Rare-earth Information Center NEWS

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

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Creative Invention Award

Lothar H. Brixner, a now-retired research scientist formerly with DuPont, earned the Creative Invention Award for his work which significantly contributes to the "material prosperity and happiness of people". He can also proudly include: "as well as their health and well-being through substantial reduction of radiation during x-ray examinations". He did this by developing rare earth phosphors that greatly improved the safety and sensitivity of x-ray film and x-ray screen systems.

Lothar H. Brixner

Although x-radiation can penetrate various tissue, it is an inefficient means of exposing normal photographic film because it converts only 5% of the x-radiation into light. In 1975, Brixner began his search for better phosphors by the systematic investigation of rare earth tantalates, which emit radiation deeper in the ultraviolet, resulting in less scatter while providing higher image resolution. His work eventually led him to phosphors based on yttrium tantalate ($YTaO_4$) that were modified with dopants such as niobium, thulium, or gadolinium to provide a wide range of absorption and emission characteristics.

As x-ray resolution and image quality improved with each development, Brixner began to concentrate on film/screen systems based on denser lutetium tantalate ($LuTaO_4$) that could be sensitive enough to be used in mammography. After nearly 20 years of work, a system that uses Brixner's $LuTaO_4$:Nb phosphor in combination with a new photographic film was perfected that greatly reduces the patient's exposure to x-rays.

Out of the 153 papers that Brixner has published, 80 deal with rare earths. He holds 40 U.S. patents. ▲

Honor Roll

20 Years

CERAC, Inc.
Ferro Corporation, Transelco Division

10 Years

APL Engineered Materials, Inc.
The Applegate Group, Inc.
Astronautics Corporation of America
CSIRO Division of Applied Physics
Dexter Magnetic Materials Division
H.C. Starck Inc.
Hicks Dome Corp.
Howmet Corporation
Minteq International Inc.
Neomet Corporation
Parkans International, Inc.
Wheeler Associates

This year we have two companies that we wish to honor for their 20 years of support. CERAC, Inc. and the Transelco Division of the Ferro Corporation join the previous twenty-four companies on our growing list of long-time members.

Twelve additional companies, APL Engineered Materials, Inc., The Applegate Group, Inc., Astronautics Corporation of America, CSIRO Division of Applied Physics, Dexter Magnetic Materials Division, H.C. Starck, Inc., Hicks Dome Corp., Howmet Corporation, Minteq International Corp., Neomet Corporation, Parkans International, Inc. and Wheeler Associates join the growing number of companies who have been with us for at least ten years. We wish to express our appreciation to all fourteen companies for their long and continued support. ▲

ETREMA and Moritex form Alliance

ETREMA Products, Inc., Ames, Iowa has formed a strategic business initiative with Moritex Corporation, Tokyo, Japan. The new arrangement allows Moritex exclusive rights to provide ETREMA Terfenol-D® smart material technology to the Japanese market.

Terfenol-D is a smart material that lengthens when subjected to a magnetic field. The material is a high-powered, fast-responding material that has applications in noise and vibration abatement, micro-position devices, sonar elements, and as sensors that can sense changes in shape and motion.

Moritex Corporation is Japan's largest manufacturer of compound glass optical fibers and supplies fiber optic illumination materials for semiconductor manufacturing equipment. Edge Technologies Rare Earth Magnetostrictive Alloys (ETREMA) Products, Inc., is located at 2500 North Loop Drive, Ames, IA 50010 USA; Tel: 515 296 8030; Fax: 515 296 7168. Moritex Corporation has representative offices in San Diego, CA and Tokyo, Japan; Tel: 03 3401 9766; Fax: 03 3401 9777. ▲

Ferro Corp.

Albert C. Bersticker, 61, has been elected by Ferro Corp's. board of directors to assume the post of chairman. He will also continue in his role as chief executive officer (CEO). Hector R. Ortino, 53, succeeded him as president and Gary H. Ritondaro, 49, was promoted to vice president and chief financial officer. All promotions were effective February 1, 1996 and prepare the Cleveland-based company for Bersticker's retirement, which the company mandates at age 65. Bersticker joined Ferro in 1958 as a researcher and rose to the position of president and CEO in 1991. Ortino has been with the company since 1971 and Ritondaro joined Ferro in 1986. ▲

Quasicrystal Conference

The international conference, "New Horizons in Quasicrystal Research and Applications," will be held at Iowa State University, Ames, Iowa, August 19-23, 1996. The conference will focus on three main topics: existing and potential applications of quasicrystals, surface and interface properties of quasicrystals, and potential new quasicrystalline materials. Rare earth alloys such as $Co_{80}Er_{20}$, $Al_{65}Fe_{28}Ce_7$, and $Al_{86}Cr_{12}Er_2$ have been identified in the quasicrystalline phase.

The conference is being organized in collaboration with the International Institute of Theoretical and Applied Physics (IITAP) at Iowa State University. For more information, contact Todd K. Watson, Conference Secretary, IITAP, 123 O&L, Iowa State University, Ames, IA 50011-3020 USA; Tel: 515 294 1253; Fax: 515 294 9333; E-mail: qcames@ameslab.gov; Web site: http://www.physics.iastate.edu. ▲

ECNS'96

The European Neutron Scattering Association (ENSA) will hold the 1st European Conference on Neutron Scattering (ECNS'96) at Interlaken, Switzerland, October 8-11, 1996. The conference is organized by the Paul Scherrer Institute (PSI) and will include parallel sessions in the following categories: glasses and glass transitions, magnetism, biology, highly correlated electron systems, polymers and soft matter, materials science and industrial applications, instrumentation, chemical structure and dynamics, and liquids.

For more information, contact: Conference Secretariat ECNS'96, c/o Laboratory for Neutron Scattering, CH-5232 Villigen PSI, Switzerland; Tel: 41 56 310 20 87; Fax: 41 56 310 29 39; E-mail: ecns@psi.ch. ▲

Rare Earth Symposium

The symposium *Rare Earths: Science, Technology and Applications*, as part of the TMS 1997 Spring Meeting, will be held February 9-13, 1997 in Orlando, Florida. The symposium will focus on the advances in the sciences, emerging technologies, and present and potential applications of the rare earths. The sciences and technologies include those relevant to resources, extraction, separation, concentration, purification, solid state physics and solid state chemistry. The advances in extraction and processing will include new reagents, solution speciation chemistry, precipitation, and processing to oxides, carbides, nitrides, hydrides, and metals. The state-of-the-art development in catalysts, lighting, permanent magnets, batteries, and other energy and environmental applications will be covered.

For more information, contact R.G. Bautista, Department of Chemistry & Metallurgical Engineering, MS 170, University of Nevada-Reno, Reno, NV 59557 USA; Tel: 702 784 1602; Fax: 702 784 1766. ▲

Conference Calendar

*** A NEWS STORY THIS ISSUE**

July '96

NATO ASI: Magnetic Hysteresis in Novel Magnetic Materials
Greece
July 1-12, 1996
RIC News, XXXI, [1] 2 (1996)

Twenty First Rare Earth Research Conference (21st RERC)
Duluth, Minnesota, USA
July 7-12, 1996
RIC News, XXX, [2] 1 (1995)

August '96

New Horizons in Quasicrystal Research and Applications
Ames, Iowa, USA
August 19-23, 1996
*This issue

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
RIC News, XXX, [1] 2 (1995)

International Conference on Substrate Crystals and HTSC Thin Films (ICSC-F'96)
Szczyrk, Poland
September 16-20, 1996
RIC News XXX, [3] 2 (1995)

October '96

Solidification and Powder Processing of Rare Earth-Based Materials
Cincinnati, OH, USA
October 6-10, 1996
RIC News XXX, [3] 2 (1995)

China: Opportunities for the Magnetic Materials Industry
Guilin, People's Republic of China
October 7-9, 1996
*This issue

1st European Conference on Neutron Scattering (ECNS'96)
Interlaken, Switzerland
October 8-11, 1996
*This issue

November '96

International Conference on Giant-Magnetostrictive Materials (ICGMM'96)
Honolulu, Hawaii, USA
November 6-8, 1996
RIC News, XXXI, [1] 2 (1996)

February '97

Rare Earths: Science, Technology and Applications
Orlando, Florida, USA
February 9-13, 1997
*This issue

April '97

12th International Conference on Solid Compounds of Transition Elements
Saint-Malo, France
April 22-25, 1997
*This issue

September '97

Third International Conference on f Elements (ICFE3)
Paris, France
September 14-19, 1997
*This issue

China Conference

Gorham/Intertech Consulting announces *China: Opportunities for the Magnetic Materials Industry*. The conference will be held in Guilin, People's Republic of China on October 7-9, 1996. The purpose of the international conference is to bring together users, producers and traders from industrialized countries for a full discussion of the many new opportunities in magnetic materials in China. Magnet producers will hear about the availability of raw materials for both ferrite and rare earth permanent magnets, as well as new applications, new plants, and the latest developments and direction in production and research and development. Attendees will learn about new sources, grades, and suppliers of finished and unfinished magnets, as well as the latest market developments.

For more information contact: Gorham/Intertech Consulting, 411 US Route One, Portland, ME 04105 USA; Tel: 207 781 9800; Fax: 207 781 2150; E-mail: info@intertechusa.com; WWW: http://www.intertechusa.com. ▲

ICFE3

The Third International Conference on *f* Elements (ICFE3) will be held in Paris, France from September 14-19, 1997. One of the aims of the conference is to bring together *f* elements specialists who are working in different fields of study.

For more information, contact: Pierre Porcher, Directeur de Recherche au CNRS, Co-Chair ICFE3, 92195 Meudon Cédex, France; Fax: 33 1 45 07 58 44; E-mail: icfe3@cnrs-bellevue.fr. ▲

Minerals Information

The office of James B. Hedrick, the rare earth specialist and expert in rare earth minerals for the U.S. Geological Survey, has moved to a new location. For information on rare earth minerals, contact him at: 983 National Center, U.S. Geological Survey, 12201 Sunrise Valley Drive, Reston, VA 22092 USA; Tel: 703 648 7725; Fax: 703 648 7722. ▲

EuB_6 is used incontrol rods for fast breeder reactors.

Arnold Engineering

The Arnold Engineering Company of Marengo, IL, has announced the completion of their new Magnetics Technology Center (MTC). The state-of-the-art, 16,800 sq. ft. magnetics development laboratory will be used for new product and improved process development by Arnold Engineering and their customers.

The MTC was developed to minimize product-cycle time and costs. The MTC serves as a powerful resource for new process development. The center will house a multitude of process and analytical equipment which will make it the most complete magnetics laboratory in the United States. Some of the major equipment includes: jaw crushers, disc mills, attritors, compaction presses, an isostatic press, vacuum ovens, sintering/annealing furnaces, high-temperature furnaces, retort furnaces, a vacuum induction melter, V-blenders and a Sweco screener. A wide array of analytical equipment is also included in the center. The center will not only be used to develop products, but will also be used for problem solution, applications engineering, sample preparation, and testing.

For more information, contact Steve Constantinides, The Arnold Engineering Company, 300 North West St., Marengo, IL 60152 USA; Tel: 815 568 2000; Fax: 815 568 2228. ▲

Price Decrease!

The Rare-earth Information Center still has a limited supply of the proceedings of both the *Twelfth International Workshop on Rare Earth Magnets and Their Applications*, and the *Seventh International Symposium on Magnetic Anisotropy and Coercivity in Rare Earth Transition Metal Alloys*. In preparation for RIC's move to another location at Iowa State University, we have decided to clear out these remaining volumes so that we don't need to take them with us!

The reduced cost of the two-volume set is US$75.00, or US$45.00 for either volume alone. The cost of the complete set previously was US$150.00 and US$75.00 for either volume alone. To order, contact the Rare-earth Information Center, Center for Rare Earths and Magnetics, Institute for Physical Research and Technology, Iowa State University, Ames, IA 50011-3020, USA; Tel:515 294 2272; Fax:515 294 3709; E-mail: RIC@ameslab.gov. ▲

SCTE '97

The 12th International Conference on Solid Compounds of Transition Elements (SCTE '97) will be held April 22-25, 1997 in Saint-Malo, France. The purpose of the conference is to provide a forum for solid state chemists and physicists to present their latest discoveries and prospective research in the physiochemistry of condensed matter. The conference will deal with the structural, chemical and physical properties of binary, ternary and quaternary compounds of *d* and *f* transition metals. Emphasis will be placed on new materials and applied science.

Further information is available by contacting the conference organizer: Henri Noël, Laboratoire de Chemie du Solide et Inorganique Moléculaire, C.N.R.S., URA 1495, Université de Rennes 1, Avenue du Général Leclerc, 35042 Rennes cedex, France; Tel: 33 99 28 62 55; Fax: 33 99 63 57 04; E-mail: scte97@univ-rennes1.fr; Website: http://www.univ-rennes1.fr/scte97. ▲

New Uses for Nd-Fe-B Magnets

Several science classrooms in the U.S. use permanent magnets to show students that iron is not only present in many consumer goods, but can be readily extracted as well {*C&EN*, 73, [47], 72 (1995)}. Permanent magnets are essential in detecting elemental iron in breakfast cereals and the occurrence of iron in the ink used to print paper currency during student science demonstrations. Science teachers prefer to use neodymium-iron-boron permanent magnets salvaged from computer disk drives, not only for their strength, but because they are relatively inexpensive and plentiful.

To illustrate the occurrence of elemental iron in certain breakfast cereals that are advertised as being "fortified with iron", approximately 3/4 cup of the cereal is placed in a blender with a cup of water for 30 seconds. After blending, the slurry is poured into a plastic cup and stirred while holding a Nd-Fe-B magnet on the outside of the cup. Within seconds, iron dust begins to build up on the inside of the cup next to the magnet.

To prove the existence of iron in the ink of printed currency, it can simply be held loosely in one hand while a magnet is brought near. The strong Nd-Fe-B magnetic field will cause the bill to swing as the iron content is attracted to the magnet. ▲

Materials Science Awards

Rare earth research figured prominently in the U.S. Department of Energy's (DOE) Materials Science Division, Office of Basic Energy Sciences (BES) 1995 awards. Three of the nine categories involved rare earth materials.

The Materials Science Division, Argonne National Laboratory, Argonne Illinois, received the solid state physics award for "significant implication for Department of Energy related technologies". The team, consisting of researchers U. Welp, G.W. Crabtree and V.K. Vlasko-Vlasov investigated the magneto-optical imaging of magnetic fields and transport currents in superconductors. The team revealed that fundamental pinning behavior of defects, such as twin boundaries in single-crystals of $YBa_2Cu_3O_7$, and the correlation of strong and weak pinning with microstructure in commercial $Bi_2Sr_2CaCu_2O_8$ wires made by the powder-in-tube process. The team produced direct images of transport currents within superconductors show the path and magnitude of the current, and its relation to the local microstructure.

A team of 11 researchers, headed by P. Canfield, Ames Laboratory, Iowa State University, won the 1995 DOE Materials Sciences Award for "outstanding scientific accomplishment" in solid-state physics. Canfield's team has been investigating the electronic and magnetic properties of single-crystal RNi_2B_2C (R= rare earth) superconductors. These materials are among a small group of compounds that are both superconducting and strongly magnetic at low temperatures. In most materials, superconductivity and magnetism are mutually exclusive; if a material is superconducting it is usually not magnetic, and vice versa. The coexistence of these states in the rare earth superconductors has allowed the physicists to learn more about them and their relationships.

Another Ames Laboratory scientist, Senior Chemist John Corbett, has won the award for "sustained outstanding research" in materials chemistry. Corbett has devoted the past 15 years to the exploratory synthesis and systematic study of broad classes of compounds made from two or more metals, of families of such compounds stabilized by common impurity atoms, and of naked clusters of metals in solids. Since 1988, he has studied the stoichiometry and structures of La_5Ge_3, La_5Pb_3, and Yb and Eu intermetallic compounds. Dr. Corbett has also investigated bonding rules for certain types of mixed-metal compounds. Among his accomplishments is the creation of the first non-carbon examples of buckyballs, or buckminsterfullerenes. ▲

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Distinguished Service Award

Iver Anderson, metallurgist at the U.S. Department of Energy's (DOE) Ames Laboratory, has been awarded the Minerals, Metals & Materials Society's (TMS) 1996 Distinguished Service Award. The award recognizes outstanding contributions to TMS, a worldwide organization of engineers and researchers that promotes professionalism and cooperation, while acting as a bridge for knowledge across the broad spectrum of metallurgy and materials science.

Iver Anderson

Anderson is also an adjunct professor in the Materials Science and Engineering Department at Iowa State University, Ames, Iowa. He is being recognized for his pivotal role in developing the Materials Design and Manufacturing Division of TMS. He served as chair of the division and also as a member of various technical committees. He has received numerous awards, including becoming a 1994 Fellow of ASM International. Anderson also received a Federal Laboratory Consortium 1991 Special Award for Excellence in Technology Transfer, and a 1991 R&D Award for the development of high-pressure gas atomization technology. ▲

Kanti Technologies Inc.

Kanti Technologies, Inc. provides laboratory analytical services in support of commercial research and development in the rare earth industry. The company can provide chemical and physical characteristics of rare earth oxides, magnetic materials, superconducting and ceramic materials, and phosphors. For more information, contact Dr. Chiran Kantipuly, Kanti Technologies Inc., 1576 Sweet Home Rd., Amherst, NY 14228 USA; Tel: 716 636 8356; Fax: 716 636 3630. ▲

Awards*/Continued from previous column* ⮎

ICFE Proceedings

The International Conference on *f*-Elements (ICFE-2) was held August 1-6, 1994 in Helsinki, Finland and was a broad-scope conference dealing with fundamental and applied aspects of *f*-element chemistry and physics. The proceedings to the conference were published in 1995 as Volume 225 of the *J. Alloys and Compounds* and was edited by K.H.J. Buschow, G.-Y. Adachi, and H.F. Franzen. The conference was attended by more than 220 scientists from 30 different countries and the Proceedings features 137 of the best papers that have been reviewed by outstanding scientists in their respective fields. All but eleven of these papers are concerned with some aspect of rare earth compounds, alloys, and complexes.

The papers in the Proceedings are grouped according to the 11 sessions that made up the conference in order of: plenary lecture, session lectures, oral presentations and posters. The sections in the Proceedings include: Theory and Spectroscopy, Solid State Chemistry and Physics, Solution Chemistry, Coordination Chemistry, Metallurgy and Magnetic Materials, Biomedical Applications, Advances in Superconducting Materials, Geochemical and Environmental Chemistry, Toxicology and Biological Effects of 4-*f* Elements, and Catalysts and Other Applications.

As more of the properties of the rare earths contribute to industrial materials as well as in consumer goods that appear in the market place and our everyday lives, we would expect coverage of this aspect to increase in conferences and their proceedings. Indeed, it is refreshing to see these contributions reflected in papers that deal with the many end uses of rare earths. A substantial portion of the Proceedings is devoted to applications with titles such as "Industrial applications of rare earths: which way to the end of the century?", "phosphors for lamps and displays: an application view", and "Luminescent lanthanide chelates-a way to more scientific diagnostic methods". Three papers deal with the applications of rare earths in catalysts and as corrosion inhibitors.

James B. Hedrick was the lone contributor to the section Geochemical and Environmental Chemistry with a paper entitled "The global rare-earth cycle", where he puts a unique perspective on the relationship between rare earths and earth science, a paper that should find a place in geology textbooks.

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The 656-page Proceedings of the 2nd International Conference on *f*-Elements is available for US$299.00 by contacting Elsevier Science S.A., P.O. Box 564, 1001 Lausanne, Switzerland; Tel:41 21 320 73 81; Fax:41 21 323 54 44; Telex:450 620 ELSA CH. Customers in the U.S.A. and Canada may obtain information from Elsevier Science Inc., Journal Information Center, 655 Avenue of the Americas, New York, NY 10010 USA; Tel:212 633 3750; Fax:212 633 3764; Telex:420 643 AEP UI. The conference proceedings include subject and author indices. ▲

Gmelin: Compounds with Carbon

The 38th release of the *Gmelin Handbook of Inorganic and Organometallic Chemistry*, 8th Edition, is published in Volume **C12a**, System No. 39, "Compounds with Carbon". Both new volumes, **C12a** and **C12b**, contain information on the systems and compounds of the rare earth elements with carbon.

Volume **C12a** deals with Rare Earth Carbides; molecules and ions in the gas phase and in noble gas matrices, solid carbides, data for individual rare earth carbides (including the Sc-C and Y-C systems), Inclusion Compounds; (Sc, Y, La, and other rare earth fullerenes), graphite intercalation compounds including EuC_6, Hydride Carbides, Oxide Carbides, Nitride Carbides, Carbide Halides, Boride Carbides.

The 459-page hardcover book was published in 1995 and includes literature up to 1994, but some more recent data has also been included. The *Gmelin Handbook* series is well known for the wealth of information that is provided in a relatively small package, and Volume **C12a** is no exception. The book is adequately supplied with tables, figures and diagrams that illustrate the properties, structures, and various magnetic properties of these rare earth-carbon compounds such that it should serve engineers and academicians alike. Those companies that provide custom preparation of these materials will find this volume particularly useful in the synthesis of rare earth-carbon compounds.

For inquiries and orders, please contact Springer-Verlag GmbH & Co. KG, Postfach 31 13 40 Berlin, Germany; Tel: 49 30 8207-0; Fax: 49 30 821 4091; price is DM 2,800.00 US$1,966.00. ▲

Violet Electroluminescence

Thin film electroluminescent (EL) displays are comprised of solid state, wide-angle light emitting pixels. The mainstay of EL displays has been the Mn-doped ZnS amber light emitting phosphors. Recently, efficient rare earth-doped alkaline rare earth sulfides have been developed that produce light over a wide range of the visible spectrum, including full-color displays. However, bright visible light of short wavelengths from EL displays has been problematic.

W. Kong, *et al.*, Department of Electrical Engineering and Applied Physics, Oregon Graduate Institute, P.O. Box 91000, Portland, OR 97291-1000 USA, {*Appl. Phys. Lett.*, 67, [1], 7-9 (1995)} report on the observation of bright violet light (404 nm) emitted from SrS:Eu EL devices. The authors also report on a weaker emission at 367 nm from SrS:Ce.

Both of the Ce and Eu activated devices were prepared in the conventional double insulating sandwich configuration. The devices were fabricated on a 5 cm square glass substrate which had a predeposited 0.35 μm layer of indium-tin oxide, followed by a 0.26 μm layer of aluminum oxide/titanium oxide composite. On top of these precoated substrates were deposited 0.1 μm undoped ZnS, followed by 0.8 μm SrS:Eu, another 0.1 μm ZnS, and topped off with an insulating layer of 0.24 μm Al_2O_3. The second set of structures were made without the ZnS buffer layers, i.e. SrS:Eu followed by Al_2O_3. All of the devices were prepared by atomic layer epitaxy. The Eu doping level was made at 1.5 at.%.

The EL devices were powered by bipolar pulses of 30 μs duration with 5 μs rise and fall times at a frequency of 1 kHz. The photoluminescent excitation source was either an Ar ion laser which was operated in the UV (~360 nm) or a mercury lamp (254 nm). The EL emission spectrum of a typical Eu-doped device with the ZnS buffer layers was reported to be a bright 9 cd/m^2 and violet in color. These results were surprising considering that other research groups have reported only orange-red light from similar SrS:Eu device structures. The authors admit that their atomic layer epitaxy grown samples may have been unintentionally codoped with Cl, since $ZnCl_2$ was used as a precursor for the ZnS buffer layer growth. The source of violet emission is the parity allowed $4f^65d$-$4f^7$ transition of Eu^{2+} in $SrCl_2$:Eu^{2+}.

The Ce-doped device was similarly fabricated, but SrS was doped with Ce only near

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RE-Developments

The rare earths continue to improve the performance and properties of materials and products. Three new recent developments in rare earth industrial applications were published in *Japan New Materials Report*, **X** [5], 4-5, 10-11 (1995). The new developments include: improved hydrogen storage alloys, lowered electrical resistance in aluminum-neodymium target materials, and a high current density in a neodymium-based single crystal superconductor.

Better hydrogen storage alloys

Hydrogen storage alloys absorb hydrogen and release heat when cooled and pressure is applied. Conversely, they release hydrogen and absorb heat when heated and pressure is reduced. The most promising rare earth hydrogen storage alloy is a $LaNi_5$. The major disadvantage of current alloys is the resulting decline in performance as impurities enter the crystal lattice during operation.

A process developed by the Hydrogen Energy Research Laboratory, Japan, involves surface processing of the fine grained alloy powder by immersing it in an aqueous solution that contains fluoride ions. This results in the formation of a thin lanthanum fluoride layer which contains minute pits, thereby expanding the surface area by 20 times. These pits act as a filter that allows entry of only hydrogen molecules into the alloy. This effectively "shuts off" access by impurities that would otherwise contaminate the alloy and lead to degraded performance.

The new fluoride process will improve the performance of rechargeable batteries. Consumers will see improvements such as increased charge-decharge intervals as well as less time needed to recharge these types of batteries in portable computers and other battery-powered devices.

Al-Nd target with lower resistance

Aluminum-neodymium target material with electrical resistance approximately one-

Continued on page 6 ⟲

Violet Electroluminescence*/Continued from previous column* ⟲

the ZnS interfaces. In this device, a much weaker emission was detected at ~367 nm. This light seemed to originate from $SrCl_2$:Ce^{3+} layers with peaks corresponding to transitions from lower excited 5*d* states of Ce^{3+} to $^2F_{5/2}$ (344 nm) and $^2F_{7/2}$ (367 nm) states. ▲

Handbook of Magnetic Materials

Volume 9 of the *Handbook of Magnetic Materials* is a continuation of the Handbook series *Ferromagnetic Materials*. The name of the series was changed in order to give more of a complete cross section of studies in magnetism. As with the preceding volumes of the series, Volume 9 serves as a text to those who wish to be introduced to a given topic in the field of magnetism and also as a reference for those research scientists conducting detailed studies in magnetism.

The book contains five topical review articles (chapters) in which each contains extensive descriptions in tabular and graphical form. Much of the emphasis is placed on the discussion of experimental material in the framework of physics, chemistry and materials science. Chapter one "Heavy Fermions and Related Compounds" presents a general account of the magnetism of heavy-fermion systems while chapter two "Magnetic Materials Studied by Muon Spin Rotation Spectroscopy" describes this novel experimental technique. Chapter three "Interstitially Modified Intermetallics of Rare Earth 3*d* Elements", including 2:17 $R_2Fe_{17}Z_3$ (where R= rare earth except Sc, and Z=N or

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RE-Developments/*Continued from page 5* ⇨

half of aluminum-tantalum wire currently used in color liquid crystal display (LCD) panels has been developed. This new wiring material has better conductance when used in LCD displays which allows for larger, higher-resolution panels and images. An added bonus of the new material is that it is able to withstand the 300-400°C temperatures used in processing LCD panels.

Nd-based record superconductor

A new neodymium-based oxide high-temperature superconducting single crystal features the ability to carry a current density of 70,000 Amps/cm^2. This high current density can be maintained in a magnetic field of one Tesla at -196°C. The new crystal contains neodymium, barium, copper and oxygen and is produced by using the traveling solvent floating zone (TSFZ) process while under low oxygen pressure. The high current density may be due to a two phase mixture in which a neodymium-substituted barium phase is distributed throughout the stoichiometric crystal, serving as flux pinning centers. ▲

Radiation Detectors

Multicomponent Crystals Based on Heavy Metal Fluorides for Radiation Detectors is a book which summarizes the work on the physical properties of multicomponent optical fluoride materials which show promise for use in scintillators in high energy physics, nuclear physics, nuclear medicine, and other related fields. It is necessary in these fields of study to detect ionizing radiation with the aid of scintillators. This has become possible due to the comparatively simple detection of optical radiation, fast scintillation processes, availability of various photo detectors such as photo-multipliers, Si-photodiodes, and gas-proportional chambers filled with gas mixtures of photosensitive additives.

The book is presented in eight chapters entitled: Intrinsic Luminescence of Inorganic Fluorides, Extrinsic (Fast) Luminescence of Inorganic Fluorides, Classification of the Main Requirements to Inorganic

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Handbook/*Continued from previous column* ⇨

C) and 1:12-type $RFe_{12-x}T_xZ_y$ (where Z=N or C, and T=Ti and Mo) structures. Chapter four "Field Induced Phase Transitions in Ferrimagnets" is concerned with the thermodynamic approach to phase transitions and shows how the understanding and description of these magnetic phase transitions can be enriched. Some of the compounds covered in chapter four include $DyCo_5$, $HoCo_3Ni_2$ and $Gd_3Fe_5O_{12}$. The final chapter "Photon Beam Studies of Magnetic Materials" shows how this type of experimental method can provide measurements not possible by conventional methods.

The hardcover book not only contains author and subject indices, but a materials index as well, a useful addition. The 696-page *Handbook of Magnetic Materials*, Volume 9, edited by K.H.J. Buschow, was published in 1995 and is available for US$297.00. The book can be ordered by contacting your nearest Elsevier Science distributor: P.O. Box 211, 1000 AE Amsterdam, The Netherlands; Tel: 31 20 485 3757; Fax: 31 20 485 3432; E-mail: nlinfo-f@elsevier.nl; P.O. Box 945, New York, NY 10159-0945 USA; Tel: 212 633 3750; Fax: 212 633 3764; E-mail: usinfo-f@elsevier.com; 20-12 Yushima 3-chome, Bunkyo-ku, Tokyo 113 Japan; Tel: 81 3 3836 0810; Fax: 81 3 3839 4344; E-mail: forinfo-kyf04035@niftyserve.or.jp. ▲

YAG Shines on New Year

During every New Year celebration in Time's Square, New York City, a glittering sphere is lowered to revelers to coincide with the bringing of the New Year. This year, instead of illuminating the sphere with conventional light bulbs, the new ball was outfitted with strobes, halogen lamps and adorned with 12,000 rhinestones. The intensity of the ball was not only greater with the additional glitz and electrical hardware, but was remarkable when two powerful YAG (Yttrium Aluminum Garnet, $Y_3Al_5O_{12}$) lasers, mounted on adjacent buildings, were used to radiate the sphere.

The 6-foot diameter sphere has been lowered from a 77-foot pole at Time's Square each New Year since 1907. ▲

Detectors/*Continued from previous column* ⇨

Scintillators for Various Applications, Physico-Chemical Principles of Search for and Preparation of New Multicomponent Fluoride Single Crystals, Distinguishing Characteristics of Preparation of Multicomponent Single Crystals, Studies of Some Physical Characteristics of Multicomponent Fluoride Materials, Optical Effects Induced by Pulse Gamma-Neutron Irradiation, and Main Results and Prospects for Further Search for High-Density Fluoride Scintillators. Some of the materials covered are $Ba_{1-x}La_xF_{2+x}$, $Sr_{.75}Nd_{.25}F_{2.5}$, and $Sr_{.75}Pr_{.27}F_{2.7}$ fluoride glasses.

Multicomponent Crystals Based on Heavy Metal Fluorides for Radiation Detectors is intended for physicists, chemists and technologists engaged in the search for, preparation and investigation of fluoride materials for various applications such as quantum electronics, construction optics, solid electrolytes, luminophors, scintillators, etc.

The publisher and editor included adequate figures, tables and diagrams, which supplement the content very well, but the addition of a subject index, particularly for the quick location of specific glasses, would have been nice. The 261-page book was edited by B.P. Sobolev and was published in 1994 and can be ordered by contacting: Servei de Publicacions, Institut d'Estudis Catalans, Carrer del Carme 47, 08001 Barcelona, Spain; Tel:93 318 55 16; Fax:93 412 22 94. The price is 3600 pesetas (~US$31.00). ▲

Oxygen Migration in Rh/Ceria Catalysts

The adsorption and reaction properties of Rh particles supported on a CeO_2 surface and on polycrystalline CeO_2 films annealed at high and low temperatures were studied using steady-state, CO oxidation kinetics and temperature-programmed desorption (TPD) techniques. The study was conducted by H. Cordatos *et al.*, Department of Chemical Engineering, University of Pennsylvania, Philadelphia, PA 19104 USA, and was published in *J. Phys. Chem.*, **100**, 785-789 (1996). The authors hoped to show why the loss of oxygen storage capacity in Rh/ceria automotive catalysts decreases during operation of the catalytic converter. Ce^{3+} and Ce^{4+} are stable in the oxide form allowing the oxide to shift between CeO_2 and CeO_{2-x} during catalysis. Thus, the lattice oxygen released during ceria reduction can react with hydrocarbons and CO under rich conditions.

The experiment included three ceria supports that were examined using TPD: an epitaxial CeO_2 film with (100) surface orientation on *r*-plane sapphire and two polycrystalline films on α-phase Al_2O_3 (0001). The single (100) CeO_2 film with was ~100 Å thick while the two polycrystalline ceria films were ~10-20 μm thick. The CeO_2 (100) film was grown using 90° off-axis radio-frequency magnetron sputtering with a gas phase of 60% Ar and 40% O_2 at a partial

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Ames Laboratory,
Institute for Physical
Research and Technology,
Iowa State University,
Ames, IA 50011-3020
Telephone: (515)294-2272
Facsimile: (515)294-3709
INTERNET: ric@ameslab.gov
http://www.ameslab.gov/mat_ref/ric.html

R. William McCallum ..... Editor
Joel Calhoun ..... Staff Writer

Optical Switches

Optical switching properties of rare earth-palladium hydride films may lead to exciting new applications in the fields of architecture, optical communication, laser technology, and photography *Nature*, **380**, pp. 231-234 (1996). Scientists at the Condensed Matter Physics & Spectroscopy (COMPAS) Institute exposed mirror-like films of yttrium and lanthanum dihydride, which were coated with palladium, to a hydrogen atmosphere, resulting in the production of transparent trihydride layers. The process is reported to be reversible. The work on the switchable properties of these window/mirror films were conducted by J.N. Huiberts *et al.*, Faculty of Physics and Astronomy, Vrije

Continued in next column ➪

Oxygen Migration*/Continued from previous column* ➪

pressure of 4×10^{-2} torr. Both polycrystalline films were annealed at 970 K, but one was annealed further at 1720 K for an additional 4.5 h. The low temperature annealing was conducted at 970 K and the high temperature annealing occurred at 1720 K. Scanning electron microscopy (SEM) and x-ray diffraction (XRD) measurements of the polycrystalline samples showed significant growth of the ceria crystallite size, as well as change in the surface morphology upon high temperature annealing. Rhodium was then deposited on the ceria supports to check for oxygen migration during the experiment. Oxygen migration is a function of grain size, porosity and surface properties such as structure and surface area. Oxygen migration between phases (CO to O_2) determines the efficiency of the catalyst.

Steady-state, CO oxidation rates were measured on two polycrystalline films before and after Rh deposition. The TPD measurements obtained from Rh films supported on the low-temperature (100) ceria and high-temperature ceria, following a saturation exposure of CO, exhibit oxygen absorption at different rates and amounts.

The authors showed that oxygen transfer to supported Rh is enhanced by small ceria crystallites. This may provide insight into methods of controlling the oxygen storage capacity of automotive emissions control catalysts. Maintaining surface area by simply adding more ceria may not be sufficient if ceria crystallite size alters the ability of the oxide to release lattice oxygen during ceria reduction. ▲

Optical Switches*/Continued from previous column* ➪

Universiteit, De Boelelaan 1081, 1081 HV Amsterdam, The Netherlands.

The dihydride films were prepared by evaporating yttrium metal on a glass substrate under a vacuum. The films are several hundred nanometers thick and plated with a thin coating of palladium in order to prevent oxidation.

When the film is exposed to a hydrogen atmosphere under pressure, the hydrogen diffuses through the palladium overlayer and reacts with the yttrium metal to form yttrium dihydride (YH_2) in a few seconds. As hydrogen pressure increases, the dihydride layer converts to yttrium trihydride (YH_3), which is transparent. The resulting layer also exhibits semiconducting properties. The transparent trihydride reverts to the mirror-like dihydride when hydrogen pressure is reduced. The optical switch occurs when the metal-insulator transition properties are changed by converting $YH_{1.8}$ to $YH_{2.9}$, but the actual mechanism that makes the hydrides transparent remains a mystery.

The unique optical switching properties discovered in the experiment have been patented, and the patent rights have been purchased by Philips. The films may someday be used in architectural glass applications. The switching time currently takes a few seconds, however, if the optical switching can be decreased to a few milliseconds, then a wide range of uses may become possible, including optical signals in communications networks. It may be possible to develop solid-state devices that electrically switch the hydride films between window and mirror states *C&EN* **74** [13] 9 (1996). ▲

Leopoldo M. Falicov (1934-1995)

Leopoldo M. Falicov, professor of physics at the University of California, Berkeley, died of cancer on January 24, 1995. He was known internationally as a distinguished condensed matter theoretician and teacher. He received his Doctor en Fisica degree from the Instituto J.A. Balseiro of the University of Cuyo in Argentina in 1958 and a PhD in physics from the University of Cambridge in 1960. He then attended the James Franck Institute at the University of Chicago where he became professor. Falicov worked on cerium and mixed valence compounds and the theory involved in valence fluctuations. ▲

In 1890, Boisbaudran separated an oxide from a samarium-gadolinium concentrate. This oxide exhibited spectral lines that did not match either samarium or gadolinium. These lines were later shown to belong to europium, however, the discovery of europium is generally credited to Demarcay, who separated the metal in a "reasonably pure" form in 1901. The element was named after the continent of Europe.

Europium occurs in two of the principle rare earth ores, bastnasite and monazite. The metal is prepared from the sesquioxide, Eu_2O_3, by heating in a tantalum crucible with Lanthanum metal under high vacuum. Under these conditions, the La reduces the Eu which vaporizes, allowing metallic Eu to condense on the walls of the crucible, which appears as a silvery-while metallic deposit. The metal is about as hard as lead and is quite ductile. It quickly oxidizes in air, making it one of the most reactive of the rare earth metals. Europium spontaneously ignites in air at 150 to 180°C. Europium sesquioxide has a dirty-white color, while the monoxide, EuO, is brown-red.

Seventeen isotopes of the metal have been identified. Several of these naturally occurring isotopes have high neutron absorption properties. The high absorption value is maintained over time because of the succession of high neutron-capture cross-section daughter isotopes. Europium boride, EuB_6, is a good neutron absorber in its own right and is used in control rods in fast breeder nuclear reactors.

Other uses of europium include glass colorizing and memory storage devices. However, the most important commercial use of europium comes from its luminescent behavior, made possible by the spectral properties of 4*f* electrons. Excitation of the atom is brought on by the absorption of either energetic electrons or ultraviolet radiation. This excitation causes specific energy level transitions within the atom, resulting in emission of visible radiation, or light.

The most exciting developments in rare earth technology and the rare earth industry came in 1964 when europium was first used in television cathode ray picture tubes. The red color emitted by the europium-activated phosphor was about four times brighter than previously used phosphors. This ushered in the age of true color television, effectively replacing the previous pastel-color television sets. The new, brighter, red color made it possible to increase the brightness of all color television images, because the intensity of the red was now more nearly equal to that of the other principle colors, blue and green. The red phosphor used is the doped-oxysulfide, $Eu^{3+}:Y_2O_2S$. Trichromatic fluorescent lighting systems are also made possible by europium, not by the emission of red, but by the blue broad spectral emission of Eu^{2+}. Commercial blue phosphors are $Eu:Sr_5(PO_4)_3Cl$, $Eu:BaMg_2Al_{16}O_{27}$, and $Eu:Sr_4Al_{14}O_{25}$. Phosphors need to be very high purity materials, often as high as "five nines" (99.999 percent) which enable them to emit light at very precise wavelengths.

Europium-based photostimulable phosphors are now used in x-ray detection systems, which utilize the Eu:BaFBr family of phosphor materials. This material absorbs x-ray radiation and emits visible radiation proportional to the absorbed dose when stimulated by a small-spot laser beam. Eu luminescence is also used for sensitive analytical techniques in medical applications and as a probe in biochemistry. ▲

Supporters 1996

★★★★★★★★★★★★★★★★★★★★★★★★

Since the March 1, 1996 issue of the RIC News went to press, RIC has received support from 3 new family members, and renewed support from 15 other organizations and individuals. The Supporters from the fourth quarter of fiscal year 1996 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 parenthesis, are listed below.

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