RARE-EARTH INFORMATION CENTER NEWS

ENERGY AND MINERAL RESOURCES RESEARCH INSTITUTE
IOWA STATE UNIVERSITY / AMES, IOWA

Volume XIV | September 1, 1979 | No. 3

14th RARE EARTH RESEARCH CONFERENCE

Incredible! Stupendous! Fantastic! Of course, we all know that these adjectives can be applied to any facet of rare earth research, but what brings them to mind at this time is the memory of the 14th Rare Earth Research Conference held June 25-28, 1979, on the campus of North Dakota State University in Fargo, North Dakota. Superb organization mixed liberally with hospitality and attention to details, e.g., fruit baskets in the rooms upon arrival, insured a relaxed atmosphere conducive to the exchange of ideas and information. The Conference attracted about 165 participants representing 18 countries including the United States. Some 30 students took advantage of the special registration fee—an encouraging sign for future rare earth research.

W. K. Zwicker (right) discussing laser materials during poster session.

About 150 papers were presented in both oral and poster sessions on the topics of spectroscopy (luminescence, fluorescence, laser, Mössbauer, 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 proceedings of the Conference will be edited by G. J. McCarthy, J. J. Rhyne, and H. B. Silber and published as a book entitled *The Rare Earths in Modern Science and Technology, Volume 2* by Plenum Publishing Corporation. Information concerning the publication of the proceedings will be announced in the *RIC News* as soon as this information becomes available. A list of the papers presented at the Conference is available from RIC upon request.

E. Parthé presenting paper on crystal chemistry of rare earth alloys.

As with previous conferences, this one generated several firsts, the most significant being the creation and presentation of the Frank H. Spedding Award. Emeritus Professor Spedding from Iowa State University was on hand to present the award to its first recipient, Professor W. E. Wallace of the University of Pittsburgh. In addition, it was decided to permanently incorporate the Rare Earth Research Conference and to change the frequency of the conference to every two years.

Speaking of the next conference, the chairman, approximate date and location of the 15th Rare Earth Research Conference are W. J. James, June 1981 and Rolla, Missouri, respectively.

And finally, as is evidenced by several of the photographs accompanying this story, rare earth conferences are not totally taken up

(continued on page 3)

$$ 1980 $$

As the rare earth scientific community plunges into the 1980's with its promise of new and exciting discoveries, the rare earth industrial community has made preparations to meet the new and increased demands for rare earth materials if the first-quarter response for fiscal year 1980 is any indication. So far twenty-six companies have responded with those who were able to increase their support outnumbering the others by four to one. First-quarter contributors are listed below. The number in parentheses is the number of years the company has supported the Center.

Brown, Boveri & Company, Limited, Switzerland (8)
CERAC, Incorporated, U.S.A. (4)
Davison Specialty Chemical Co., Subsidiary of W. R. Grace & Co. U.S.A. (12)
Denison Mines Limited, Canada (8)
Ferro Corporation, Transelco Division, U.S.A. (4)
Foote Mineral Company, U.S.A. (8)
Th. Goldschmidt AG, Germany (11)
Hitachi Magnetics Corporation, U.S.A. (6)
Indian Rare Earths Ltd., India (11)
Inland Motor Division, Kollmorgan Corp., U.S.A. (4)
Kolon Trading Co., Inc., U.S.A. (7)
Lunex Company, U.S.A. (10)
MCI - Megon A.S., Norway (9)
Mitsubishi Chemical Industries, Limited, Japan (7)
Molycorp, Inc., U.S.A. (12)
Rare Earth Products Limited, England (8)
Reactive Metals & Alloys Corporation, U.S.A. (4)
Reactor Experiments, Inc., U.S.A. (10)
Rhone-Poulenc-Chimie Fine, France (10)

(continued on page 4)

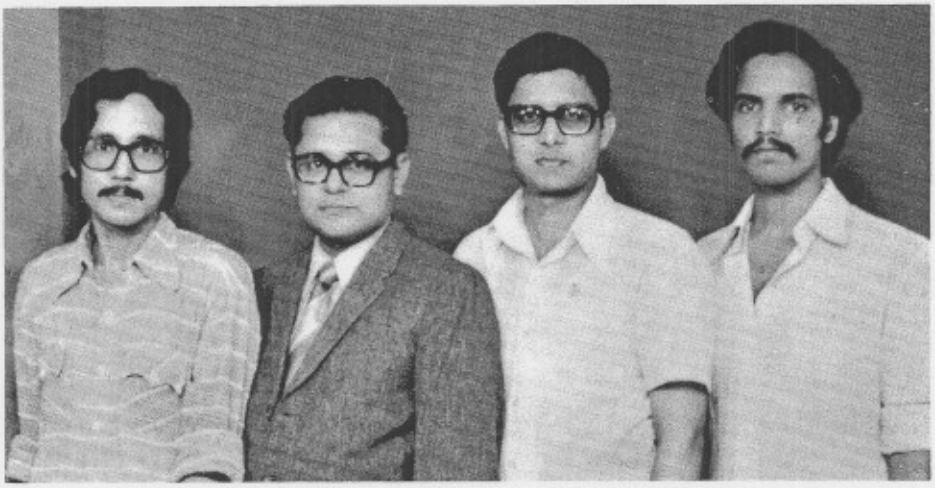
Ho

1879

Holmium joins scandium and samarium in celebrating its 100th anniversary of discovery in 1979. Holmium is actually a third-generation rare earth in that yttria was first discovered and then erbia was separated from the yttria. Finally, Swedish chemist P. T. Cleve noticed that the atomic weight of erbium was not constant and succeeded in separating erbia into erbia, thulia and holmia. Holmia is the Latinized name of Cleve's birthplace, Stockholm. The discovery of holmium does not belong solely to Cleve however. While examining the absorption spectra of erbia J.-L. Soret, a Swiss chemist, independently recognized the presence of a new "earth x" and characterized it by its absorption spectra. Later it became apparent that Soret's earth x and Cleve's holmia were one and the same and the name holmia was retained. Holmium has found application in phosphors and magnetic bubble garnet devices.

Amorphous Structure Effects

The origin and consequences of local couplings on the magnetic properties of amorphous alloys have been reviewed by R. W. Cochrane, R. Harris and M. J. Zuckermann [*Physics Reports* **48,** 1-63 (1978)]. The structure of amorphous metals is described and then related to the dense-random-packing-of-hard-spheres model. The experimental data for both soft and hard magnetic amorphous alloys are summarized. The main portion of the review is devoted to the HPZ theory of random magnetic anisotropy including electrostatic fields in amorphous systems and the crystal field Hamiltonian, magnetic properties of computer-generated clusters, mean field theory, and initial magnetization and hysteresis in spin glass-like states. Two recent applications of the random magnetic anisotropy model, the study of spin dynamics of amorphous ferromagnets and specific heat of amorphous rare earth-transition and noble metal alloys, are described.



Left to right: A. Rajput, R. Ramji, A. Ramanand and J.V.S.S. Narayanamurthy.

RARE EARTH RESEARCH IN INDIA

Indian Institute of Technology—

In 1971 Dr. R. Ramji Rao of the physics department of the Indian Institute of Technology, Madras 600036, India initiated studies on the elastic and thermal properties of the hexagonal-close-packed (HCP) rare earth metals (REM). The lattice dynamics of the metals Gd, Tb, Dy, Ho, Er, Tm, Lu, Sc and Y were investigated in order to study the lattice contribution to the specific heat. The analysis of the magnetic contribution to the specific heat of the heavy rare earth metals has been done by Mr. Ramanand and Mr. Narayanamurthy. Along with Dr. C. S. Menon, presently working in the physics department at the University of Calicut, Kerala, India, and Mr. Ramanand, Dr. Rao has studied the anharmonic properties of the rare earth metals, such as the thermal expansion, on the basis of third-order elastic constants (TOEC). All of the independent TOEC have been calculated and used to evaluate the pressure derivatives of the second-order elastic constants. The TOEC have also been applied to calculate the Anderson-Grüneisen parameter which is useful in determining the temperature dependence of the bulk modulus of the solid metals. Additionally, the changes in the lattice parameters and volume in all of the REM due to the application of hydrostatic pressure have been estimated using the TOEC data. Mr. Rajput and Mr. Narayanamurthy have been working on the calculation of the TOEC, thermal expansion and compression curves of Tm, Y, Sc, Nd and Pr, the latter two having the dhcp (double hexagonal close-packed) structure. The theoretical work done at the Indian Institute of Technology on the TOEC, low-temperature thermal expansion and compression of the rare earth metals has been useful because of the lack of experimental data in these areas. Future plans of the group include the investigation, in greater detail, of the thermodynamic properties of the dhcp rare earth metals.

POLISHING POWER

N. L. Kudryavtseva, N. E. Khar'kov, M. V. Bykov and G. S. Khodakov have undertaken an analysis of commercial glass polishing powders from America, England, France, Japan and West Germany to determine the composition, physical and chemical properties and to compare the polishing ability of each with that of Russian powders [*Opt. Mekh. Promst.* **45,** 41-4 (1978); Eng. Transl. - *Sov. J. Opt. Technol.* **45,** 306-8 (1978)]. The composition of the powders ranged from 100% CeO_2 to a solid solution of mixed rare earth oxides. Polishing abilities varied greatly but it was observed that the powders that contained some free CeO_2 had better polishing abilities than the powders which contained only a solid solution of mixed rare earth oxides. The amount of residual microstrains in the powder also influenced the polishing characteristics, the smaller the amount the better the polishing ability. None of the imported powders were observed to produce scratches or deposits on the glass surface.

14th R. E. Conference
(continued from page 1)

with the exchange of scientific information. On Wednesday evening Conference chairman Gruber was convinced by his associates to fill in and provide the promised entertainment—Indian dancing—and he

J. Cannon aiding local musicans.
Photo courtesy of E. Westrum

J. Gruber addressing attendees at Wednesday's fish fry after rain dance.
Photo courtesy of E. Westrum

performed a rain dance. However, several of the perpetrators were observed the next day being drenched by passing clouds and the next day's headline in a local Iowa newspaper read "Powerful Storm System Formed in North Dakota." It appears unwise to underestimate the abilities of a rare earth research conference chairman!

RIC News
(USPS 464-960)
Vol. XIV No. 3 September 1, 1979
published
March, June, September and December
by
Rare-Earth Information Center
***
Second-Class postage
paid at Ames, Iowa 50011
***
Postmaster: send address changes to:
RIC News, Rare-Earth Information Center,
Energy and Mineral Resources Research Institute,
Iowa State University, Ames, Iowa 50011

Telephone: Area Code 515-294-2272
FTS...865-2272
K. A. Gschneidner, Jr. ...Editor
Bernie Evans...Staff Writer

Intermediate Valence

The current status of theoretical and experimental research on the intermediate valence, IV (or interconfigurational fluctuation, valence instability, mixed valence, fluctuating valence), problem is the subject of reviews by J. M. Robinson [*Physics Reports* **51,** 1-62 (1979)], and J. H. Jefferson and K. W. H. Stevens [*J. Phys. C* **11,** 3919-47 (1978)].

Robinson first reviews the experimental data obtained by X-ray optical, electrical, thermodynamic, neutron diffraction, magnetic susceptibility and Mössbauer resonance techniques for both rare earth and actinide IV materials. Various IV theories, including the Ramirez-Falicov-Kimball model, hybridized models, lattice change models, ground state theories and the atomic representation, are discussed. The author concludes that configuration-based treatments offer more hope for a detailed quantum mechanical description of the electronic states of these materials than do the single particle approximations.

Jefferson and Stevens concentrate on the theoretical aspects of the IV problem. After briefly examining experimental aspects, an "ideal" Hamiltonian is proposed. Current theories, such as a thermodynamic theory, microscopic theory, low energy states, hybridization and Green function methods, renormalization group methods and variational methods, are related to the "ideal" Hamiltonian. The parts of the IV problem that are not well understood are noted in addition to the areas where understanding is reasonably satisfactory. Finally, the authors put the IV problem into perspective by comparison with other narrow band phenomena such as the Kondo problem and the excitonic insulator.

Chalcogenide Valences

Data on the valence of samarium and thulium chalcogenides obtained from several different experimental methods have been reviewed by R. Suryanarayanan [*Phys. Stat. Solidi (b)* **85,** 9-43 (1978)]. A brief history of mixed valence studies is given along with preparation and characterization techniques for both bulk and film samples. Optical absorption spectra and electrical and magnetic property measurements pertaining to the valence question are presented for samarium and thulium monochalcogenides, their anion and cation substituted monochalcogenides and the Sm_2S_3-Sm_3S_4 system. Various theoretical models are presented.

Distinguished Professor

K. A. Gschneidner, Jr., was named a Distinguished Professor in Science and Humanities at a recent meeting of the faculty at Iowa State University in recognition of outstanding accomplishment as evidenced by superior ability and professional prominence. The title is accompanied by a plaque and a $500 honorarium and is retained by the recipient for the rest of his career. Gschneidner is currently the program director for Metallurgy and Ceramics at Ames Laboratory-DOE and director of the Rare-Earth Information Center. Current research interests include low-temperature heat capacity, magnetic susceptibility and electrical resistivity of rare earth alloys and superconductivity.

FRENCH RE CONFERENCE

The Proceedings of the International Conference on the Physics of the Metallic Rare Earths, St. Pierre-de-Chartreuse, France, September 4-7, 1978, have been published in *Journal de Physique (Paris) Supplement* **40,** C5-1-404, (1979). Sponsored by the Centre National de la Recherche Scientifique, the meeting attracted 216 participants from 22 countries. 144 papers were presented, 21 of which were invited. Topics ranged from physics, electronic structure, exchange interactions and crystal field effects, $3d$-$4f$ metallic compounds, metallic hydrides, valence instabilities, amorphous alloys and spin glasses to a review of applications.

The cost of the proceedings is 220 F.F. in France and 245 F.F. (~ $58.00) abroad and may be obtained by contacting: Journal de Physique
Z.I. de Courtaboeuf
B.P. 112
91402 Orsay, France

Z. Bieganski Dies

RIC has been informed of the untimely death of Dr. Z. Bieganski, who, at the age of 49, died as the result of a heart attack on May 4. Bieganski was educated at the Technical University of Wrocław, receiving a master's degree in chemistry in 1956 and his Ph.D. in chemistry in 1962. He was initially employed at the Technical University of Wrocław but then moved to the Institute for Low Temperature and Structure Research of the Polish Academy of Sciences where he was appointed as head of the Low Temperature Calorimetry Laboratory. Bieganski is best known in the rare earth community for his low-temperature heat capacity studies on the rare earth di- and trihydrides.

Business News

Rhone-Poulenc Expands

Citing substantial developments in industrial applications of the rare earths, Rhone-Poulenc-Chimie Fine of France has announced plans for increasing its capacity for separation and production of the rare earths. An increase in handling capacity from 8000 to 12,000 tons per year is scheduled for the ore-crushing and preparation plant at La Rochelle in western France. Additionally, Rhone-Poulenc's U.S. subsidiary in Freeport, Texas intends to add a rare earth processing plant to its current installation.

Mitsubishi + Megon

Fifty percent of A/S Megon has been purchased by Mitsubishi Chemical Industries and its name has been changed to MCI-Megon A.S. The company will continue to produce high-purity yttrium oxide at its plant at Kjeller, Norway. The plant's present capacity is 3 metric tons per year of yttrium oxide. New fields of application are expected to double the demand for Y_2O_3 in the near future.

Wako Bussan's 25TH!!

May 14, 1979 was a day for celebration for Wako Bussan Company Ltd., as it signified the twenty-fifth anniversary of the establishment of Wako Bussan in 1954. We congratulate them on their past success and wish them prosperity in the future.

NEW CRYSTAL SERIES

Rare earths have played a large part in the introduction of a new series of volumes by Springer-Verlag entitled *Crystals: Growth, Properties and Applications, Vol. 1 Crystals for Magnetic Applications* in that four of the five articles in Volume 1 deal with rare earth materials. The new series is designed to present critical reviews of recent developments in the theory, mechanisms and techniques of crystal growth. Edited by C. J. M. Rooijmans, Volume 1 was published in 1978, contains 139 pages and 79 illustrations and costs $29.00.

In the first article, W. Tolksdorf and F. Welz review the method of bottom growth for single crystals of yttrium iron garnets from high temperature solutions. A detailed description of materials, apparatus and procedures is given. 120 references are cited.

The state of the art of preparation of single crystal gadolinium garnets is reviewed by F. J. Bruni in the second article. Citing the rigid requirements of magnetic bubble devices, the author describes the sources and nature of crystal defects in addition to the growth techniques used to eliminate them. 49 references are cited.

A review of the liquid phase epitaxial growth of magnetic garnets by M. H. Randles constitutes the third article. Background, chemistry, apparatus and growth kinetics of the most successful technique for the growth of garnet films for bubble memory applications are presented. 103 references are cited.

The fourth article, by L. N. Demianets, reviews the hydrothermal crystallization of magnetic oxides including rare earth orthoferrites and garnets. Methods of obtaining both bulk single crystals and single crystal films are discussed. 74 references are cited.

$$ 1980 $$

(continued from page 1)

Ronson Metals Corporation, U.S.A. (12)
Santoku Metal Industry Co., Ltd., Japan (10)
Shin-Etsu Chemical Industry Co., Ltd., Japan (10)
V/O Techsnabexport, U.S.A. (3)
Treibacher Chemische Werke AG, Austria (8)
United States Radium Corporation, U.S.A. (10)
Wako Bussan Co., Ltd., Japan (11)

Special recognition is accorded to six companies this year for the part they have played in the success of the Rare-Earth Information Center. With this year's contribution they qualify for the RIC Honor Roll which signifies 10 years as a benefactor of the Center.

Rare-Earth Information Center
Energy and Mineral Resources Research Institute
Iowa State University
Ames, Iowa 50011