, [1] 3 (1994)

The Third International Symposium on Physics of Magnetic Materials
Seoul, Korea
August 21-5, 1995
*This issue

September '95
European Magnetic Materials and Applications Conference (EMMA 95)
Wein, Austria
September 4-8, 1995
RIC News, **XXIX**, [1] 3 (1994)

International Conference on Strongly Correlated Electron Systems (SCES'95) Goa, India
September 27-30, 1995
RIC News, **XXIX**, [3] 2 (1994)

September '96
Fourteenth International Workshop on Rare-Earth Magnets and Their Applications and Ninth International Symposium on Magnetic Anisotropy and Coercivity in Rare-Earth Transition Metal Alloys
São Paulo, SP, Brazil
September 1-5, 1996
*This issue

14th International Workshop

The Fourteenth International Workshop on Rare-Earth Magnets and Their Applications will be held September 1-4, 1996 *and* the Ninth International Symposium on Magnetic Anisotropy and Coercivity in Rare-Earth Transition Metal Alloys will be held September 5, 1996, in São Paulo, Brazil. To receive additional information about either the Workshop or Symposium, contact Prof. Frank P. Missell, Instituto de Física, Universidade de São Paulo, C.P. 20516, São Paulo, SP, Brazil; Tel:55 11 818 6881; Fax:55 11 818 6984; E-mail:"remxiv@if.usp.br". ▲

MAG '95*/Continued from previous column* ➪

information on MAG '95, or to receive a registration form, contact Ms. Tana Herndon, Conference Coordinator, Center for Magnetic Bearings, MANE Dept/ McCormick Road/MEC 105, University of Virginia, Charlottesville, VA 22903, USA; Tel:804 924 3292; Fax: 804 982 2246. ▲

International Conferences Set

The International Steering Committee on *f*-Conferences met at ICFE-2 in Helsinki Finland, August 1994, and confirmed the locations and years of future broad-based rare earth conferences through the year 2000 The dates and organizers are as follows:

1995	August 21-25, Baotou, People's Republic of China, Liu Aisheng (ICREDA-3) - *see above in conference calendar*
1996	July, Duluth, Minnesota, USA, Larry Thompson (RERC-21)
1997	September, Paris, France, Jean-Claude Krupa and Pierre Porcher (ICFE-3)
1998	Australia, Dudley Kingsnorth
1999	USA, Lynne Soderholm (RERC-22)
2000	Madrid, Spain, Saez Puche (ICFE-4)

Compounds With Carbon

Compounds With Carbon, Rare Earth Elements, Volume C 12b, Gmelin Handbook of Inorganic and Organometallic Chemistry, 8th Edition, is the latest compilation of research on rare earths from the world-renowned Gmelin series. This volume deals with the compounds and systems of the rare earth elements with carbon.

Most of the volume is concerned with the rare earth carbonates, oxide and hydroxide carbonates, alkali carbonates, thiocyanates, and alkali and alkyl ammonium thiocyanates. The volume includes descriptions of the preparation and properties of carbonates of divalent rare earth elements, followed by the description of M_2O_3-CO_2 and M_2O_3-CO_2-H_2O systems, especially under hydrothermal conditions. Rare earth chemists will appreciate that the publishers have included the derived stability fields which show the existence of a series of basic carbonates in addition to the $M_2(CO_3)_3 \cdot nH_2O$ carbonates. These carbonates are usually obtained by precipitation from aqueous solutions of rare earth salts with alkali carbonates. Of particular interest to some researchers will be the results of extensive studies of the thermal decomposition of $M_2(CO_3)_3 \cdot nH_2O$, as well as $M_2(CO_3)_3$ by employing several methods. In the decomposition studies, the initial carbonates and their intermediate decomposition products were characterized mostly by infrared spectroscopy. Crystallographic data are included as well.

Topics on gaseous and matrix-isolated rare earth cyanides deal mainly with the thermodynamic properties of the molecules and their gas-phase reactions. Emphasis is placed on the preparation and formation of solid cyanides and cyanamides. Other topics include the preparation and systematics of rare earth cyanides, thiocyanates, selenocyanates and their alkali compounds in the solid state and in solution. The information on the cyanides, cyanates and selenocyanates is less than that presented on the thiocyanates. Somewhat less-known compounds are included as well, such as a separate section that is dedicated to scandium hydroxide thiocyanate, $Sc_4(OH)_2(NCS)_{10} \cdot nH_2O$.

The 362-page *Rare Earth Elements* C 12b *Compounds With Carbon* was published in 1994, contains 41 figures and includes what has become a Gmelin hallmark, a table of

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Rare Earth Intermetallics

Rare earth intermetallics play an important role in the study of magnetic materials and the development of semi- and superconducting materials. The *Handbook of Crystal Structures and Magnetic Properties of Rare earth Intermetallics* contains six chapters, including: Crystal Structures of Ternary Lanthanide Intermetallics; Magnetic Properties; Magnetic Properties of the Intermetallic $R_xT_yX_z$ Compounds with $y/x \leq z$; and Magnetic Materials Based on 3-d-Rich Ternary Compounds. Following an introductory chapter that presents a brief review the crystal structures, magnetic properties, and a host of a family of phases of rare earth intermetallic compounds, the book explores RTX, RTX_2, RT_2X, $R_2T_3Si_3$, RT_2X_2 phases, among others; over 20 structure types, magnetic interactions, the crystal electric field (CEF) model, magnetic moments and exchange interactions of these materials.

Scientists and industrial manufacturers of rare earth permanent magnets will be interested in the magnetic properties of $R_2Fe_{14}B$, $R_2Fe_{14}C$, and $R_2Co_{14}C$ compounds, including their hydrides. Information is also provided on substitution compounds as well as magnetocrystalline anisotropy of rare earth intermetallics. A chapter of concluding remarks completes the text.

This book provides materials scientists, engineers and physicists with all the critical information needed to use rare earth intermetallics effectively in the development of new materials. The 282-page *Handbook of Crystal Structures and Magnetic Properties of Rare Earth Intermetallics*, edited by A. Szytula and J. Leciejewicz, contains a subject index, a list of 767 references, and was published in 1994. The cost of the book is $95.00 US in the U.S.A./$114.00 US in other countries. To order, contact CRC Press, Inc., 200 Corporate Blvd., N.W., Boca Raton, FL 33431-9868 USA; Tel: 407 994 0555 (outside the U.S.A.); U.S. customers order toll free: 800 272 7737; Fax: 800 374 3401. ▲

Compounds/*Continued from previous column* ➪

physical constants and conversion factors. The cost to receive the hardcover book is DM 2,195.00 ($1,400.00 US) and can be ordered from Springer-Verlag GmbH & Co. KG, Tiergartenstrasse 17, D-69121 Heidelberg, Germany; Tel:62 21 487-0; Fax:62 21 41 39 82. ▲

Lanthanides in Organic Synthesis

There is a vast and often bewildering array of methods and reagents available today to organic chemists who wish to prepare organic lanthanide compounds and complexes. Since many organic chemists feel comfortable with their own methods when preparing compounds, they may not take advantage of newer, more efficient methods to produce synthetic compounds and materials. New and unfamiliar methods may allow a particular synthetic step to be accomplished more readily and with a higher yield, but there may be some hesitation on the part of some chemists to try unfamiliar methods. *Lanthanides in Organic Synthesis* is one of the *Best Synthetic Methods* series of books which allow the practicing synthetic chemist to choose between all of the alternatives, and assess their real advantages and limitations. The book deals concisely with the preparation of lanthanide compounds from a practical point of view while providing precise experimental directions and hints.

The book, following a brief introduction, provides background on the general properties of the lanthanides including oxidation states, ionic radii, occurrence, and toxicity, which should provide useful information to the beginning chemist or student learning the art of organic lanthanide preparation. There is a chapter devoted to the use of lanthanide metals in synthesis, which includes various alloys, such as the hydrogenation procedure of $LaNi_5H_6$, and reactions with activated metals. Reactions and synthesis of the divalent, trivalent, and tetravalent lanthanides are also explained. The book comes complete with tables, figures, and illustrations of chemical reactions so that laboratory workers can readily follow the sequence of events in virtually every reaction proposed in each chapter. Each described synthesis reaction includes a list of references where researchers have previously and successfully prepared organic lanthanide compounds and complexes.

The 154-page *Lanthanides in Organic Synthesis* was written by Tsuneo Imamoto and edited by Otto Meth-Cohn and was published in 1994. This book can be ordered from Harcourt Brace & Company Ltd, Foots Cray High Street, Sidcup, Kent DA14 5HP, UK; Tel: 081 300 3322; Fax: 081 309 0807. The cost of the hardcover book is $30.00 US. ▲

Nd-Fe-B Flywheel Battery

The concept of storing kinetic energy by means of angular momentum in a rotating mass is one of the oldest methods of energy storage, and may be reborn as a high-tech alternative in modern electric and hybrid vehicles {*RIC Insight*, [7] July, 1994}. A hybrid vehicle is a vehicle that uses more than one source of energy for propulsion, such as a car that has both an internal combustion engine and an electric motor. The impetus to the rekindled interest in flywheels stems from the legislative requirement which forces automobile manufacturers to offer non-polluting cars to customers in the state of California by 1998. Ford Motor Company and General Motors are hoping that flywheel batteries can economically replace the heavy and relatively inefficient lead acid batteries that are currently the best choice for storing electrical energy in vehicles for long periods of time.

Westinghouse Electric Corp. is looking into the feasibility of using powerful neodymium-iron-boron magnets that can spin up to 100,000 revolutions per minute. In a flywheel of this type, kinetic energy can be stored for weeks at a time and converted to electrical energy at a moments notice. The flywheel is supported by magnetic bearings in a vacuum, so the effect of friction is greatly reduced, enabling the spinning flywheel to stay in motion for extended periods of time. The amount of energy that can be stored depends on the mass of the flywheel and the speed of rotation. The flywheel is made of lightweight and strong carbon graphite fibers that are tightly wound and then sealed in epoxy resin. Nd-Fe-B permanent magnets are embedded in the flywheel and generate electricity as the resultant magnetic field cuts across a coil of conductive wire, thus functioning as an electric generator.

A flywheel battery of this type is claimed to be more than 10 times as powerful as a lead acid battery, and contrary to lead acid batteries, can be recharged through a process known as regenerative braking. That is, as a car in motion is slowed down, the energy that is normally generated as heat from friction by applying brakes is wasted. However, a regenerative braking system captures this "stopping energy" and converts it into storable energy in the flywheel that can be recovered on demand. Another advantage of a magnetic flywheel is that it works extremely well at either high or low

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Bulk Superconductor Process

Two Japanese companies have jointly developed a new process for producing commercially-available yttrium-barium-oxide superconductors in large quantities. Chuba Electric Power Company Inc., and Dowa Mining Company Ltd. are claimed to be the world's first organizations to accomplish this feat {*Japan New Mater. Report* IX [1], 11 (1994)}.

Processes to produce bulk superconductors previously used samarium-barium-oxide seed crystals, but these crystals are difficult to manufacture. However, the new process uses a magnesium oxide seed crystal. The yttrium-barium-copper-oxide feed material is heated to 1,150°C, at which point it turns semi-molten. The semi-melt is then rapidly cooled to 1000°C while in contact with the seed crystal, enabling crystal growth to take place in a radial pattern. The vertical temperature gradient is held at about 15°C per centimeter, which makes possible the production of large-sized, high quality crystals that have a diameter of about 4.5 cm.

The magnetic repulsion effect of the superconductor is 0.83 kg/cm^2, three times that of previous bulk superconductors. In the future, the new superconductor material may be used together with permanent magnets to form flywheels for the large-scale storage of electricity. The superconductor could be used in a 100 KWH fiber-reinforced plastic flywheel that would rotate at 5000 revolutions per minute. The bulk material may also find applications in nearly friction-free magnetic bearings. The researchers are working on developing a commercial scale process to produce bulk superconductors with diameters of about 10 cm. ▲

Battery*/Continued from previous column* ➪

temperatures, while the effectiveness of lead acid batteries decreases with low temperature.

The availability and sophistication of computer chips and microprocessors in the past few years make it feasible to control the many minute and important switches and sensors that are required to keep the flywheel spinning. A flywheel-equipped hybrid vehicle would probably have a single flywheel battery, whereas an all-electric vehicle would use several flywheels, perhaps one for each wheel, whose storage parameters and electrical outputs would have to be controlled electronically. ▲

Permanent Magnet Materials

In the early 1970's, shortly after the rare earth permanent magnets were discovered, magnets and their performance dramatically improved, leading to new applications for these materials. Currently, these magnet technologies have matured, along with a significant improvement in performance in the devices which use these materials.

Permanent Magnet Materials and Their Application is a comprehensive design text for ceramic ferrite, alnico, samarium-cobalt, neodymium-iron-boron, and bonded permanent magnets. The book is written as a comprehensive review of permanent magnet technology and is intended for scientists and engineers involved in all stages of the manufacture, design and use of magnets. The book is arranged in a logical format which includes a progression of the development and production of permanent magnets. The seven chapters include: fundamentals of magnetism, permanent magnet processes, thermal stability, magnetic circuit design, magnetic field analysis, magnetizing and testing, and applications. A brief theory of magnetism explains the behavior of the different classes that lead to diverse material chacteristics. Most of the book details the methods that are used to design permanent magnets, including assessments of the changes they experience under normal operating conditions. Modern analytical techniques are described, including the finite element method, with reference to the accurate simulation of permanent materials. The book also emphasizes the most important modern applications, and discusses the viability of the various magnet types now available. For anyone interested in the design and application of permanent magnets, this book is an effective tool in understanding the behaviors and properties of these materials.

The 207-page *Permanent Magnet Materials and Their Application* was written by Dr. Peter Campbell and was published in 1994 by Cambridge University Press. The cost to receive the book is $49.95 US, and can be ordered from the publishers at The Pitt Building, Trumpington Street, Cambridge CB2 1RP, UK. North American customers can contact: Cambridge University Press, 40 West 20th St., New York, NY 10011-4211, USA; Tel: 800 872 7423; Fax: 914 937 4712. ▲

Solar neutrinos can be detected by using the radioactive isotope Dyprosium-163.

Thin Film Multilayer Interconnects for $YBa_2Cu_3O_{7-x}$

More and more applications are being found for high T_c superconductors in the electronics industry. Before superconductors can be used in microelectronics circuits, interconnects consisting of thin-film wires, insulating crossovers, and vias (window contacts) between wires are needed. These three components are essential in order for applications in electronics and microelectronics and are part of superconducting interconnect technology. The factors involved in developing this technology include materials, the electronic circuits, and fabrication techniques. A review, written by F.C. Wellstood, J.J. Kingston and J. Clarke entitled "Thin-film Multilayer Interconnect Technology for $YBa_2Cu_3O_{7-x}$" appears in *J. Appl. Phys.*, Vol. **75**, No.2, pp.683-702 (1994) and discusses the remarkable progress made in this area.

Following a brief introduction that sets the background of the uses and potential of high-T_c superconductors in microelectronics, the review contains three sections which contain information on general construction principles and requirements, selection of materials and deposition techniques, and patterned structures. The construction of microelectronics circuits from superconductor materials requires at least two classes of structures: one or more active devices, such as a Josephson junction, and an interconnect technology, which is needed to wire together the active devices. The essence of the paper deals with the latter: the interconnect technology. In order to utilize these materials in electronics, interconnects involve three components (thin-film superconducting wire, insulated crossover, and superconducting contacts with no insulating layer, or with a "via" in the insulating layer). Although there are admittedly other structures necessary for contacts between superconducting films and external wiring such as resistors and normal metal contacts, they are not discussed in this paper.

In preparing these materials, the paper addresses pulsed laser deposition in conjunction with shadow mask patterning, photolithographic pattern definition, acid and ion-beam etching, and surface cleaning to produce multilayer interconnects from $YBa_2Cu_3O_{7-x}$ (YBCO) superconductor material. These processes have been used to produce a variety of passive high-temperature superconducting components and circuits, including crossovers, window contacts,

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General Electric's lighting division announced that a new long-life household light bulb is currently available in Europe, with introduction in the U.S.A. slated for late this year. The new lamp, known as the E-lamp because it uses electronic controls, produces the same light as a 75-watt incandescent bulb while only consuming 23 watts of electrical power. Contrary to ordinary incandescent bulbs which produce light by heating a filament inside the bulb, the new E-lamps provide light by electronically converting current into high frequency power that is fed into an electrical coil. The coil then excites a gas in the bulb to produce ultraviolet light, which in turn, strikes a rare earth phosphor coating inside the bulb in much the same way as in fluorescent bulbs, turning it into visible light.

In addition to the energy-saving qualities of the lamp, it is expected that the lifetime will be about 10,000 operating hours under normal conditions, 10 times the life of a standard bulb. The E-lamp is about the same size and shape as an ordinary light bulb that it is designed to replace, and can be used in existing fixtures. The new lamps will be manufactured at G.E.'s new plant located in Nagykanizsa, Hungary. The cost of the new bulbs will be about $20 US each.

Two rare earth phosphors are used in the lamp. The red phosphor is $Y_2O_3:Eu^{3+}$ (YEO), while the green is $LaPO_4:Ce^{3+},Tb^{3+}$ (LAP). No blue rare earth phosphor is added. According to Dr. William W. Beers, Senior Research Chemist at General Electric Company's Lighting Technology Division, the use of rare earth phosphors is increasing due to better color-rendering possibilities, government energy efficiency regulations, and the more extreme environment inside the lamp. He also expects "that in the next several years, additional new phosphors using rare earths will be commercialized." ▲

Thin Film/*Continued from previous column* ➪

multiturn coils, and flux transformers. These procedures have also been employed to produce integrated magnetometers which incorporate superconducting quantum interference devices (SQUIDs), multichip modules with semiconductor die bonded to YBCO interconnect structures, and analog-to-digital converters. As research and improved fabrication processes continue on these important materials, expect additional progress in the field. ▲

Ce-Doped Scintillator Crystal

Scintillator crystals are important for the detection of gamma rays and x-rays in many applications such as medical imaging devices and measuring equipment used in scientific research. These applications include computerized tomography (CT), positron emission tomography (PET), nuclear and particle physics experiments, and geophysical exploration. The scintillator crystal works by converting a fraction of the energy released by an incident gamma ray or x-ray into a burst of visible or ultraviolet photons (light energy) which is then converted into an electrical signal by a photomultiplier tube or photodiode that is optically coupled to the crystal. Ideal scintillators have a high emission intensity which provides a good signal-to-noise ratio, a fast decay of the scintillation emission for high count rate capability and good coincidence timing, and a high density and atomic number for high detection efficiency.

Experimental results by Schlumberger-Doll researchers C.L. Melcher and J.S. Schweitzer describe the discovery of a new inorganic scintillator crystal that has better scintillator properties than crystals that are currently available. The new material is a Ce-doped lutetium oxyorthosilicate (LSO) single crystal with the composition $Ce:Lu_2(SiO_4)O$. The crystal possesses the unique combination of properties that make excellent scintillator crystals.

The crystal was prepared by the Czochralski technique, but since LSO is a new material and no seed crystal was available, crystal growth was initiated on an iridium wire, along with 99.99% pure Lu_2O_3, SiO_2, and CeO_2 as raw materials. After the raw materials were mixed and pressed into pellets, they were melted in an inductively heated iridium crucible. Crystal growth was carried out under a continuous flow of N_2 with 3000 ppm O_2.

The crystal prepared by the researchers possesses an index of refraction of 1.82, which is lower than other scintillators which results in less reflection at the crystal photomultiplier tube interface and permits a higher percentage of the light produced by the crystal to be converted into electrical pulses. It is not hygroscopic and is claimed to be reasonably rugged so that it can be shipped and handled without much difficulty. For more information on the new scintillator crystal, contact the researchers at: Schlumberger-Doll Research, Old Quarry Road, Ridgefield, CT 06877-4108. ▲

Honorary Professorship

At the conclusion of the 11th International Conference on the Solid Compounds of Transition Elements (SCTE-11), which was held June 5-8, 1994 in Wrocław, Poland, Dr. Tadao Kasuya was named an Honorary Professor of the W. Trzebiatowski Institute of Low Temperature and Structure Research, Polish Academy of Sciences in Wrocław. Professor Kasuya is the first recipient of this honor and was recognized for his outstanding contributions to solid state physics and chemistry, as well as for his assistance in developing the Institute.

Prof. Tadao Kasuya

Professor Kasuya is primarily concerned with the behavior of rare earths and actinides and their compounds, their electronic structure, magnetic ordering, and properties resulting from interactions of *f*-electrons with band states: Kondo lattice, mixed valence, spin fluctuations, hybridization, and anisotropy. ▲

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SCES '93 Proceedings

The International Conference of Strongly Correlated Electron Systems (SCES'93) was held at the University of California, San Diego, August 16-19, 1993 and brought over 300 leading researchers together whose interest is mostly in condensed matter physics. The presentations and papers from this conference were published in *Proceedings of the International Conference on Strongly Correlated Electron Systems*.

The *Proceedings* contain a plenary talks section, and nine chapters. The chapters cover topics on normal and heavy fermion systems, theory of heavy fermions, high temperature superconductivity, non-Fermi liquids, multichannel Kondo effect, Kondo insulators, Kondo and intermediate valence effects, and superconductivity and *f*-electron materials.

Although most of the papers include results of uranium and other actinide-series compounds, many deal directly with rare earth compounds. Of particular interest are the experimental results on the magnetic, physical, and thermal properties of $CeCu_6$, $CeCu_5$, CeB_6, $CeInCu_2$, CePdAl, and other cerium intermetallic compounds. Many of the papers which describe experimental results on superconducting materials and compounds deal with rare earths, not only of the $YBa_2Cu_3O_{7-x}$ phase, but also interesting magnetoresistance studies of Nd-Ce-Cu-O compounds, and the magnetic properties in La-Sr-Cu-O superconducting compounds.

The overall production of the proceedings is nicely done in typical Elsevier fashion. The mathematical equations, especially in the theory papers, are clear in their presentation. All of the papers contain neat tables, graphs, or diagrams that are not only easy to read, but they maintain consistency in presentation throughout both Volumes.

The 678-page *Proceedings of the International Conference on Strongly Correlated Electron Systems* is published as *Physica B*, Vols. **199&200** (1994). With 220 papers represented in the volume, the list of authors, in addition to a subject index at the end of the book, is useful. The cost of these two volumes, available under a single cover, is $334.00 US, and are available from Elsevier Science B.V., P.O. Box 1991, 1000 BZ Amsterdam, The Netherlands; Tel:31 20 5862 911; Fax:31 20 5862 623; In the U.S., Elsevier Science Inc., P.O. Box 945, Madison Square Station, New York, NY 10160-0757 USA; Tel:212 633 3650; Fax:212 633 3680. ▲

Young Scientist Prize

Dr. Guofu Zhou of the Van der Waals-Zeeman Laboratorium at the University of Amsterdam was awarded the Young Scientist ISMANAM-1994 Gold Medal Prize for his work and contributions in preparing metastable alloys and nanocrystalline materials by mechanical milling of intermetallic compounds. This was the first time this award has been presented, and is sponsored by the International Symposium on Metastable, Mechanically Alloyed and Nanocrystalline Materials. He was awarded the Prize during a conference held June 30, 1994 in Grenoble, France.

Dr. Guofu Zhou

He has also made a number of new, interesting and important discoveries, such as phase transformations from one complex crystal structure to another complex crystal structure, a new type of atomic disorder in B82 compounds, and two new spin glass materials that were previously unknown. His most recent rare earth publication deals with the spin glass behavior of mechanically milled crystalline $GdAl_2$ and appears in *Phys. Rev. Lett.*, **73**, [2], 344 (1994). RIC congratulates Dr. Zhou in his accomplishments. ▲

Superconductors/*Continued from page 1* ⟲

of nearly half of the papers and addresses the topic of $YBa_2Cu_3O_{7-x}$ preparation and other superconducting materials, including the topics of metalorganic chemical vapor phase deposition of thin films, sequentially evaporated $YBa_2Cu_3O_{7-x}$ thin films on microwave substrates, and melt-processed $YBa_2Cu_3O_{7-x}$ superconductors. Part II deals with various properties of these materials, such as noise, photoresponse and optical detection using high-T_c thin films, and electrodynamic properties of high-T_c thin films. Part III, Applications, explores the future uses of these materials in space, microwave devices, micro-electronics, junction structures, and the potential uses of superconducting suspensions.

The 703-page *Synthesis and Characterization of High-Temperature Superconductors* is available as three volumes, 130-132 of *Mater. Sci. Forum*, for SFr 298.50 ($199.00 US) from Trans Tech Publications Ltd., P.O. Box 10, Hardstr. 13, CH-4714 Aedermannsdorf, Switzerland; Fax: 41 62 74 10 58. ▲

Structures of Perovskites

The review "B-Cation Arrangements in Double Perovskites", written by M.T. Anderson, et al., appeared in *Prog. Solid St. Chem.*, Vol. **22**, pp. 197-233 (1993). The survey covers the crystal structure and, as the title implies, describes the three distinct B-cation arrangements of $A'A''B'B''O_6$ double perovskites (perovskites have the general formula ABX_3, where A is a large electropositive cation, B is a small transition metal ion from the main group elements, and X is commonly an oxide or halide ion). The three double perovskite structures that are known include: random, rock salt, and layered. The authors provide examples which illustrate the most common symmetries of these B-cation sublattices and to show how they can be assigned based on powder diffraction patterns. They also examine the factors that influence B-cation arrangement: charge, size, electronic configuration of the B cations, and the A/B size ratio.

Following an introduction that wastes no time covering the charge differences of various double perovskites, the review addresses the topics of factors that influence B-cation sublattice type, sublattice crossover region, which includes a case study of R_2CuMnO_6 (R=lanthanides, Y) and (M=Ge, Mn, Ti, Ir, Sn, Zr, Pb), and layered B-cation sublattices. Compounds that have a random sublattice generally have a cubic 1*ap* unit cell, such as $BaLaScZrO_6$, $BaLaFeMoO_6$, and $BaLaScMoO_6$, or an orthorhombic unit cell, such as $SrLaCuRuO_6$. Other examples of these perovskites, but those that have a rock salt type structure are $LaCaMnCoO_6$ and Ba_2PrPtO_6. An example of a compound with a layered structure arrangement is La_2CuSnO_6. The preparation of Ln_2CuMoO_6 is described, as well as the equipment used to collect powder x-ray diffraction and powder neutron diffraction measurements of the material.

"B-Cation Arrangements in Double Perovskites" contains 11 tables and 17 figures and is a comprehensive survey of these compounds. It is an excellent survey for researchers and students alike and it is apparent that the authors did their homework as the paper comes complete with 79 references. ▲

LUTETIUM, atomic number 71, was independently discovered by G. Urban in 1907 and C.A. von Welsbach in 1908. Urban named element 71 for the ancient name of Paris, Lutetia.

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★★★★★★★★★★★★★★★★★★★★★★★★★★★★

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LETTERS TO THE EDITOR

16 December 1994

Dear Dr. Gschneidner:

There is a biography published on H.G.L. Moseley, I forget the author's name; its good reading about his work on the K (and L) lines of the elements. It will have the dates correctly (I believe) about when he worked on the rare earths. You are aware, I suppose, that he died in the first world war at Gallipoli, otherwise almost surely he would have received a Nobel.

Best regards,

Peter E. D. Morgan
Rockwell International
Science Center
1049 Camino Dos Rios
Thousand Oaks, CA 91360

EDITOR'S REPLY

Dear Dr. Morgan:

The book is entitled ***H. G. J. Moseley. The Life and Letters of an English Physicist 1887-1915****, and it was written by J. L. Heilborn, University of California Press, Berkeley (1974). In chapter 5, "Journeyman", we find that he carried out his x-ray spectra studies at Oxford after moving there in November 1913. The major portion of his work on the rare earths were carried out from late in January through early March. The famous French chemist, G. Urbain, remarked that "he (Urbain) left eight samples for further analysis and returned to Paris, having untangled in a few days conundrums that had taken chemists six generations merely to propose".*

Sincerely yours,

Karl Gschneidner, Jr.
Director RIC

...and Furthermore...

On page 4 of the September issue of the *RIC News* we mentioned how Prof. Renata Reisfeld was presented an honorary doctorate by the University of Lyon, France, and that she authored the book *Lasers and Excited State of Rare Earths*. Actually, she worked closely with her co-author, Prof. Christian K. Jørgensen on this book. In addition, she started a cooperation with a laser group at the University of Lyon in 1976. The group was first directed by Mme. F. Gaume, and then by Prof. Georges Boulon. Both Profs. Jørgensen and Boulon have worked closely with Prof. Reisfeld in their research on rare earths. ▲

REMXIII Proceedings

The *Thirteenth International Workshop on Rare-Earth Permanent Magnets and Their Applications* and the *Eighth International Symposium on Magnetic Anisotropy and Coercivity in Rare Earth-Transition Metal Alloys* are the published proceedings of a conference that was held in Birmingham, United Kingdom, September 11-15, 1994. The proceedings were published in 1994 and appear in two separate hard cover volumes: one contains the papers presented at the *Workshop* (99 papers), and the other, the *Symposium*, 50 papers. The format is consistent with previous publications of this conference. A Supplement is also available that includes four papers from both the *Workshop* and *Symposium* that could not be included in the main proceedings.

The 926-page *Workshop* proceeding is arranged in twelve sessions that cover topics concerning rare earth permanent magnets such as: new and important applications and innovations in the Nd-Fe-B and Sm-Co permanent magnet industry, including the use of Sm-Co magnets in water softening; the use of rare earth magnets in energy efficient household appliances; new brushless DC linear motors; mechanical power transmission using magnets; and new and improved processing technology for the materials. The use and properties of underwater transducers using Terfenol and magnetostriction in TbDyFe thin films and characterization and physical properties of Terfenol, among other topics, are covered in this book. Corrosion resistance has always been a concern for producers and users alike of these materials and several authors report on the developments in this field.

The present status of Sm-Fe nitrides is covered, including $Sm_2Fe_{17}N_x$-based permanent magnets. The development of magnetic coercivity in Sm_2Fe_{17} that is produced by the calciothermic method and the preparation of coercive $Sm_2Fe_{17}N_x$ by hydrogenation-disproportionation-desorption-recombination (HDDR), as well as properties of other HDDR-processed permanent magnet alloys, is included.

The 479-page *Symposium* contains four sessions that deal mainly with the processing and production of Nd-Fe-B melt-spun magnets. Topics include the physical properties of these materials such as the hardening mechanism, magnetic viscosity, and microstructures of these permanent magnet alloys, among others. Hydrogen and nitro-

Continued in next column ➪

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REMXIII*/Continued from previous column* ➪

gen absorption studies in Nd-Fe and HDDR studies on several Nd-Fe-B phases are also included. Reports of the influence of Co additions in the microstructure of Nd-Fe-B alloys and the prospects for property improvements in isotropic bonded iron-rare earth magnets should also interest workers in the field.

As with previous Workshops and Symposia, there are also several reports that forecast the commercial markets of rare earth permanent magnets, as well as world production and commercial applications of rare earths. Of particular interest to permanent magnet producers will be reports of the burgeoning Chinese economy and how the potential for Chinese industrial production of these materials may impact western and worldwide markets.

Both the *Workshop* and *Symposium* volumes contain an author index. However, it would have been a nice touch if the publishers had arranged the titles according to topic or subject area, and if subject indices had been included. It is always interesting to see trends develop, and the fact that 20% of the papers are on the applications of magnetic materials, and 17% on Sm_2Fe_{17}-interstitials, reflects growing interest in these areas.

Copies of these hard-bound books can be ordered from Prof. I.R. Harris, Chairman, REMXIII, School of Metallurgy and Materials, The University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK; Tel:44 21 414 5165; Fax:44 21 471 2207. The proceedings can be ordered as a set or separately. The cost for both books is £125.00 ($195.00 US), or £80.00 ($125.00 US) for the *Workshop* proceeding and £60.00 ($94.00 US) for the *Symposium* proceeding if ordered separately. Contact Prof. Harris for an order form which contains a listing of shipping rates. ▲