Rare-earth Information Center NEWS

Center for Rare Earths and Magnetics
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Ferromagnet with No Net Magnetic Moment

Our concepts of magnetic order start out fairly simple. If the atomic moments are aligned parallel, it is a ferromagnet; if they are all equal, and aligned in some sort of anti-parallel pairing, it is an antiferromagnet. If there are two different sublattices with different net moments, which are aligned antiparallel, we have a ferrimagnet.

This last case is interesting because the two sublattices may have different temperature dependencies. As a result, there is the possibility of a compensation point, a temperature where the magnitudes of the magnetizations of the two lattices are equal, resulting in zero net magnetization. Compensation points are quite useful in such applications as magneto-optical recording.

Early on in our study of magnetism, we learned that the atomic moment results from unpaired electrons, which have both spin and orbital moments. In transition elements, the orbital moment is usually quenched by interactions with the lattice, but in the rare earth elements, the 4-f electrons are shielded from the lattice. There is some crystal field splitting of the 4-f levels, but the total moment of the ground state, J, is given by Hund's rule, which states that J =L-S for the light rare earths and J=L+S for the heavies, where L is the orbital moment and S is the spin.

This picture plays an important role in the magnetization of rare earth intermetallics. The coupling of a rare earth spin to a transition element spin is antiferromagnetic and thus, in order to have a ferromagnet, we must have a light rare earth coupled to the transition element so that the total moment, J, of the rare earth is parallel to the spin of the transition element. (This is fortunate since it means that the best permanent magnets are Nd-Fe-B not Er or Tb-Fe-B. Since the light rare earths are much more abundant, they are also much cheaper so we can afford to use them.)

If we think about a ferromagnetic light rare earth transition metal intermetallic, such as $REAl_2$, the rare earths couple indirectly through the conduction electrons. We might hypothesize that we have magnetic lattices, a spin lattice and a lattice of orbital moments, which are coupled antiferromagnetically, a sort of a self-ferrimagnet. Generally, we do not think of rare earths in these terms because L and S are tightly coupled, and J is a good quantum number. However for Sm^{3+}, the spacing of the J multiplets is small enough that the states are mixed, and L and S may have different temperature dependencies. If the size of the two moments is comparable, it should be possible to have a compensation point, however, no compensation point has been observed for Sm compounds.

Recently, H. Adachi and H. Ino {*Nature*, **104**, 148-60 (1999)} have adjusted the relative magnetizations of the spin and angular moment lattices by substituting a small amount of Gd for Sm in $SmAl_2$. Gd has a pure spin moment, which appears to follow the temperature dependence of the Sm spins. The Sm orbital moment has a different temperature dependence. The result is a compensation point in a material that is ferromagnetically ordered on the atomic scale, a ferromagnet with no net magnetic moment. ▲

The RIC Database in Transition

Well before the arrival of the personnel computer, the RIC began collecting and cataloging technical and scientific articles on rare earth materials. The database originally ran on the Iowa State University mainframe computer and the database program was written at Ames Laboratory in PL1.

Over the years the database has migrated from the mainframe to the Ames Laboratory VAX cluster and then to a VAX station. Each time the database program was recompiled but the structure of the database remained unchanged. Now for the first time the structure is changing drastically. While this has been planned for some time, it is being accelerated by changes in the Laboratory computing environment.

By the time you read this, the VAX Station will be shut down and database searches are being conducted using Access. This however is only a temporary solution as Access is not particularly friendly for remote users. This fall the database will be migrated to a structured query language database on a Windows NT server.

After we are satisfied with the performance of the new database, RIC supporters will have the option of accessing the database directly via the web or continuing to rely on the RIC staff. In the mean time, if you request a search you will receive a search like the one pictured in the Search of the Month, on page 7. ▲

In This Issue:

In Memory of Melissa Charalambous

Melissa Charalambous, whose experimental work led to several discoveries in the field of superconductors, died on May 17, 1999, in Athens, Greece.

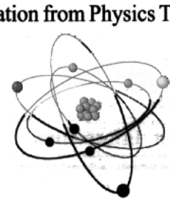
Melissa was an active young scientist on the staff of the National Center of Scientific Research (CNRS) and working at the Centre de Recherches sur les Très Basses Températures (CRTBT) at the time of her death. Her research involved careful investigation of the heat of fusion of the vortex lattice and characteristics of the specific heat curve of pure YBaCuO single crystals. She was involved in supervising students and post-docs, and she also created networks of collaborators in Grenoble, the US, Canada, and several other European countries. She was aware of the need for links between research and industry, and worked to develop those relationships as well.

Among her scientific accomplishments was the development of a new three-dimensional lithography technique that facilitated transport measurements in the study of the melting of the vortex lattice of YBaCuO

Melissa was born April 26, 1965, in Geneva, Switzerland. She completed the equivalent of a master's degree in physics in 1988 at the University of Grenoble. She then studied at the CRTBT for her Ph.D., which she completed in 1992. She held a post-doc position at IBM Corp's Thomas J. Watson Research Center in Yorktown, New York, form 1992 to 1994, when she joined the CNRS.

She was enthusiastic, and the quality of her research brought invitations to conferences, where her power to convince was evident to her audiences. She was an example to all her colleagues at CRTBT and to all who knew her through the scientific community.

— information from Physics Today 52 [11] ▲



Conference Calendar

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

August '00

The 11th Magnetic Recording Conference (TMRC 2000)
Santa Clara, California, USA
August 14-16, 2000
*This issue

Seventh International Symposium on Magnetic Bearings
Zurich, Switzerland
August 23-25, 2000
RIC News **XXXV**, [1] 3 (2000)

September '00

ICFE'4
Madrid, Spain
September 17 – 21, 2000
RIC News **XXXV**, [1] 3 (2000)

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

January '01

The 8th joint Magnetism and Magnetic Materials (MMM)-Intermag Conference
San Antonio, Texas, USA
January 8-11, 2001
*This issue

May '01

The Third International Conference on Hydrogen Treatment of Materials (HTM-2001)
Donetsk, Ukraine
May 14-17, 2001
*This issue

June '01

The 4th International Conference on Rare Earth Development & Applications (ICRE-2001)
Beijing, China
June 15-20, 2001
*This issue

September '01

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

July '02

The 23rd Rare Earth Research Conference
Davis, California, USA
July 13-18, 2002
*This issue

"*This issue" denotes a news story for this conference is in this issue

E. Joel Calhoun, Cattle Rancher

For the past decade, Joel Calhoun has served the rare earth community through the *Rare-earth Information Center*. While most of you never met Joel, he has been the friendly, knowledgeable voice on the phone, who delivered expert help in formulating database searches and rapid service in supplying the results. Joel has also written the vast majority of the articles in the *RIC News*.

Unfortunately, Joel has left the RIC for greener pastures; at least they are greener when it rains in western Nebraska. Joel is moving his family to the northwest corner of Nebraska where he and his wife are taking over her family's cattle ranch. Joel assures us here at the RIC that he will not be riding a horse and packing a six-gun, but he will be a cowboy on a four-wheel ATV. ▲

Magnetic Float Polishing

An interesting method of polishing ceramic spheres, using CeO_2 and Nd-Fe-B magnets, has been developed at Oklahoma State University. The method was developed for Si_3N_4, which is the material of choice for ceramic bearings because of its high toughness.

Since surface defects result in fatigue failure, surface imperfections must be minimized. Conventional polishing methods require long times, high loads, and expensive diamond abrasives. The new magnetic float polishing method uses CeO_2, which is much closer in hardness to the Si_3N_4, and which minimizes damage during the initial stages of polishing and high material removal rates.

The process uses a magnetic fluid, presumably a commercial suspension of submicron particles in oil. The abrasive, in this case CeO_2, is added to the magnetic fluid. A non-magnetic float pushes the balls to be polished into the fluid. When an appropriate magnetic field is applied, the magnetic particles in the fluid are drawn into the field, displacing the abrasive up against the balls with a uniform low pressure.

Since the pressure is low, the float can be rotated at relatively high speeds, 1000-10,000 rpm. This enhanced polishing rate gives reduced polishing times of 16-20h, which makes one wonder how long the conventional method takes {*MRS Bull.*, **25**, [4], 20-1 (2000)}. ▲

CeO_2 on (001) Ge

Much of life, as we currently know it is dependent on metal-oxide-semiconductor structures that make possible most of our microelectronics. Given the number of semiconductor-oxide-metal combinations, one might ask why the vast majority of electronics is based on Si/SiO_2 junctions. The answer lies in the fact that a well defined, read almost atomically flat, interfaces between the semiconductor and the oxide are required.

Ge and SiGe alloys have attractive properties as semiconductors, but the native Ge oxides are not suitable for device applications. On the other hand, it is extremely hard to produce a non-native oxide layer on Ge without an underlying GeO_2 layer. Recently, D. P. Norton et al. {*Appl. Phys. Lett.*, **76**, [13], 1677-9 (2000)} have achieved just that, using pulsed laser deposition of CeO_2. Since the CeO_2 is much more stable than the GeO_2, the oxygen does not diffuse into the Ge layer.

This is, however, only half the problem since the vacuum requirements to keep a Ge surface from oxidizing are extremely high. However, the extreme stability of the CeO_2 makes it possible to perform the deposition under a partial pressure of H_2 at elevated temperatures where the GeO_2 is not stable. The resulting interface is atomically abrupt. ▲

Lucent Awarded Y-123 Patent

Lucent Technologies was recently awarded the basic material patent for Yttrium-123, for work conducted at Bell Labs (formerly AT&T Bell Labs) in 1987. Other contenders for the patent included IBM and the Naval Research Laboratory. The award ended one of the longest standing patent interferences in US history.

In March of 1987, four entities applied for patents on Y-123 (Y1B2Cu3Ox, or YBCO) almost simultaneously. The University of Houston was eliminated early on for not being able to meet the "count." In this case, the material needed to be 90% pure and superconducting above 70K. After a series of investigations, a tie was declared between IBM and Bell Labs. Bell Labs won the patent because they filed their application before IBM.

The awarding of the patent has no immediate financial benefits, however, as industrial applications have yet to be developed. IBM still has the option to patent the oxygen process used to make Y-123, as they included this information in their patent application, while Bell Labs did not. ▲

Yellow or Orange Emission from GaN

GaN is being investigated as a host material for RE-based electroluminescent devices (ELD) {*Appl. Phys. Lett.*, **76**, [12], 1525-7 (2000)}. In situ doped GaN:RE ELDS have exhibited emission in the three primary colors: green (Er^{3+}), red (Eu^{3+}, Pr^{3+}), and blue (Tm^{3+}).

Now a single ELD has been fabricated from GaN thin films codoped with Er and Eu, which emits both yellow and green light that results from the green emission from Er and red from Eu. The color of the emissions varies from orange to yellow as the bias voltage is increased from 70 to 100 volts. Interestingly, color on increasing voltage is different from that observed when the voltage is decreased. ▲

Hydrogen Sensor Based on SnO_2:La_2O_3

Solid state gas sensors are of considerable interest for applications in process control, environmental monitoring and safety. Semiconductor devices exhibit a change in electrical conductivity when exposed to various gases, and the challenge is to make gas specific sensors.

When SnO2 is exposed to oxygen, the resulting chemisorbed oxygen layer creates a layer with high electrical resistivity. If the chemisorbed oxygen is removed by a reducing gas, the resistivity decreases in a manner that be calibrated to yield the concentration of the reducing gas. Thus, the detection of H is rather simple.

However, pure SnO2 is not gas specific, any reducing gas will have a similar effect. A considerable amount of research has been directed at finding dopants, which enhance the sensitivity to one specific gas while reducing the sensitivity to others. The addition of La2O3 to SnO2 has been shown to be advantageous in this respect {*J. Electrochem. Soc.*, **147**, [1], 390-3 (2000)}.

The La2O3 is believed to be important, both in the chemistry and microstructure of the sensor. The La2O3 prevents grain growth at elevated temperature, stabilizing the surface area of the sensor while at the same time it stabilizes the surface oxygen sites. The addition of Pd to the sensor is thought to produce a catalytic effect for the oxidation of H2. A SnO2 sensor made with 2 wt% La2O3 and 0.5 wt% Pd can detect 1000 ppm H2 in air at room temperature. ▲

Oxide-ion Conductors

Oxide-ion conductors are typically materials in which there are distinct anion and cation sites. If the ratio of anion to cation sites in the crystal lattice is not matched to the ratio of the valences of the two ions, the charge is balanced by vacancies on one of the sites. In this case, oxygen ions can diffuse from an occupied site to a crystallographically equivalent vacant site by overcoming a small energy barrier.

Unfortunately, the thermal energy required to overcome even a small energy barrier corresponds to a relatively high temperature. Thus, solid oxide fuel cells, oxygen sensors, etc. must operate at relatively high temperatures. Naturally, there is considerable interest in finding new oxide conductors.

Recently, a new structural family has been observed to exhibit fast oxide-ion conduction above 580°C {*Nature*, **404**, 856-8 (2000)}. The material is based on $La_2Mo_2O_9$, which is a low symmetry phase, and is postulated to be monoclinic. While there is significant ion conductivity at 400°C, above a crystallographic phase transition at 580°C, the conductivity increases almost two orders of magnitude. Of, perhaps, more general interest than the paper itself, is the commentary on the paper by J. B. Goodenough {*Nature*, **404**, 823 (2000)}, which provides a precise overview of oxide conductors. ▲

The 8th Joint MMM-Intermag Conference

The 8th Joint MMM-Intermag Conference will be held January 8-11, 2001, in San Antonio, Texas, USA. Members of the international scientific and engineering communities interested in recent developments in magnetism and associated technologies are invited to attend the Conference and contribute to its technical sessions.

This Conference will include all basic and applied science and technology related to the field of magnetism. The technical subject categories for the Conference are: fundamental properties and cooperative phenomena, transport properties, computational magnetics and imaging, soft magnetic materials and applications, hard magnetic materials and applications, artificially structured materials, other magnetic materials, magnetic recording, and applications and interdisciplinary topics. A feature of the conference will be the 2001 MMM Student Award for "Best Paper" presented at the Conference by a student completing his or her Ph.D.

Abstracts must be submitted online at http://www.aip.org/cgi-bin/mmm/startmmm using the password magnet00 by the submission deadline of July 19, 2000. For more information, the AIP Coordinator, Janis Bennett, can be contacted by e-mail at magnet@aip.org. Tel: 631-576-2403 Fax: 631-576-2223. ▲

23rd Rare Earth Research Conference

The 23rd Rare Earth Research Conference will be held July 13-18, 2002, at the University of California, Davis, California, USA. The Conference will be held at the University of California, Davis. Set between the Coast Range to the west and the towering Sierra Nevada to the east in the heart of the Central Valley, UC Davis is close to California's state capital and the San Francisco Bay Area.

The program of the 23rd Rare Earth Research Conference (RERC) will integrate both basic and applied multidisciplinary research that is centered on the f-elements. Forefront results will be featured in the form of invited oral talks or contributed posters on topics in chemistry, physics, and material, earth, environmental, and biological sciences. Highlighting the program will be the presentation of the Frank H. Spedding Award for excellence in rare earth research.

For more information, contact Susan M. Kauzlarich, Department of Chemistry, University of California, One Shields Ave., Davis, CA 95616. Tel: 530-752-4756; Fax: 530-752-8995; smkauzlarich@ucdavis.edu. ▲

11th Magnetic Recording Conference (TMRC 2000)

The 11th Magnetic Recording Conference (TMRC 2000) will be held August 14-16, 2000, in Santa Clara, California, USA. TMRC 2000 will be using the campus facilities of Santa Clara University. The Santa Clara Valley has many recreational and cultural attractions. Also known as Silicon Valley, it is home to a large number of high technology companies.

The topic of this year's conference will be magnetic recording systems. In addition to traditional topics such as channel characterization, equalization, detection, and timing recovery, special focus will be given to topics of current interest including iterative decoding, high data rate issues, and alternatives to longitudinal recording such as perpendicular and optical.

For more information, visit http://www.iist.scu.edu on the World Wide Web, or contact anyone on the conference steering committee, as listed at that address. ▲

Modern Trends in Magnetostriction

A NATO Advanced Study Institute (ASI), "Modern Trends in Magnetostriction Study and Application" was held in May in Kiev, Ukraine. The location reflects the NATO effort to hold these institutes in the NATO partner countries. While the ASI covered a wide range of materials, there was considerable discussion of rare earth based thin films and multilayers.

Typical applications for such films are those proposed in the area of microelectricomechanical systems (MEMS) where small pumps, valves, and other active parts are machined out of Si, using etching techniques. While there has been considerable interest in MEMS, at the current time it seems to be a technology in search of an application.

Other talks focused on rare earth manganites, which, in addition to magnetostriction, exhibit colossal magnetoresistance. In some of these materials, there is an interesting transition from a high volume paramagnetic insulator to a low volume ferromagnetic metal. The proceedings of the institute will be published in the NATO Science Series. ▲

Two New NeoEnergy Products from Magnequench

Two new permanent magnet products, NeoEnergy 13-9 Isotropic Powder and NeoEnergy 15-7 Isotropic Powder, are now available from Magnequench. Magnequench is a producer of neodymium magnetic materials that provide magnetic energy for products in global markets including automotive, computer and office automation, consumer electronics, household appliances, and factory automation/industrial applications.

NeoEnergy 13-9 Isotropic Powder is a high-energy Neodymium magnetic material used for developing new applications that previously were too economically costly. This material can be used in applications for products that range from DVD players to electrical fuel pumps to hand-held power tools, and in the automotive, consumer electronics, appliance, medical, and factory automation industries.

NeoEnergy 13-9 has a lower coercivity [Hci] and energy product [(BH)max] compared to other NeoEnergy powders, but does have moderate magnetization requirements. This material is appropriate for multi-pole stepper and spindle motors for a wide-array of applications.

NeoEnergy 15-7 Isotropic Powder is a high-energy material especially developed for injection-molding processes that allow the creation of intricate magnetic subassemblies, often eliminating steps in the manufacturing or assembly process.

NeoEnergy 15-7 is a lower coercivity material that yields a higher saturation level at a lower magnetizing field. It is appropriate for multi-pole applications where high magnetizing fields can not be achieved with standard magnetizing instruments. This energy benefits inserted permanent magnet applications, as injection-molded inserts can typically be provided at a much lower cost than sintered magnets that often require secondary grinding or finishing processes.

Magnequench is headquartered in Anderson, Indiana, USA, and currently supplies its NeoEnergy powder products to companies in the North American, Asia-Pacific, and European markets. Additional information about Magnequench and its global end-to-end magnetic solutions can be found by accessing the Magnequench World Wide Web site at www.magnequench.com or by calling 888-335-0258 in the USA or 1-765-648-5000 from international locations. ▲

Consultants Corner

To appear in our Consultants Corner, any individual, company, or group must be involved in are earth or rare-earth-related consulting activities. Just send us the appropriate information: contact name, company name, mailing address, Tel/Fax number(s), email, web address and areas of expertise.

- **Applied Logic Engineering, Inc.:** Gerald Peterson, 3630 Tryclan Drive, Charlotte, NC 28217, Tel: 704 525-2523; Fax: 704 525-2503; geraldpeterson@juno.com, **http://www.Applied–Logic.com** ▲ injection molding, compression molding, and compounding of rare earth magnets.

- **Austrian Research Centers:** Boro Djuricic, Ph.D., A-2444 Seibersdorf, Austria, Tel: 43 2254 780 2737; Fax: 43 2254 780 3344; **boro.djuricic@arcs.ac.at** ▲ the synthesis of ceramic powders, particularly for motor vehicle pollution control, and other applications.

- **Industrial Minerals Research:** Charles Houssa, Principal Analyst, 16, Lower Marsh, London SE1 7RJ, United Kingdom; Tel: 44 20 7827 6475; Fax: 44 20 7827 6441; **cehoussa@metalbulletin.plc.uk**, IMR@metalbulletin.plc.uk, **http://www.mineralnet.co.uk** ▲ marketing studies for rare earths and their markets ranging from general market overview to detailed market penetration studies.

- **Institute of Low Temperature Physics and Engineering**, National Academy of Sciences of Ukraine: Anatoly B. Beznosov, 47 Lenin Avenue, Kharkov 61164, Ukraine; Tel: 38 0572-308503; Fax: 38 0572-335593; **beznosov@ilt.kharkov.ua** ▲ physical properties [magnetic, (magneto)elastic, (magneto)transport, (magneto)optical] and their relation to electronic structure of rare earth alloys and compounds, including high temperature superconductors and giant magneto-resistance systems.

- **Shanghai Iron & Steel Research Institute:** Huang Gangxiang, 1001 Taihe Road, Wusong, BaoShan district, Shanghai, 200940, China; Tel: 86-21-56840123-2262; Fax: 86-21-56424627; **gxhuang@online.sh.cn**, **www.tradezone.com/tradesites/sisri/html** ▲ Advanced Metal and Alloy Analysis Center can offer analysis of rare-earth metal and alloy composition, measuring mechanical and physical properties failure analysis and evaluation for parts and their service life of any kinds of engineering alloy contained rare-earth metals.

- **Tata Research Development & Design Centre:** Dr. Pradip, 54B, Hadapsar Industrial Estate, Pune 411 013, India; Tel: 91-20-687-1058; Fax: 91-20-681-0921; **pradip@pune.tcs.co.in**, **http://www.pune.tcs.co.in** ▲ Minerals and materials processing related to rare earths. Development of flowsheets as well as optimization of operation of plants treating rare-earth containing ores, selective separation of rare-earths, including solvent separation, and powder metallurgy related to processing of rare earth powders, including fine grinding. Reagents design for rare earth processing, mathematical modeling of unit operations in rare-earth processing.

The Third International Conference on Hydrogen Treatment of Materials (HTM-2001)

The Third International Conference on Hydrogen Treatment of Materials will be held May 14-17, 2001 in Donetsk, Ukraine and will focus on the materials-hydrogen problems that are most important for today's hydrogen industries, and for successful development of hydrogen economy in the 21st century.

Of particular interest to the rare earth community are sessions on intermetallic materials containing rare-earth metals and the usage of rare-earth alloying elements in steels for preventing their hydrogen degradation in various industries. The former includes $LaNi_5$ - for hydrogen storage; $SmCo_2$, $PrCo_2$, Y_2Al - suitable for hydrogen amorphisation technologies; $Nd_2Fe_{14}B$, Sm_2Co_{17}, Sm_2Fe_{17}, $SmCo_5$, $TbFe_2$ - hard magnetic materials of the type suitable for HD- and HDDR-processes, while the latter includes chemical, petrochemical, electrochemical, metallurgical, machine engineering, aviation and space industries; natural gas pipe-lines; nuclear energy; fusion; hydrogen energy equipment and technologies. The program will also cover all the fundamental topics of hydrogen treatment of materials as a new field of Materials Science and Engineering.

For more information contact: Professor Victor A. Goltsov, Chairman of HTM-2001, Donetsk State Technical University, 58 Artyoma Street, Donetsk 83000, Ukraine. Tel.: 38 0622 936141; Fax: 38 0622 921278; e-mail: Goltsov@physics.dgtu.donetsk.ua. ▲

Two-color Holographic Recording

Holographic recording is believed to be capable of high storage densities, short access times and high transfer rates. The general process consists of exciting electrons from their ionic ground states into traps elsewhere in the material. This results in a change in the optical absorption properties of the material.

A major problem with this process is that, in general, the process of measuring the absorption characteristics frees the electrons from their traps, and they then decay back to the ground state resulting in a destructive read. Ideally, one would read with a photon energy, which is not sufficient to free the electrons from their traps, but in a two-level system, this is thermodynamically impossible since the trap would then be the ground state.

M. Lee et al. {*Appl. Phys. Lett.*, **76**, [13], 1653-5 (2000)} have recently demonstrated nonvolatile two-color holographic recording in Tb-doped LiNbO3. This is possible because the system is a three-level system. In this scheme, there are two traps with differing stabilities: a shallow trap and a deep trap. The shallow trap may be depopulated by thermal energy in a relatively short time, decaying back to the ground state while the deep trap requires a photon.

The excitation energy to excite an electron into the shallow trap is less than that required to excite an electron into the deep trap. In the write process, the electron is excited to the shallow trap by one photon, and then before it can decay to the ground state, it is excited into the deep trap. This changes the absorption at the photon energy required to excite into the shallow trap, but measuring this absorption does not free electrons from the shallow traps. ▲

4th International Conference on Rare Earth Development & Applications (ICRE-2001)

ICRE is a series international rare earth conference organized by the Chinese Society of Rare Earths (CSRE). The 4th International Conference on Rare Earth Development and Applications (ICRE-2001) will be held in Beijing, China, on June 15-20, 2001. The conference will be a forum for rare earth scientists, engineers, producers, business executives, managers, and consumers to learn and exchange new research results, new ideas, market information, and to find new opportunities for R&D programs, cooperation, and trade.

In addition to the plenary sessions that will be highlighted by keynote speakers in the fields of rare earth research, applications, and markets, three parallel sections will be held, covering all areas of basic and applied sciences related to rare earth materials. Specific topics include: rare earth new materials and applications; high Tc superconductivity; hydrogen storage materials; luminescence, phosphors, and lasers; rare earth chemistry; rare earth applications in agriculture and medicine; rare earth catalytic materials; electronic structure and spectroscopy; rare earth resources and metallurgy; rare earth separation; mathematical modeling; extraction mechanisms; process engineering; on-line analysis and automatic control; hydrometallurgy; preparation of metals, alloys, and high purity compounds; geochemistry and ore dressing; and environmental protection.

For information on deadlines, registration, exhibitions and sponsorships, hotels and accommodations, or for other information, please contact Mr. Jingkao Niu or Mr. Zhanheng Chen, The Conference Secretariat, 76, Xue Yuan Nan Lu, Beijing 100081, China; Tel: 86-10-6218 2748; Fax: 86-10-6217 3501; CRSE@263.net. ▲

Santoku America, Inc.

Santoku America, Inc., having purchased Rhodia's rare earth alloy manufacturing plant in Phoenix, is closing its Chicago office and consolidating all activities in Phoenix.

The new address is Santoku America, Inc., 8220 West Harrison Street, Phoenix, AZ 85043, Telephone: 623-936-1481, Fax: 623-936-3614 ▲.

RIC Has New Communications Specialist

Angela O'Connor has joined the RIC as its new Communications Specialist. She has taken over for Joel Calhoun, who left the RIC earlier this year (see related story, this issue).

Angela earned her B.S. in Ceramic Engineering in 1999. As an undergraduate student, she worked at Ames Lab preparing rare-earth superconductor research samples. She is currently in the middle of working on a Master of Science in Materials Science, for which she is working with rare-earth metallic glasses. She also has degrees in music and accounting. When not at the RIC, or playing her French horn in local music groups, Angela spends time at home with her husband and son in Fort Dodge, Iowa.

Angela looks forward to working with everyone at the RIC, and hopes she will have the chance to meet, talk, or exchange e-mail with many of you. ▲

Energen, Inc. Receives Contract for Continued SRF Tuner Development

Energen, Inc. has received a Phase II contract under the SBIR program from the U. S. Department of energy to continue the development of tuners for superconducting radio frequency (SRF) cavities at the Thomas Jefferson National Accelerator Facility (JLAB). SRF cavities are at the heart of particle accelerators and similar devices. Under this two-year, $750,000 contract, the company will continue development beyond two prototype tuners previously delivered to Jefferson Laboratory.

JLAB's primary mission is unclassified research on subatomic particle. Having designed and operated their own particle accelerators and free electron lasers, JLAB is responsible for many design concepts incorporated into particle accelerators.

Energen develops, manufactures, and markets precision actuators for precision positioning, robotics, and active vibration control based on magnetic smart materials technology.

For more information contact: Chad H. Joshi, President, e-mail: energen@energeninc.com, Tel: 978-671-5400, or on the web at http://www.energeninc.com. ▲

Update on *High T_c Update*

The High T_c Superconductivity Information Center has ended its publication of *High T_c Update* after a successful 13-year run. The *High T_c Update* was a tool to assist in the dissemination of information on high-temperature superconductivity research and was an answer to the large amount of research conducted in this area beginning in the late 1980s.

Credit for the success of *High T_c Update* goes to its science editor, John Clem, and to Sreeparna Mitra, the High Tc Superconductivity Information Center's project director.

Support from the International Institute for Theoretical and Applied Physics and other federal and private sources will allow the service to be continued on the World Wide Web. The High Tc Update Web site can be visited at http://www.iitap.iastate.edu/htcu. ▲

Search of the Month/RIC Database

Ric Database Report

keywords (ND,AL,FE) ***AND*** ***keywords*** 1997
or (ND,AL,CO) ***or***

Document Number	***Article***
199712890	INOUE;A; ZHANG;T; TAKEUCHI;A; ——Hard magnetic bulk amorphous alloys ——IEEE Trans. Magn., 33, [5], 3814-6 (1997) ——1997 AMORPHOUS ALLOY (ND,AL,FE) (PR,AL,FE) COMPOSITION (ND,FE)90AL10 (PR,FE)90AL10 COERCIVITY CURIE-TEMP T>500 REMANENCE MAG-PROP MORPHOLOGY MICROGRAPH SAED THICKNESS MELT-SPUN
199722710	VANDORMAEL;D; GRANDJEAN;F; BRIOIS;V; MIDDLETON;DP; BUSCHOW;KHJ; LONG;GJ; ——X-ray-absorption spectral study of the R2Fe(17-x)M(x) solid solutions (R = Ce, Nd and M = Al, Si) ——Phys. Rev. B, 56, [10], 6100-6 (1997) ——1997 R2FE17AL R2(AL,FE)17 CE2FE17AL CE2(AL,FE)17 ND2FE17AL ND2(AL,FE)17 SOLID-SOLUTION (ND,AL,FE) (CE,AL,FE) (CE,FE,SI) (ND,FE,SI) ND2(FE,SI)17 CE2(FE,SI)17 X-RAY ABSORPTION SPECTRA XANES
199726570	JONEN;S; RECHENBERG;HR; ——Metamagnetic transition in Nd6Fe(14-x)Al(x) compounds ——J. Appl. Phys., 81, [8], 4054-6 (1997) ——1997 METAMAG-TRANS ND6(AL,FE)14 MAG-FIELD TEMP-DEPENDENC MAGNETIZATION LATTICE-CONST NEEL-TEMP ND6FE10AL4 (ND,AL,FE)
199730540	INOUE;A; ZHANG;T; ——Thermal stability and glass-forming ability of amorphous Nd-Al-TM (TM = Fe, Co, Ni or Cu) alloys ——Mater. Sci. Eng. A, 226-228, 393-6 (1997) ——1997 THERMAL-STABIL (ND,AL,CO) (ND,AL,CU) (ND,AL,NI) (ND,AL,FE) ND70AL10FE20 AMORPHOUS GLASS CRYSTALLIZATIO CASTING
199730540	INOUE;A; ZHANG;T; ——Thermal stability and glass-forming ability of amorphous Nd-Al-TM (TM = Fe, Co, Ni or Cu) alloys ——Mater. Sci. Eng. A, 226-228, 393-6 (1997) ——1997 THERMAL-STABIL (ND,AL,CO) (ND,AL,CU) (ND,AL,NI) (ND,AL,FE) ND70AL10FE20 AMORPHOUS GLASS CRYSTALLIZATIO CASTING
199730560	INOUE;A; ——Bulk amorphous alloys with soft and hard magnetic properties ——Mater. Sci. Eng. A, 226-228, 357-63 (1997) ——1997 MAG-PROP AMORPHOUS ALLOY ND-COMPOUNDS MAG-FIELD (ND,AL,FE) DSC-ANALYSIS (ALBCFEGAPSI) SILICIDE

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The search above satisfies a search for references on the (ND,FE,Al) **OR** (ND,FE,CO) systems **AND** published in 1997. Many more citations would have been referenced if more years had been included or if specific compounds/alloys were requested.

The new database report, which is provided when the search is purchased, includes the keywords used for the search and the bibliographical information of the reference, along with other keywords associated with the reference, for each of the references found. A preliminary search will list titles and keywords of the items that match the request.

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Separation of Rare-earth Elements a National Historic Chemical Landmark

The American Chemical Society designated the separation of rare-earth elements by Charles James a National Historic Chemical Landmark on October 29, 1999, as reported in C&EN, November 22, 1999, 77 [47]. The honor was bestowed during ceremonies at Conant Hall at the University of New Hampshire, Durham, where James conducted his separations work.

Despite his contributions, James is not well known today. He was born April 27, 1880, at Earls Barton near Northampton, England, studied with Sir William Ramsay at University College, London, and graduated from the Institute of Chemistry in 1904. He came to the U.S. in 1906 to work at the National Refining Co. as a chemist, but soon left to accept a position at New Hampshire College.

Charles James began devising novel fractional crystallization techniques for separating rare-earth elements beginning in 1906. The separation of rare-earth elements is not easy, and is made difficult by their electronic structure. The quest for successful separation took over 100 years to complete, and depended on fractional precipitation and separation techniques.

James made the road to success easier by publications of the details of his experiments with the preparation of many different salts of the rare earths, and his method was widely adopted by other scientists. His method involved the use of bromates and double magnesium nitrates for fractional crystallization, and he was able to separate large amounts of rare earths, often on the scale of one-kilogram amounts. His first success was with the separation of wha[t] was then considered ytterbium into what i[s] now known as ytterbium and lutetium, i[n] 1906-1907. His was the best availabl[e] method for rare-earth separation until th[e] 1940s and the advent of ion exchange. ▲

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Since the March issue of the RIC News, we have received support from three new family members and renewed support from 18 other organizations and individuals.

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