RARE-EARTH INFORMATION CENTER NEWS

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14th Rare Earth Research Conference

Less than a month from now many of you will be on your way to Fargo, North Dakota to participate in the Fourteenth Rare Earth Research Conference. A complete program has been arranged with both invited and contributed papers on the subjects of Spectroscopy, which includes luminescence, fluorescence, laser, Mössbauer and ESR; Metallurgy and Materials Preparation; Solution, Solvation and Analytical Chemistry; X-Ray and Neutron Diffraction; Transport and Thermal Properties; Hydrides; Magnetism; and Rare Earth Technology. The use of poster sessions has eliminated the need for concurrent oral sessions. The invited speakers and their topics are listed below.

W. E. Wallace, Plenary Address
F. Pobell, Spectroscopy
C. K. Jørgensen, Spectroscopy
K. A. Gschneidner, Jr., Metallurgy and Materials Preparation
G. R. Choppin, Solution, Solvation and Analytical Chemistry
E. Parthé, X-ray and Neutron Diffraction
E. F. Westrum, Jr., Transport and Thermal Properties
F. Hulliger, Hydrides
K. J. Strnat, Rare Earth Technology
F. Rothwarf, Rare Earth Technology
R. P. Turcotte, Rare Earth Technology
D. Givord, Magnetism

For those who have not yet registered there is still time. The $70 fee includes a copy of the proceedings, a ticket for the bison feed Tuesday evening and a ticket for the fish fry Wednesday evening. Of special note is the $10 registration fee for students (does not include a copy of the proceedings). Transportation will be provided from Fargo's Hector Airport to the conference site on the North Dakota State campus on Monday and back to the airport on Thursday.

Sooooo...if the creeks (Red River) don't rise (much further) we will see you all at Fargo!!

FIRST RARE EARTH PRIZE TO WALLACE

F. H. Spedding

W. E. Wallace

The selection committee has chosen to honor two outstanding rare earth scientists in the awarding of the first Rare Earth Prize at the opening of the Fourteenth Rare Earth Research Conference to be held June 25-28, 1979 at North Dakota State University, Fargo, North Dakota. The selection committee unanimously agreed that this honor should henceforth be called the "Frank H. Spedding Award." Citing Spedding's contributions of research and leadership in the rare earth field, the committee deemed his career, which has spanned over 50 years, to be the most outstanding model by which all others could be measured. Among his colleagues he is equally admired for the breadth of his scientific interest and wisdom, his unquenchable enthusiasm, his encouragement and friendly criticism, and for his dedication to science. Without his efforts, rare earth research, industry and technology could not have progressed to where they are today. Professor Spedding will be on hand to present the first Frank H. Spedding award to Professor W. E. Wallace of the University of Pittsburgh. Professor Wallace was chosen to be the first recipient of this award based on the testimony from many colleagues of international reputation of the many years of outstanding research and service he has given to the field of rare earth science and technology. The award cites his character, personality, sense of commitment, and intellect in providing both a model and a challenge to his students and colleagues alike. Immediately following the presentation at the opening session, Tuesday morning, Professor Wallace will give the plenary address.

Sm

1879

Samarium also claims 1879 as the year of its discovery which makes 1979 its 100th birthday. Like most of the rare earths, samarium's existence was suspected long before its actual discovery. In 1841 C. G. Mosander had treated lanthana with dilute nitric acid and separated a new rose-colored oxide which he named didymium. As early as 1853 J.-C. G. de Marignac believed that didymia was not a pure substance. Later spectroscopic studies of didymia by M. Delafontaine and L. de Boisbaudran showed a variation in the spectrum of didymia according to its source. In 1879 de Boisbaudran added ammonium hydroxide to didymia and observed a new oxide which precipitated before the didymia. De Boisbaudran observed that the spectrum of this new oxide was different from that of didymia and came to the conclusion that he had discovered a new element which he named samaria after a Russian mine official, Colonel M. Samarski.

LAST QUARTER

Contributions have been tallied for the 1979 fiscal year. With the receipt of contributions in the fourth quarter from the eight companies listed below, RIC ends out the year with a total of 46 benefactors, 44 sustaining members and two new companies. This year's total ties with last year's record total for the largest number of companies to come to the support of RIC. The number in parentheses indicates the number of years the company has contributed to the support of the Center.

Apache Chemicals, Inc., U.S.A. (3)
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Research Chemicals, U.S.A. (11)
Union Carbide Corporation, Linde Division, U.S.A. (3)

RE HANDBOOK

An attempt to combine and integrate as far as is practical the physics and chemistry of the rare earths has resulted in the publication of the first volume of a four-volume set entitled *Handbook on the Physics and Chemistry of the Rare Earths, Volume 1: Metals,* K. A. Gschneidner, Jr. and L. Eyring, eds., North Holland Publishing Co., Amsterdam (1978). The editors have invited experts in various areas to write comprehensive, broad, up-to-date and critical reviews. Volume 1 is concerned with the rare earth metals. Chapters and authors are listed below.

"Atomic properties (free atom)," Z. B. Goldschmidt
"Preparation and basic properties of the rare earth metals," B. J. Beaudry and K. A. Gschneidner, Jr.
"Electronic structure of rare earth metals," S. H. Liu
"Cerium," D. C. Koskenmaki and K. A. Gschneidner, Jr.
"Low temperature heat capacity of the rare earth metals," L. J. Sundstrom
"Magnetic and transport properties of the rare earths," K. A. McEwen
"Magnetic structures and inelastic neutron scattering: metals, alloys and compounds," S. K. Sinha
"Elastic and mechanical properties," T. E. Scott
"High pressure studies: metals, alloys and compounds," A. Jayaraman
"Superconductivity: metals, alloys and compounds," C. Probst and J. Wittig
"Kondo effect: alloys and compounds," M. B. Maple, L. E. DeLong and B. C. Sales
"Diffusion in rare earth metals," M. P. Dariel

Other features include the Prologue by F. H. Spedding, a list of contributors, and an extensive subject index. The book contains 894 pages and costs $130.00 (Dfl. 300). Subscription price is $112.50 (Dfl. 255).

Volume II, Alloys and Intermetallics is 620 pages in length, costs $85.00 (Dfl. 200) and is scheduled for publication later this year. Likewise, both *Volume III, Nonmetallic Compounds I* and *Volume IV, Nonmetallic Compounds II* are scheduled for publication this year

Re'ers Elected to NAE

Three rare earthers were among the 99 new United States members elected to the National Academy of Engineers (NAE) this year. They are H. G. Drickamer, University of Illinois, P. Duwez, California Institute of Technology, and J. A. Wernick, Bell Telephone Laboratories. Inclusion in this distinguished group is one of the highest forms of recognition accorded to American scientists and engineers.

Russian Books Acquired

Recently RIC has received several Russian volumes which include *Redkozemel'nye Poluprovodniki. Tekuschchaya Bibliograficheskaya Informatsiya 8* [*Rare Earth Semiconductors. Current Bibliographic Information, No. 8*], V. P. Zhuze, ed., Fiziko-Teknicheski Institut im. A. F. Ioffe, Akademii Nauk SSSR, Leningrad (1978), and also No. 9 which carries the same title, editor and publisher as No. 8. The eighth bibliography has 588 citations while the ninth has 646. References are printed in their original language and a brief subject index is included in each volume. Additionally we received *Redkozemel'nye Poluprovodniki* [*Rare Earth Semiconductors*], V. P. Zhuze and I. A. Smirnov, eds., Izdatel'stvo Nauka, Leningrad (1977). This book deals mainly with the semiconducting rare earth chalcogenides and oxychalcogenides.

The former costs $97.75 (Dfl. 220) and is 664 pages long while the latter costs $86.75 (Dfl. 195) and is 590 pages in length. Subscription prices for Volumes II, III and IV are $72.25 (Dfl. 170), $83.00 (Dfl. 187) and $73.75 (Dfl. 166), respectively. It is anticipated that this will become an open-ended set and that, subsequent to the release of Volume IV, supplements will be issued on a regular basis to keep the Handbook up-to-date.

For more information contact your bookseller or either of the following addresses.

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New York, NY 10017, U.S.A.

Award to Drickamer

Case Western Reserve University, Cleveland, has announced the presentation of the Michelson / Morley award for an outstanding achievement by a scientist or engineer to H. G. Drickamer. Currently a professor of chemical engineering at the University of Illinois, Urbana, Drickamer is also the chairman of the National Research Council committee on ultrahigh pressure technology. He is being cited for the development of high-pressure techniques for the study of electronic states, electronic transitions and chemical changes. His current research interests include high pressure luminescence studies on phosphors doped with rare earths.

$Cu + Gd_2O_3$

A high conductivity and high specific heat copper-7.2% Gd_2O_3 composite has been developed for cryogenic applications according to W. A. Steyert [*J. Appl. Phys.* **49,** 3612-3 (1978)]. The Gd_2O_3 is an undissolved inclusion and does not contribute to either the electrical or thermal conductivity of the copper, however, near 4 K the specific heat of the composite is about 60 times larger than that of pure copper due to magnetic ordering in Gd_2O_3. Inexpensive methods of fabricating wares with residual resistance ratios greater than 1000 are proposed.

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What's the Difference?

It is hard for the average person to imagine what the difference is between 1 million bubbles and 4 million bubbles. However researchers at Bell Laboratories and International Business Machines (IBM) do know what the difference is and each, using a different technique, has managed to place 4 million magnetic bubbles into one square centimeter of a rare earth garnet thin film [*C &EN* **57,** [13] 25 (1979)]. Bell Laboratories has accomplished this by placing a layer of aluminum / copper alloy over the europium garnet film and then etching holes in the 0.25 μm Al layer. When electric current moves through the Al layer and around the holes a local magnetic field is created which attracts the magnetic bubbles in the garnet film and allows them to move from hole to hole. Smaller magnetic bubbles can be used resulting in the increased storage capacity.

IBM has accomplished the same increased storage capacity by adding a second garnet layer which contains gadolinium, placing gold circuit patterns over this layer and then bombarding the device with helium atoms. The helium atoms destroy the ability of the gadolinium garnet film to form bubbles except where the gold pattern was since gold absorbs helium. When an external field is applied charged walls are formed in the Gd garnet according to the gold circuit pattern. The magnetic bubbles in the Eu garnet film are attracted to the charged walls and are carried along the circuit in this manner.

RE Screens Affect Balance of Payments?

"Yes!" says R. A. Wilson [*Am. J. Roentgenology* **131,** 926-7 (1978)]. In addition to reducing X-ray exposure to patients, the rare earth screens allow a reduction of the silver content in the film. In some cases this amounts to 23% less silver used. The author notes that in the light of reduced silver production (increased imports), the current balance of payments, the scarcity of silver and the relative abundance of the rare earths, there is more benefit to be gained in the use of rare earth X-ray screens than just the reduction of patient exposure.

New Materials Award

B. T. Matthias of Bell Laboratories and the University of California, San Diego has been named one of three co-recipients of the American Physical Society's International Prize for New Materials. The three are being cited "for the discovery of intermetallic compounds and alloys exhibiting unusually high superconducting transition temperatures and for their demonstration that these materials retain their superconductivity under conditions of high currents and fields, thereby opening up the practical application of superconductivity to electric power technology and the magnetic confinement of plasma in future thermonuclear fusion reactors."

Matthias joined Bell Laboratories in 1948 and the University of California in 1961. In 1971 he was named director of the Institute for Pure and Applied Physical Sciences of the University of California, San Diego. Current interests include work on superconducting materials, many of which contain rare earths, and the coexistence of superconductivity and ferromagnetism.

LUTETIUM DISPLAY

Lutetium, long portrayed as the densest rare earth with little or no hope of useful application, may beat some of the allegedly less-dense rare earths to the market place according to M. M. Nicholson and R. V. Galiardi [*Soc. for Information Display '78 Digest,* pp. 24-5]. A lutetium diphthalocyanine complex has been deposited as a film and then inserted into an electrochemical cell. When different voltages are applied the complex varies in color from deep blue and violet through several shades of green to orange and red. Writing and erasure in this system occur in less than 50 ms with low input voltage and switching energy. Other desirable properties of this complex include a non-volatile memory, wide viewing angle, and good appearance in both low ambient light levels and direct sunlight. A variety of alphanumeric and graphic displays are possible applications.

SMOOTH REs

G. P. Sharonov and V. I. Tsyptsin have examined the use of rare earth diheptylphosphinates as lubricating oil additives to accelerate break-in and improve the wear resistance of machine parts [*Khim. i Teknol. Topliv i Masel* **1978,** No. 1, 44-9; Eng. Transl.-*Chem. Tech. Fuels and Oils* **14,** 53-9, (1978)]. They found that when oil with the rare earth complex was used the initial break-in of the machine parts was at least three times faster than with regular oil additives, the machine parts showed only one-sixth as much wear, and that a greater load could be applied to moving parts before seizure occurred. In analyzing the break-in process the authors concluded that initially the friction causes a chemical change converting the rare earth complex to rare earth and iron phosphides which have low friction coefficients and form a film on the moving surfaces and thereby reduce friction. This results in an increase in the seizure load. The final chemical modification results when the rare earth and iron phosphides react to form a ferrite which has a garnet structure on the surface of the moving parts. The garnet material is harder than the original alloy and provides greater wear resistance.

Increasingly Attractive

D. T. Curry is talking about rare earth-cobalt permanent magnets but not just about their magnetic properties [*Machine Design* **50,** No. 20, 94-9 (1978)]. Because of innovations in both product design and material composition many companies are taking a much closer look at the rare earth permanent magnets. Line printers, motors, alternators, window lifts, agitators, torque devices, servosystems, traveling-wave tubes, and tachometers are a few of the applications that many companies have either already incorporated the rare earth magnets into or begun programs to study the possibility of substituting the rare earth magnets for what they presently use. Several companies are examining mischmetal-cobalt magnets in an attempt to add low cost to the list of advantages which already includes superior magnetic properties and both reduced weight and volume requirements.

POWDER PREPARATION

In a study to develop a simple and expedient technique for consistently producing sinterable powders of lanthanide, hafnium and zirconium oxides, S. L. Dole, R. W. Scheidecker, L. E. Shiers, M. F. Berard and O. Hunter, Jr. have developed a procedure to produce powders which yield nearly theoretically dense specimens [*Materials Sci. and Eng.* **32,** 277-81 (1978)]. Water removal from the hydroxide precursor was determined to be the critical step in producing highly sinterable powders. An acetone wash removed most of the water and this was followed by a toluene wash which forced the remaining free water from the material. A final acetone bath prepared the material for drying. Sintering tests on Gd_2O_3, Er_2O_3, Y_2O_3, Sc_2O_3, Eu_2O_3, and HfO_2 or ZrO_2 stabilized by Pr_2O_3, Er_2O_3, Eu_2O_3, Y_2O_3, Tb_2O_3, or Gd_2O_3 consistently resulted in densities of 99% theoretical density. This is an improvement of from 3 to 5% over the typical densities of powders dried from aqueous mediums.

COOL REVIEW

Hyperfine enhanced nuclear magnetic cooling is the subject of a review by K. Andres [*Cryogenics* **18,** 473-7 (1978)]. Following a brief history of the origin of nuclear magnetic cooling, the physical principles involved in obtaining sufficiently high magnetic fields for hyperfine enhanced nuclear magnetic cooling are outlined. Pertinent properties of the praseodymium compounds, PrBi, $PrTl_3$, $PrCu_6$, $PrCu_2$, $PrCu_5$, $PrPt_5$, $PrNi_5$ and $PrBe_{13}$, are listed in tabular form. Praseodymium intermetallic compounds have the advantage of needing smaller magnetic fields to obtain larger cooling entropies per unit volume than other candidates. The author concludes that temperatures in the area of 100 μK are feasible if a way is found to shorten thermal relaxation times or if a two-stage cooling scheme can be developed.

MOTHER KNOWS BEST

In this case, Mother Nature knows best according to A. E. Ringwood, S. E. Kesson, N. G. Ware, W. Hibberson and A. Major who have developed a material for storing radioactive nuclear reactor wastes based on minerals in which they occur naturally [*Nature* **278,** 219-23 (1979)]. Apart from the human element involved in the production of nuclear energy, the major concern at present is the disposal of the radioactive wastes (of which the rare earth elements constitute approximately 26.4 Mol. %) in such a fashion as to insure that the radioactive materials do not leave the disposal site. Concern has arisen recently because of the discovery that under certain conditions the currently used glass encasement devitrifies allowing the water-soluble elements to escape. The present authors did not originate the idea of storing radioactive wastes in crystalline material, however they have developed a mixture of only three minerals, hollandite, perovskite, and zirconolite, and a process for incorporating the wastes which is comparable in cost to the current methods. Leaching of samples under 500 atm. pressure and up to 900°C in both pure water and 10% NaCl solutions resulted in no degradation of the mineral and no loss of the radioactive wastes.

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