Rare-earth Information Center NEWS

Center for Rare Earths and Magnetics
Ames Laboratory
Institute for Physical Research and Technology
Iowa State University, Ames, Iowa 50011-3020 U.S.A.

Volume XXXIV September 1, 1999 No. 3

High-Tc Superconductors

Studies of High Temperature Superconductors (Advances in Research and Applications) is a series of monographs dealing with the current state of research and commercialization of high temperature superconductors.

Hg-Based High T_c Superconductors Part II

Volume **24** of the series deals primarily with mercury-based superconductors so only one chapter (Chapter 6 of eight) contains information on rare earth superconductors: High pressure synthesis and properties of Hg-$Ba_2Ca_{n-1}Cu_nO_{2n+2\delta}$, $Y_2Ba_4Cu_{6+n}O_{14+n}$, $Sr_{1-x}Ca_xCuO_2$ and $Sr_{0.73}CuO_2$ Crystals. Crystal growth of Y-124 and Y-247 compounds and the superconducting parameters and flux pinning of Y-124 is covered.

Chemistry and Related Aspects of High Tc Superconductors

Volume **25** contains two chapters that provide information on the rare earth oxide superconductors: "Classification of Superconducting Oxides as Interstitial Alloys" that may contain more information on superconductor properties than any previous 61 pages of scientific literature in history (256 references). This chapter is highly recommended for students needing a solid background in the field, or for the long-time researcher to remind them how much work has been done the past two decades. "Studies on Preparation and Substitution of $YBa_2Cu_4O_8$" covers the phases of the homologous series $Y_2Ba_4Cu_{6+n}O_{14+n}$, crystal structure, physical properties, and synthesis and substitution in this compound.

Quaternary Borocarbides, Superconductors and Hg-Based High Tc Superconductors

Volume **26** contains five chapters, the first providing general information

☛ *Continued from previous column*

on the discovery of Y-Ni-B-C and R-Ni-B-C compounds. The remaining sections pertaining to rare earths include reports on: the interrelation between magnetism and superconductivity in RNi_2B_2C, material parameters in quaternary borocarbides, including transitions metal doped borocarbides and the effect of thermal treatment; superconducting thin films; and a re-

Continued in next column ☛

view of x-ray and neutron powder diffraction analysis of YNi_2B_2C.

Order from Nova Science Publishers, Inc., 6080 Jericho Turnpike – Suite 207, Commack, New York 11725 USA; Tel: 516 499 3103; Fax: 516 499 3146. Volume **24** (244 pages) was published in 1997 and costs US$93.00, Volumes **25** (331 pages) and **26** (202 pages) were both published in 1998 are available at a cost of US$93.00 and US$97.00, respectively. ▲

Sr_2CeO_4 Blue Phosphor

A blue emission powder with the composition Sr_2CeO_4 was prepared by the chemical coprecipitation technique by a team from the Phosphor Technology Center of Excellence, Georgia Institute of Technology, Atlanta, Georgia 30332 USA {*Appl. Phys. Lett.*, **74**, [12] (1999)}. The process is claimed to be readily adapted to large-scale commercial production in order to satisfy the phosphor requirements for field emission displays (FEDs).

Someday, FEDs may replace cathode ray tubes (CRTs) because they can provide comparable or superior performance than CRTs, but operate at lower excitation voltages (~5 kV) and higher current densities (10 – 100 A/cm²). This requires the phosphors to have a high efficiency at low voltages, high resistance to current saturation, long service life, and equal or better chromaticity than phosphors used in CRTs. Current FED phosphors are Ce-doped $SrGa_2S_4$ (blue) and Eu-doped $SrGa_2S_4$ (green), however, these sulfides have a tendency to decompose during operation and emit sulfide gas, which decreases the luminous efficiency of the phosphors while deteriorating the cathode. Attempts to solve this decomposition by coating the phosphor resulted in decreased luminous efficiency.

The solution to these problems seems to have been solved when Sr_2CeO_4 was prepared last year via a combinatorial materials synthesis technique {*Science*, **279**, 837-9 (1998)}. The oxide phosphor was found to have an orthorhombic crystal structure with one-dimensional chains of edge-sharing CeO_6 octahedra, and that the luminescence originates from a ligand-to-metal Ce^{4+} charge transfer. Although the combinatorial synthesis method provides good results, the product is an oxide thin film, not attractive for large-scale production like chemical production methods.

The Sr_2CeO_4 powder was prepared by dissolving $Sr(NO_3)_2$, $Ce(NO_3)_3 \cdot H_2O$ and $(NH_4)_2C_2O_4 \infty H_2O$ in water, filtering, precipitating, and separating the products. After drying, Sr_2CeO_4 was fired at various temperatures but the powder that was subjected to 1200°C for 2 hours had the higher luminous efficiency at both 4 kV and 10 kV. Tests showed that the powder exhibited an emission peak at ~470 nm, and chromaticity coordinates were $x = 0.19$ and $y = 0.26$. The authors are confident that this phosphor has potential for field emission displays. ▲

Consortium on Advanced Magnets

The annual meeting of "Consortium on Advanced Magnets" will be held October 15, 1999 at Wright-Patterson Air Force Base, Dayton, Ohio, USA. The consortium will deal with the current and future trends in permanent magnets and their applications. For more information, contact Helen Long, University of Delaware, Department of Physics & Astronomy, 223 Sharp Lab., Newark, DE 19716 USA; Tel: 302 831 2661; Fax: 302 831 1637; hlong@udel.edu. ▲

NATO Magnetic Storage Systems

The NATO ASI conference "Magnetic Storage Systems Beyond 2000" will be held on the Greek Island of Rhodes, June 25 – July 7, 2000. For more information, contact Dr. G.C. Hadjipanayis, University of Delaware, Department of Physics & Astronomy, Newark, DE 19716 USA; Tel: 302 831 2736; Facsimile: 302 831 1637; hadji@udel.edu. ▲

RE-Doped Materials

"Rare-Earth-Doped Materials and Devices IV" is conference oe07 of SPIE's International Symposium on Optoelectronics 2000, Integrated Optoelectronic Devices, and will be held January 22 – 28, 2000. The conference will bring together researchers and engineers from academia and industry to discuss the recent developments in the rapidly growing field of rare earth-doped semiconductors, polymers, laser sources and fiber amplifiers. The conference is open to all aspects of rare earth-doped materials and devices for optical and optoelectronic applications and will include the topics of rare earth-doped materials: glasses, crystals, polymers, semiconductors, hybrid materials, fibers, fiber lasers and amplifiers, planar waveguides, waveguide lasers and amplifiers, light-emitting devices, integrated lasers and amplifiers, miniature solid state lasers, modeling, and new design and fabrication techniques.

Continued in next column ☛

If interested, contact SPIE, The International Society for Optical Engineering, Tel: 360 676 3290; Fax: 360 647 1445; spie@spie.org. ▲

Conference Calendar

*** A NEWS STORY THIS ISSUE**

Note: Reach as many potential conference attendees as possible! Send us your conference announcement and we will publish it here. ▲

September '99
Physics of Strongly Correlated Electron Systems
Madrid, Spain
September 14-18, 1999
RIC News* **XXXIV, [2], 2 (1999)

EUROMAT99
Munich, Germany
September 27-30, 1999
RIC News **XXXIV**, [1], 3 (1999)

Magnetic and Superconducting Materials (MSM-99)
Tehran, Iran
September 27-30, 1999
RIC News **XXXIV**, [1], 3 (1999)

October '99
Consortium on Advanced Magnets
Dayton, Ohio, USA
October 15, 1999
*This page

November '99
Magnetism and Magnetic Materials (MMM'99)
San Jose, California, USA
November 15-18, 1999
RIC News **XXXIV**, [1], 3 (1999)

January '00
Rare-Earth-Doped Materials and Devices IV
San Jose, California, USA
January 22-28, 2000
*This page

March '00
Rare Earths and Actinides: Science, Technology, and Applications IV
Nashville, Tennessee, USA
March 12-16, 2000
RIC News* **XXXIV, [2], 2 (1999)

May '00
NATO ASI: Modern Trends in Magnetostriction Study and Application
Crimea, Ukraine
May, 2000
*This issue (page 3)

June '00
NATO ASI: Magnetic Storage Systems BEYOND 2000
Rhodes, Greece
June 25 – July 7, 2000
*This page

September '00
The Third International Conference "Noble and Rare Metals" (NRM-2000)
Donetsk, Ukraine
September 19-22, 2000
RIC News **XXXIV**, [1], 3 (1999)

September '01
Rare Earths - 2001
São Paulo - SP, Brazil
September, 2001
RIC News **XXXIII**, [4], 3 (1998)

Handbook Volume 25

The 25th Volume of the *Handbook on the Physics and Chemistry of Rare Earths* contains four chapters (Chapters 165 - 168 in the series) that continue the quest of the *Handbook* series: to provide answers to fundamental questions regarding physical and chemical properties of rare earth metals, alloys and compounds. These elements have played a key role in developing the theories of electronic structure, magnetic properties and spectroscopy, which are central to the development of physics and chemistry. Through this aim, the contributing authors of Volume **25** have enriched the fields of earth science, biological science, and medicine via the extraordinary properties inherent in these materials.

The first chapter "Rare earths in steels" introduces the reader by explaining how rare earths were used in the steel industry since the early 1920's to affect deoxidation and desulfurization. More modern uses utilize rare earths to provide steels with specific characteristics such as designed thermodynamics, shape control, mechanical properties, directionality, grain refinement, and structure. The chapter also covers hydrogen embrittlement, the effect of rare earths on hydrogen-induced delayed failure, stress corrosion cracking, permeability in steels, powder metallurgy, creep behavior, and welding.

The second chapter "Ternary and higher order nitride materials" reviews the synthesis of ternary rare earth nitrides and covers the properties of ternary nitrides and oxynitrides, including Li_2CeN_2, Ce_2N_2O, $BaCeN_2$, $BaCeR(O,N)_4$, and $PrBN_2$, $Ce_3B_2N_4$, and $Ce_{15}B_8N_{25}$-type boronitrides. The Y-Zr-O-N system is also reviewed.

The following chapter "Spectral intensities of f - f transitions" discusses the unique appearance of intraconfigurational electronic transitions in f–type lanthanides. Transition mechanisms, intensity theory, magnetic dipole transitions, Judd-Ofelt theory, intensity parameterization of transitions between crystal-

Continued in next column ☛

field levels and J - multiplets, hypersensitivity, vibronic transitions, two-photon spectra, and the color of lanthanide ions are reviewed.

The final chapter "Organometallic π complexes of the f-elements" reviews the available literature on the main classes of complexes of both the lanthanide and actinide organometallics, and the preparation and structure of these compounds are discussed.

Volume **25** of the 492-page hardcover *Handbook* was published in 1998 and is available for US$227.00/NLG395.00 by contacting Elsevier Science, P.O. Box 211, 1000 AE Amsterdam, the Netherlands; Tel: 31 20 485 3757; Fax: 31 20 485 3432; nlinfo-f@elsevier.nl; www.elsevier.nl. ▲

NATO in Magnetostriction

The NATO Science Program Advanced Study Institute (NATO ASI) will serve as a forum for discussing fundamental issues in the field of magnetostriction phenomena and the principles of their applications in various disciplines of science and technology. The conference "Modern Trends in Magnetostriction Study and Application" will include lectures, progress reports and poster presentations that cover the new developments that relate to both fundamental and practical applications involving magnetostriction phenomena. The conference will be held in Crimea, Ukraine in May, 2000.

Topics of the conference will include: general introduction to modern trends in magnetostriction study and application, theory of magnetostriction and related phenomena, rare earth magnetostriction study and application, magnetostriction of amorphous materials, giant magnetostriction in superconductors, GMR materials, structural study of magnetostriction, industrial applications, and magnetostriction of nanostructure materials.

For more information, contact the Institute for Low Temperature Physics & Engineering, 47, Lenin Ave., 310164, Kharkov, Ukraine; Tel: 380 572 321 223; Fax: 380 572 322 370/380 572 335 593; ASI-2000@ilt.kharkov.ua. ▲

Latin American Workshop

The *IV Latin American Workshop on Magnetism, Magnetic Materials and Their Applications* was held in São Paulo, Brazil, June 7-11, 1998. Most of the 111 participants of the workshop were researchers from Brazil, however, many Latin American countries were represented, Argentina, Colombia, Mexico, Cuba, Peru, and Venezuela.

The topics covered at the workshop included thin films, giant magnetoresistance, magnetoimpedance, nanocrystalline materials, superconducting oxides, magneto-optics, and others. Rare earthers will be primarily interested in the sections concerning the neutron diffraction studies of magnetic materials and reduced dimension systems, structural and magnetic properties of Sm/Fe thin films, light-emitting diode based transverse magneto-optical Kerr effect, and colossal magnetoresistance in rare earth manganites (primarily $(La,Ca)MnO_3$, and $(R,Ce)_2CuO_4$, $(Eu,Pr)CuO_4$, and (La,Sr)Cu. The highest number of rare earth papers are contained in the section "Hard Magnets" and cover the topics of nanocrystalline $Nd_2Fe_{14}B$-α Fe composites, flash annealed PrFeB, hybrid magnets, magnetic properties and spectroscopic studies of magnetic rare earth alloys, the HDDR process of Nd-Fe-B alloys, and magnetic properties of $Sm_2Fe_{17}N_x$. The contributions concerning low temperature magnetism include $(La,Pr)BaCuO_5Fe$, magnetic ordering in TbNi5, and the physical properties in $(Ce,La)Fe_2Ge_2$, and devices based on first order magnetic phase transition of $(R_{1-x}R'_x)Co_2$ pseudobinary compounds. Two contributions on fluids and particles include magnetic 3d impurities in a hexagonal close-packed iron host, and the electrochemical behavior of magnetic materials in various solutions.

The 85 contributions are contained in the 499-page soft cover book entitled "Magnetism, Magnetic Materials and Their Applications" and was published in *Materials Science Forum* Volumes **302-303** in 1999. The cost of the book is US$174.00/£98.00/CHF235.00 and can be ordered from Trans Tech Publications Ltd., Brandrain 6, CH-8707 Uetikon-Zurich, Switzerland; Fax: 41 1 922 10 33; www.ttp.net. ▲

Net Shape Laboratory

Net shape or near net shape processing is aimed at producing functional materials in the form required by the application without requiring extensive machining or grinding after the material is formed. The Net Shape Laboratory at the University of Birmingham, UK, has recently begun operations and one of their initial projects is to develop production procedures of "ready to go" Nd-Fe-B permanent magnets {*Magnews*, Spring, p. 10 (1999)}. Most high-end permanent magnet applications require precision shapes and the costs associated with grinding the magnets to shape represent a significant fraction of the total magnet cost. Thus net shape processing could result in cost reductions and increased demand for Nd-Fe-B magnets. While net shape bonded Nd-Fe-B magnets routinely produced, the bonded magnets have an energy product one quarter of that which can be obtained in sintered magnets.

Currently, high energy product Nd-Fe-B magnets are produced by a powder sintering route that uses hydrogen decrepitation (HD) to produce fine powder from ingot material. The powder is aligned and pressed in a magnetic field. The green density of the pressed compact is less than 90% so that a volume change in excess of 10% occurs on sintering. To meet the customers' specifications, the magnet must then be machined, which not only takes additional resources, but also produces waste materials that must be recycled or disposed of properly. These final production stages are responsible for up to half of the production costs involved in Nd-Fe-B magnets.

The development of methods to produce economically feasible high-energy product net shaped rare earth permanent magnet materials is the goal of the Net Shape Laboratory through research and development. The investigations will include hot pressing of bulk alloys and of HD and Hydrogen Decomposition Desorption Recombination .(HDDR) powdered alloys. This also includes solidification trials on the bulk material using advanced foundry facilities. Anisotropic

Continued in next column ☛

HDDR powders are used in the hot pressing trials and in the production of anisotropic polymer bonded magnets. A range of processing parameters is also investigated in order to optimize production of these magnets, including process modeling.

For more information, contact Dave Brown, Department of Metallurgy & Materials, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK; Tel: 44 121 414 5213; Facsimile: 44 121 414 5247; E-mail: d.n.brown@bham.ac.uk. ▲

Manganite Review

A review by J.M.D. Coey, Physics Department, Trinity College, Dublin 2, Ireland, *et al.* {*Adv. Phys.*, **48**, [2], 167-293 (1999)} covers the state of our understanding of mixed-valence manganese oxides $(R_{1-x}A_x)MnO_3$ (R= rare earth cation, A= alkaline or alkaline earth cation), and other magnetic semiconductors. These rare earth perovskites display a variety of crystallographic, electronic and magnetic phases and exhibit a phenomena such as colossal magnetoresistance near the Curie temperature, dense granular magnetoresistance and optically-induced magnetic phase transitions.

The authors address the nature of the electronic ground states, the metal-insulator transition as a function of temperature, pressure and applied magnetic field, the electronic transport mechanism, dielectric and magnetic polaron formation, magnetic localization, the role of cation disorder and the Jahn-Teller effect. Sample preparation and the properties of related ferromagnetic oxides are also discussed.

A discussion of Eu chalcogenides (EuO, EuS, EuSe, and EuTe) magnetic semiconductors includes influence of carriers on magnetic properties, and transport and related phenomena. Although the magnetic structures and magnetic properties of $(La,Ca)MnO_3$ and $(Pr,Ca)MnO_3$ are somewhat similar, their electronic structures are quite different. The authors provide some insight into this situation by explaining that for a ferromagnetic phase for $x=0.3$ in $(La_{1-x}Ca_x)MnO_3$ and for x closer to 0.2 in $(Pr_{1-x}Ca_x)MnO_3$, it

Continued in next column ☛

does not have the high conductivity associated with ferromagnetism in a cubic or rhombohedral phase. The transport properties are also different, as are structural details such as the Mn-O-Mn bond angle for the double exchange mechanism. ▲

Scintillators and Phosphors

New Inorganic Scintillators and Storage Phosphors for Detection of Thermal Neutrons is a 180-page soft cover book that reviews the current level of knowledge related to neutron detector technology. The focus is on inorganic scintillator and storage phosphor materials, however, new materials have been studied and their potential for application in detectors has been considered.

The mechanisms of storage phosphors and scintillators are shared in that they convert ionizing radiation into visible light while storing a portion of their energy. Free electrons and holes created by radiation absorption do not readily recombine, but are separately trapped at impurity or defect sites in the material, which is liberated via optical stimulation. The recombination of the electrons and holes can then occur.

The book, authored by Mathijs Knitel, deals with the subject in 8 sections. Following a brief introduction, thermal neutron detection methods are presented, including the ^{155}Gd and ^{157}Gd reaction (neutron capture methods), and counting detectors (scintillators), and integrating detectors; selection of materials, radiation sensitivity and decay times, and the scintillator Eu-doped BaFBr; $LiBaF_3$ as a thermal neutron scintillator; scintillation and storage properties of $LiYSiO_4$:Ce and $LiLuSiO_4$:Ce; photoluminescence in Eu^{2+} and Ce^{3+} borates; thermal neutron image plates using Eu^{2+} activated $M_2B_5O_9X$ (M=Ca, Sr, Ba; X=Cl, Br); and the recombination of charge carriers in the haloborate $Sr_2B_5O_9Br:Eu^{2+}$.

The book is published in 1998 by Delft University Press, Mekelweg 4, 2628 CD Delft, The Netherlands; Tel: 31 15 278 3254; Fax: 31 15 278 1661; dup@dup.tudelft.nl. ▲

I.S.A. Buys Neomet

Neomet Corporation closed their doors for business May 31, 1999 and were purchased by International Specialty Alloys (I.S.A.) on June 1, 1999. For more information, contact Joseph Patrick, President, International Specialty Alloys, P.O. Box 428, Edinburg, PA 16116 USA; Tel: 724 667 3003; Fax: 724 667 3002. ▲

Join-line Industries Inc.

Join-Line Industries Inc. is a company that is involved in the recycling and recovery of Nd-Fe-B and Ni-Metal Hydride alloys. The recovered Neodymium Oxide and Dysprosium Oxide are then processed into Neodymium and Dysprosium metal that are claimed to meet the specifications of Nd-Fe-B and Ni-Metal Hydride alloy producers. Join-Line will purchase waste materials for recycling, and will offer materials for the production of Nd-Fe-B permanent magnets and NiMH batteries. Contact Mindele Chan, Join-Line Industries Inc., 11D, Blue Building, Yenzo Holiday Resort, High Tech Industrial Development Zone, Changsha, Hunan, People's Republic of China; Tel: 86 731 8806188; Facsimile: 86 731 8805988; E-mail: joinline@public.cs.hn.cn. ▲

Intertech has Moved!

Intertech Corp., the rare earth consulting, conferences & studies company, has moved. Their new address is: 19 Northbrook Drive, Portland, ME 04105 USA; Tel: 207 781 9800; Fax: 207 781 2150; E-mail: info@intertechusa.com; www.intertechusa.com. ▲

Ferro Electronic Materials

Ferro Electronic Materials is the new name for the company formerly known as the Transelco Division of Ferro Corporation. For more information, contact G. Braun, Ferro Electronic Materials, 1789 Transelco Drive, Penn Yan, NY 14527 USA; Tel: 315 536 3357; Facsimile: 315 536 8091; E-mail: www.ferro.com. ▲

Atlantic Metals & Alloys

Atlantic Metals & Alloys, Inc. has moved. Their new address is 355 Benton Street, P.O. Box 589, Stratford, CT 06615-0589 USA; Tel: 203 378 9025; Fax: 203 378 9570. ▲

Santoku's Chicago Office

Santoku America, Inc., has opened an office in a Chicago suburb. Their new address is: Two Continental Towers, 1701 Golf Road, Suite 605, Rolling Meadows, IL 60008 USA; Tel: 847 437 5520; Fax: 847 437 5521. ▲

Nd-Fe-B Ninja

In the highly competitive sport motorcycle market, manufacturers strive to improve performance of their products on a continual basis. The major areas that provide the most immediate positive result on a motorcycle are improvements in handling, power delivery, and weight reduction.

The Kawasaki Motor Company (www.kawasaki.com) has made a significant reduction in weight on its 899cc Ninja motorcycle engine by making it 20 pounds lighter. To achieve this, Kawasaki's engineers completely redesigned the engine, learning more than a thing or two from a ground-up powerplant upgrade on a smaller-engined model.

One of the improvements that made the weight loss possible was replacing its chain-driven alternator with a Neodymium-Iron-Boron magnet unit that they attached directly to the end of the crankshaft. Other design changes also contribute to the weight loss, such as using aluminum-magnesium alloys in the engine and replacing a "new" hydraulic clutch actuator unit with an "older" cable operated unit. Power has always been the big Ninja's strong suit and continues be so, as Kawasaki claims these improvements provide for four more horsepower (measured at the crankshaft). The Nd-Fe-B permanent magnet alternator lowers the rotating engine mass. It is this lowered engine mass, when coupled with decreased weight, that makes for a higher-revving engine and quicker throttle response. ▲

Australian Deposit

The Dubbo Rare Metal Project will mine and extract minerals from the Toongi deposit, which is located about 400 km northwest of Sydney, New South Wales, Australia. The project is centered between the towns of Dubbo and Peak Hill and lies in the Lachlan Fold Belt, which has been identified to contain anomolous concentrations of niobium, zirconium, hafnium, and rare earths. The hydrothermally altered volcanic rock (trachyte) is in an elliptical band and covers approximately 185,000 m^2.

The intrusive minerals in the Toongi deposit consist of fine grained alkali rocks made up of potassic feldspars, albite and aegerine with carbonate, accessory quartz and the ore minerals. The ore minerals are categorized in four major groups: 1) Zirconium – zirconium silicate with calcium, yttrium, and rare earth elements; 2) Yttrium – occurring as silicates with other rare earths; 3) Niobium/Tantalum minerals, and; 4) Rare earth-containing calcian bastnasite of 2 - 100 micron size. Surveys indicate a resource of 10 million mt grading 0.12% Y_2O_3, and 0.75% rare earth oxides. The deposit may also contain another 40 million mt at similar grades for a total of 50 million mt. Recent mapping has discovered that the intrusive body extends 200 - 300 m to the east and is covered by a shallow sedimentary cover. This suggests, that if mined, the reserves could double to 100 million mt.

Extractive metallurgy of the rare earth minerals will include crushing, grinding, sulfuric acid leach, solvent extraction and refining, and selective precipitation. Sulfuric acid leach appears to be the key step in processing since the mineral ore species present since much of the host rock is insoluble to the sulfuric acid, which should limit acid consumption while restricting the volume of elements in solution.

Development of the deposit and commercialization of rare earth products is possible in 2000-2001. Contact Alkane Exploration NL, 129 Edward Street, Perth WA 6000, Australia; Tel: 618 9227 5677; Fax: 618 9227 8178; www.alkane.com.au (see *Consultants Corner* on page 7). ▲

Advanced Scandium Alloys

Advanced Aluminum Alloys Containing Scandium deals with the structure and properties of binary Scandium-aluminum alloys and more complex Sc-Al alloys also containing transition metals. The book also includes a thorough analysis of the reference data available and is an attempt to generalize and analyze the extensive experimental and theoretical work on Sc-Al alloys performed by researchers in the field.

The effects of scandium on the phase composition, structure, phase transformations and properties of aluminum alloys are considered from the perspective of physicochemical analysis. Phase diagrams of Scandium-aluminum binary, ternary, and multicomponent alloys are considered in detail, as are the effects of solidification conditions on phase equilibria, recrystallization, superplastic behavior, and decomposition of supersaturated solid solutions. Based on the quantitative analysis of their structure and properties, the microstructure stability for these aluminum alloys are determined by various calculations. The interrelation between the structure and properties of Sc-Al alloys with different phase compositions and the hardening mechanisms are discussed. Some practical recommendations are provided for alloying aluminum alloys with Scandium by leading researchers in this field. The ternary Sc-Al-TM alloys covered include Cu, Fe, Mg, Mn, Si, and Zr. The more complex alloys include (Sc-Al-Mg-Si-Zr), (Sc-Al-Li-Mg), and (Sc-Al-Mg-Zn).

The development of commercial aluminum alloys for large-scale welded structures that are used to support heavy loads were dependent on the experimental results, along with the available reference data, compiled by the contributors of this book. Aluminum alloys are also used in corrosive media and alloys exposed to irradiation. *Advanced Aluminum Alloys Containing Scandium Structure and Properties* was published in 1998. The 175-page hard cover book is available for US$75.00 through Gordon and Breach Science Publishers, PTT, P.O. Box 566, Williston, VT 05495-0566 USA. ▲

New Materials

Strongest Magnet

A sintered Neodymium-Iron-Boron permanent magnet that has been developed by Sumitomo Special Metals, Osaka, Japan, is claimed to feature a world record maximum energy product of 55.8 MGOe (444 KJ/m^2). The residual magnetic flux density was measured to be 15.14 KG – 95% of the theoretical maximum flux density for this $Nd_2Fe_{14}B$ intermetallic compound phase.

The magnetic properties of the new magnet were gained by a combination of reducing the nonmagnetic phase of the grain boundaries, increasing the polycrystalline orientation to approximately 98% alignment and density to 99%.

Applications for the new magnet is expected to be in small electric motors for computer disk drives, magnetic resonance imaging equipment, and motors for hybrid-electric automobiles. Sumitomo Special Metals Company Ltd., No.3 Sumitomo Bldg., 4-7-19 Kitahama, Chuo-ku Osaka 541-0041, Japan; Tel: 06 6220 8822; Fax: 06 6220 8909; www.ssmc.co.jp. ▲

Thermoelectric Power

A new thermoelectric power generation element that uses an oxide material has been developed by Tokyo Gas Company Ltd. Thermoelectric voltage, until now has been generated by metals such as bismuth and tellurium. This occurs as a result of temperature differences between the *n* (electron donor) and *p* (electron acceptor) elements in a semiconducting diode. Thermoelectric generator devices are needed where small size and no moving parts are required. They have been used in superior-orbit space satellites for many years but potential uses would include power generation by waste heat from industrial production processes, garbage incineration, motor vehicles, etc. (400°C - 800°C temperature range), provided that operating efficiencies increase.

The new thermoelectric element uses Na-Co oxide on the *p*-side, and Nd-Cu oxide (with Zr added) on the *n*-side. It shows an increased heat resistance over the metal elements, which allows the devices to be operated at higher temperatures. This allows an increase in temperature differential, which boosts the efficiency of electric power generation. The new device generates 280 mV using a temperature difference of 200°C. Another advantage of the oxide elements is that they can be used in an ordinary atmosphere with out degradation. Tokyo Gas Company Ltd., 1-5-20 Kaigan, Minato-ku, Tokyo 105, Japan; Tel: 03 3433 2111; Fax: 03 8437 9190. ▲

Lanthanum Gallium Oxide for Fuel Cells

The compound lanthanum gallium oxide has been developed for use as a solid electrolyte for fuel cells. The new electrolyte material features an operating temperature of about 600°C, low enough to allow the use of many metals in the structure of the fuel cell. The researchers hope that the new material will replace the ceramics currently used in fuel cells since this will improve efficiency in fuel cell production.

Current ceramic fuel cells generate 0.2 W at a temperature of about 1000°C, whereas the Lanthanum Gallium Oxide material produced 0.4 W/m^{-2}, sufficient for practical applications. This may be explained by the fact that the lanthanum electrolyte allows an increase in the flow of oxygen as compared with the yttria-stabilized zirconia solid electrolyte material. For more information, contact: Oita Faculty of Engineering, Oita University, 700 Dannoharu, Oita 870, Japan; Tel: 0975 54 7752; Fax: 0975 54 7760. ▲

Consultant's Corner

To appear in our Consultant's Corner, any individual, company, or group must be involved in rare earth or rare earth-related consulting activities. Just send us the appropriate information: contact name, company name, mailing address, Tel/Fax number(s), e-mail and web address, and areas of expertise. *(continued on bottom of page 6)*

Auer-Remy GmbH: Dr. Johannes Lange, Baumwall 5, D-20459 Hamburg, Germany; Tel: 49 040 369 00126, Fax: 49 040 363 842, Email: **remyhh@aol.com.** ▲ Import/Export/Distribution of rare earth alloys, compounds, metals and concentrates.

Eindhoven University of Techology: Bert Hintzen, Laboratory of Solid State and Materials Chemistry, P.O. Box 513 STO 2.26, 5600 MB Eindhoven, The Netherlands; Tel: 31 40 247 3113, Fax: 31 40 244 5619, Email: **h.t.hintzen@tue.nl**. ▲ rare earths in nitrides and oxynitrides, optical and thermal properties.

John Forti, 5 Chadwick Rd., Englishtown, NJ 07726 USA; Tel: 732 792 8424, Fax: 413 740 2668, Email: **fortijo@aol.com.** ▲ rare earth marketing and sales

Daniel Karpen, Professional Engineer & Consultant, P.C., 3 Harbor Hill Dr., Huntington, NY 11743 USA; Tel: 516 427 0723. ▲ energy conservation, full spectrum polarized lighting, environmental conservation, expert testimony, patent and inventions, engineering research and development, and rare earth doped glasses.

Laltech Corp.: Larry Liebowitz, P.O. Box 249, Milltown, NJ 08850 USA; Tel: 732 251 5446, Fax: 732 247 1094, Email: **larryaall@cwix**. com. ▲ formulation of ceramic dielectrics containing rare earths, addition of rare earth compounds to ceramics to improve properties and/or ease of processing.

Multi Metal Consultants Pty. Ltd.: Ian Chalmers, P. O. Box 8178, Perth Business Centre, WA, Australia; Tel: 61 8 9328 9411, Fax: 61 8 9227 6011, Email: **multimet@iinet.net.au**, Web: iinet.net.au/~multimet. ▲ geological consultants that provide a broad range of technical and management expertise in exploration, feasibility, mining and production. MMC's is currently managing the feasibility study for Alkane Exploration's Dubbo Zirconia Project in New South Wales, Australia (see story on page 5, column 3).

The Natural History Museum: Ms. Frances Wall or Dr. C. T. Williams, Department of Mineralogy, Cromwell Road, London, SW7 5BD, UK, Tel: 44 (0)20 7942 5623/5663, Fax: 44 (0)20 7942 5537, Email: **f.wall@nhm.ac.uk** or **t.williams@nhm.ac.uk**. URL: **http://www.nhm.ac.uk/science.** ▲ rare earth minerals, rare earth ore deposits, REE mobility, and REE in fossil bone. Analysis of minerals and rocks including electron microprobe analysis of REE, laser ablation ICP-MS, X-ray Diffraction.

James Mitchell Smith, P.O. Box 23, Liberty, IN 47353-0023 USA, Tel: 765-458-5854. ▲ sand foundry

Soltec Ventures, Inc.: Larry Evans, Suite 232G Cummings Center, Beverly, MA 01915 USA; Tel: 978-922-9446, Fax: 978-774-6665; Email: **soltec@neaccess.net.** ▲ Twenty-five years of experience manufacturing high purity rare earth compounds, rare earth salts, laser crystal synthesis; NMR shift reagents, fluorophores, high purity cerium salts, 99.99%(REO), and rare earth dopants for superconductors and lasers.

"STIGMA" Ltd.: Nosovky Alexander, 111024, Moscow Krasnokazarmennaya 23-76, Russia; Tel: 7 095 362 5890, Fax: 7 095 216 7723, Email: **stigma.ltd@relcom.ru**, URL: **http://www.lemes.se/stigma** or **http://195.84.172.147/stigma**. ▲ high purity minor metals and silicon, and A3B5 semiconductor materials.

Technimet, Materials Engineering, Testing and Consulting: Tijs van Wershoven, 2345 S. 170th St., New Berlin, WI, 53151-2701 USA; Tel: 414 782 6344; 800 726 6385, Fax: 414 782 3653, Email: **technimet@execpc.com**, Website: www.technimet.com. ▲ materials engineering - metallurgical engineering, polymer science, welding technology; stress/strain analysis, vibration technology, engineering calculations (FEM), metallography and photomicrography, mechanical/hardness testing, chemical analysis (GDS and ICP), corrosion testing, nondestructive testing, weld qualification, paint analysis, FTIR/TGA/DSC polymer analysis.

University of Tennessee: George K. Schweitzer, PhD, ScD, Chemistry Department, 401 Buehler Hall, Knoxville, TN 37996-1600 USA, Tel: 423 974 3422, Fax: 423 974 3454, Email: **gschweitzer@utk.edu.** ▲ rare earth separations by continuous counter-current solvent extraction, preparation of 99.999% rare earths, ICP-MS analysis, separation by precipitation-aided solvent extraction and by redox.

YSZ Ceramic Coating

Yttria-stabilized zirconia (Y_2O_3-ZrO_2) has been well known as a ceramic coating on components that are used in powerful and efficient engines which are subject to high temperatures. These thermal barrier coatings extend the operating life cycle of metal engine parts by protecting them from the rigors of extreme temperatures. They are used on gas turbine (turbine-jet) engines that are utilized in the aircraft, maritime, and stationary power generation industries.

The National Institute of Standards and Technology (NIST) is conducting research on the microscopic behavior of YSZ coatings to determine how their microstructures change when subjected to extreme temperatures inside these engines. It had been previously thought that ceramic microstructures do not change until within 50% of their melting point. However, NIST has discovered that YSZ microstructures change after being heated to only 800°C, which is far lower that zirconia's melting point of 2750°C. The researchers are hoping that new information on the microstructure study on YSZ will lead to improved coatings for engines.

For more information, contact Emil Venere, NIST, Gaithersburg, MD 20899 USA; Tel: 301 975 5745; Electronic mail: emil.venere@nist.gov; Web site: www.nist.gov. ▲

1999 Supporters

Since the June issue of the RIC News went to press, we have received support from one new family members and renewed support from 31 other organizations.

The supporters from the fourth quarter of the 1999 fiscal year who wish to be listed, grouped according to their appropriate category, and with the number of years that they have contributed to RIC in parenthesis, are listed in the next column.

Benefactor ($10,000 or more)

Donor ($4000 to $9999)

Sponsor ($2000 to $3999)

CERAC, Inc., USA (24)
Osram Sylvania Inc., USA (27)
The Chinese Society of Rare Earth, PRC (15)

Patron ($1000 to $1999)

Sustaining ($400 to $999)

Atlantic Metals & Alloys Inc., USA (11)
CSIRO, Division of Telecommunications and Industrial Physics, Australia (13)
Dexter Magnetic Materials Division, USA (14)
GFS Chemicals, Inc., USA (7)
Nippon Yttrium Co., Ltd., Japan (21)
Sumikin Molycorp, Inc., Japan (7)
Ugimag, Inc., USA (12)
Vacuumschmelze GmbH, Germany (16)
Wheeler Associates, USA (14)

Contributor (less than $400)

Crumax Magnetics, Inc., USA (26)
CTI, Inc., USA (4)
Engelhard Corporation, USA (3)
Ferro Corp., USA (24)
Ford Research Lab, USA (13)
Dr. Ekkehard Greinacher, Germany (8)
Join-Line Industries Inc., PRC (1)
Korea Institute of Science and Technology, Korea (2)
Magnetfabrik Schramberg GmbH and Company, Germany (7)
Noah Technologies Corp., USA (7)
Office of Atomic Energy for Peace, Thailand (10)
Stanford Materials Company, USA (5)
Symyx Technologies, USA (3)
Tianjiao International Inc., USA (14)

Individual

Tadaaki Amano, Japan (5)
Joseph Budnick, USA (2)
Keith W. Forsyth, USA (6)
Laura H. Greene, USA (3)
J. J. Lin, USA (5)
W. A. Otis, USA (13)

RIC News

Vol. XXXIV, No. 3 September 1, 1999

Published quarterly in March, June, September, and December by Rare-earth Information Center a Unit of the Center for Rare Earths and Magnetics, 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
Facsimile: 515 294 3709
INTERNET: ric@ameslab.gov
http://www.external.ameslab.gov/ric/

R.William McCallum .... Editor
Karl A. Gschneidner, Jr. Editor Emeritus
Joel Calhoun .... Writer

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