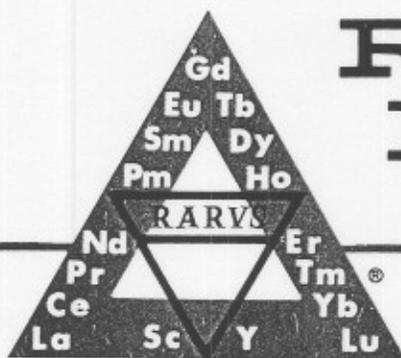


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RARE-EARTH
INFORMATION
CENTER NEWS

Rust



ENERGY AND MINERAL RESOURCES RESEARCH INSTITUTE
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The 13th Rare Earth Research Conference, with one exception, did not support the myths often associated with the number 13. Change and progress were much more symbolic of the Conference held September 16-19, 1977 at Oglebay Park, West Virginia. Around 130 participants represented 13 countries which included Brazil, Canada, England, France, India, Israel, Italy, Japan, Sweden, Switzerland, Turkey, the U.S.S.R. and the United States. The red and gold patchwork scenery typical of late autumn in the eastern United States was enjoyed by all.



Left to right: C. Lundin, R. C. Ropp and J. R. Jackman converse during poster session. Photo courtesy of Leon Luyckx

Approximately 100 papers were presented in the highly interdisciplinary meeting with sessions on solid state chemistry and physics, bioinorganic and general chemistry, metallurgy and spectroscopy. For the first time poster sessions were used to eliminate some of the problems caused by concurrent oral sessions and also to stimulate discussion on a one to one basis. Also for the first time in several years the proceedings of the Conference will be formally published as a book entitled *The Rare Earths in Modern Science and Technology*. Plenum is the publisher. Information concerning the availability of the proceed-

ings will be announced in the *RIC News*. In addition, a list of the papers presented at the Conference is available from the Center upon request.



Left to right: J. B. Gruber, K. A. Gschneidner, Jr., B. Beaudry and S. Taher get together over some rare earths. Photo courtesy of Leon Luyckx

Another first for the Conference was a paper which presented evidence to suggest that yttrium atoms in the compound $Y_6(Fe_{1-x}Mn)_x$ have a small magnetic moment. For our readers who are not magnetically inclined, yttrium has no unpaired electrons from which to derive a magnetic moment...or so it was thought! This is just one of the many interesting papers included in the proceedings.



Photo courtesy of Greg McCarthy

Looking ahead, the chairman, date and site for the 14th Rare Earth Research Conference have been chosen and they are, respectively, J. B. Gruber, June 25-28, 1979 and Fargo, North Dakota.

And finally, Jim Rhyne, the "unlucky" recipient of a broken leg at the

CONTRIBUTORS

Three companies renewed their support of the Center during the second quarter of fiscal year 1978 bringing the total number of contributors to date to 30. Contributions were received from Indian Rare Earths Ltd., India, contributing for the ninth year, Foote Mineral Company, U.S.A. and Rare Earth Products, Ltd., United Kingdom, both six year benefactors of RIC.

Rust Inhibitor

Not only does cerium aid the mechanical properties of steel by controlling the sulfide inclusion morphology, it also provides rust prevention control according to H. Shimada, Y. Sakakibara, and H. Okada [*Corrosion* 33, 196-9 (1977)]. It was reported elsewhere that the first step in the rust formation process is the dissolution of a $(Mn,Fe)S$ into water. Therefore if all of these water soluble sulfides are converted to water insoluble sulfides rust formation would be greatly hindered. This study found that the best rust prevention was achieved by fixing all the sulfur in the steel as cerium manganese oxysulfides, $(Ce,Mn)(O,S)$.

UNION OIL + MOLYCORP

Molycorp has become a wholly owned subsidiary of Union Oil as a result of Molycorp stockholder approval. Molycorp's headquarters will remain in White Plains, New York.

13th Rare Earth Research Conference is back on his feet now and getting around with the aid of crutches. On behalf of all the conferees we wish him a speedy recovery and perhaps a word of advice... "better watch out for black cats, too!"

ICM '76

The Proceedings of the International Conference on Magnetism '76 held September 6-10, 1976 in Amsterdam, The Netherlands are now available as a three volume set edited by P. F. de Châtel and J. J. M. Franse and published by North-Holland Publishing Co., Amsterdam, 1977. Reprinted from the journal *Physica*, volumes 86-88B, the three books total about 1550 pages in length and cost U.S. \$193.75 (Dfl. 475).

The ~ 580 articles deal with a variety of materials including rare earth metals, their alloys and compounds; 3d metals, their alloys and compounds; dilute alloys; disordered and amorphous systems; insulators and semiconductors. Topics covered include itinerant electron magnetism, transport in magnetic metals, critical phenomena, dimensionality and impurity effects, exchange, optical properties, spin dynamics, resonance and relaxation, anisotropy, domains, surface and size effects. Approximately one third of the articles deal with rare earth materials.

The Proceedings are available from Associated Scientific Publishers, Book Division, P.O. Box 211, Amsterdam-W, The Netherlands.

LaB₆ Emission Anisotropy

In an effort to gain more knowledge on the emission characteristics of LaB₆, P. H. Schmidt, D. C. Joy, L. D. Longinotti, H. J. Leamy, S. D. Ferris and Z. Fisk have measured the thermionic electron emission of various axial orientations of a LaB₆ single crystal [*Appl. Phys. Letters* 29, 400-1 (1976)]. Maximum emission was observed for an $\langle 110 \rangle$ orientation around 1600 K. Minimum values were seen with the $\langle 510 \rangle$ axis. The $\langle 100 \rangle$ emission was twice that of $\langle 510 \rangle$ and yet 10 times less than $\langle 110 \rangle$. Visual emission patterns show four spots forming a square for $\langle 100 \rangle$ and for $\langle 110 \rangle$ a rectangular pattern is seen. The LaB₆ thermionic emitters were designed to directly replace tungsten hairpin cathodes in scanning electron microscopes and, with proper axial orientation, seem capable of emission fluxes two orders of magnitude higher than the tungsten emitters.

1977 Nobel Prize in Physics



P. W. Anderson



J. H. Van Vleck



N. F. Mott

Three rare earthers have been named co-recipients of the 1977 Nobel Prize for physics. Dr. P. W. Anderson of Bell Telephone Laboratories and Princeton University, Dr. J. H. Van Vleck, emeritus professor at Harvard University, and Sir N. F. Mott of Cambridge University, England are cited for their work on describing electronic states in magnetic and disordered materials. "Particularly in the treatment of and emphasis on localized electronic states, they have gone far beyond the conventional theories, with direct importance for experiments and technique" according to the Nobel citation.

Van Vleck's studies have greatly aided the development of magnetic materials while Mott's and Anderson's research has been applied in the development of semiconductors and solar cells. Current research interests of both Mott and Anderson include the mixed valence question embodied by a wide range of rare earth compounds.

Lu Diet Finally Recognized

In an effort to shed its reputation as the heaviest rare earth, checking in at 174.97, lutetium has been on a diet for some time now. Although initial progress was admittedly slow, Lu stuck with it and now even the International Union of Pure & Applied Chemistry has recognized the achievement by revising Lu's official atomic weight to 174.967 ± 0.003 ! Actually, rare earthers never did believe that Lu was as dense as they said. For you weight watchers, Lu attributes the loss to a high proton diet.

RE-Co WORKSHOP

The Third International Workshop on Rare-Earth Cobalt Permanent Magnets and Their Applications, sponsored by the University of Dayton and the University of California, San Diego, will take place June 27-30, 1978 on the LaJolla Campus of the University of California. The workshop will consist of prepared lectures, formal panel discussions and informal but organized topical conversations with participants representing industries, universities and governmental agencies on a world-wide basis.

A wide spectrum of topics and problems of a technological and business nature relating to the rare earth-cobalt magnets and their device applications will be discussed. Production and design problems, engineering and economic aspects, novel applications and magnetic circuit and device development head the list of topics to be covered. The commercial availability of the magnets and raw materials will be reviewed. There will be an exhibit of industrial products and developmental items and, if enough interest is expressed, a special symposium Saturday morning on the physical origins of coercivity or on the medical uses of these permanent magnets. Your comments and suggestions for the workshop content and/or organization are welcomed.

Attendance is limited to about 150. Registration is \$300 and includes the printed proceedings. Submission deadlines are December 1, 1977 for abstracts and March 1, 1978 for manuscripts. For further information contact Dr. K. J. Strnat, University of Dayton (KL-365), Dayton, Ohio 45469, U.S.A.

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K. A. Gschneidner, Jr. Editor
Bernie Evans, Staff Writer

INTERNATIONAL C.N.R.S. COLLOQUIUM ON "PHYSICS OF METALLIC RARE EARTHS"

St-Pierre de Chartreuse, France—September 4-7, 1978

As announced in a first circular, a specialized meeting on the Physics of Metallic Rare Earths is to be held next summer near Grenoble.

The following topics have been selected:

- 1 - Valence instabilities, theory and experiment: Kondo effect and magnetic order, phase transitions, effect of pressure and magnetic field.
- 2 - Exchange and crystal field: magnetization processes, magnetic structures, magnetic form factors, magnetic excitations, neutron spectroscopy, critical phenomena, magnetism of $4f-3d$ compounds.
- 3 - Physical properties: thermal properties, transport, E.P.R., hyperfine interactions.
- 4 - Theory and experimental determination of electronic structures: band calculation, photo-emission, de Haas-van Alphen effect, magnetic order and superconductivity.
- 5 - Liquid and amorphous: magnetic, thermal and transport properties, neutron scattering.

Each topic will be presented in a general way in plenary sessions by one or two speakers. Particular aspects will then be developed in several shorter talks, interspersed with discussion periods. To accommodate the remaining communications, informal poster sessions will be arranged. A special session with only invited papers will be devoted to technical applications: permanent magnets, hydrogen storage, magnetostrictive devices.

The total number of participants will be limited to about one hundred. All the communications will be published in the "Journal de Physique" as a special volume in the series "Colloques internationaux du C.N.R.S.," in either of the working languages, English or French.

The registration fee has been fixed to 250 French Francs.

All the participants and accompanying persons will be lodged in St-Pierre de Chartreuse. The cost of lodging and meals per day will be between 100 F and 150 F according to the Hotel category. St-Pierre de Chartreuse is a village resort beautifully situated at 1000 m on the western edge of the Alps in the Massif de la Chartreuse.

More detailed information concerning the registration and hotel reservations will be given in the 3rd announcement.

Deadline dates:

March 15, 1978 for the receipt of abstracts (authors of accepted abstracts will be notified by May 1st, together with instructions for the preparation of manuscripts).

June 1st, 1978 for the registration (the registration fee and pre-payment of 150 F for hotel reservation will be required at this time).

July 15, 1978 for the receipt of papers.

International Scientific Committee: J. FRIEDEL (France, Chairman), J. C. ACHARD (France), E. F. BERTAUT (France), E. BUCHER (Germany), P. DE CHATEL (Netherlands), B. R. COLES (Great Britain), B. COQBLIN (France), W. C. KOEHLER (U.S.A.), R. LEMAIRE (France), A. R. MACKINTOSH (Denmark), C. H. de NOVION (France), B. STALINSKI (Poland).

INSTRUCTIONS FOR PREPARATION OF ABSTRACTS

Authors are asked to prepare their abstracts for direct reproduction offset, without retyping. Except for reduction in size, the material will appear exactly as the authors prepare it. The following rules apply:

- 1 - the abstract must be contained within an 18 x 15 cm rectangle and typed single-spaced on good quality white paper with an elite typeface.
- 2 - The material (including title, authors, their affiliations, footnotes, references, etc. . .) must fit into an 18 x 15 cm rectangle which is positioned 7 cm from the top of the page. Within the space allotted, the authors may use diagrams, equations, etc. Lettering and figures should be of sufficient size to remain legible after reduction by about 35%.
- 3 - The title should be all in capitals, the authors' names, not underlined, and their affiliations should be in initial capitals and lower cases.
- 4 - The name and complete address of the author to whom further correspondence should be addressed should appear in the space below the abstract.
- 5 - Remember that errors, erasures, smudges, etc. . .will be reproduced in the Program. If you wish to draw an 18 x 15 cm rectangle and type within it, you may use very light blue lines since they are not reproduced in a photographic copy.
- 6 - The original and two copies should be submitted to the Secretary of Colloquium on "Physics of Metallic Rare Earths," Laboratoire Louis Néel, C.N.R.S., 166X, 38042-Grenoble-Cedex, France.

18 cm

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Valence Instability

The proceedings of the International Conference on Valence Instabilities and Related Narrow Band Phenomena held at the University of Rochester, Rochester, New York November 11-13, 1976 have been published as a book entitled *Valence Instabilities and Related Narrow Band Phenomena*, R. D. Parks, ed., Plenum Press, New York (1977). The book is 562 pages long and costs \$49.50.

This volume represents an excellent introduction for the uninitiated to the theoretical nightmare and experimental "paradise" of valence instability. An extremely wide range of rare earth materials is discussed. Topics range from Fermi liquids to Kondo effects. Sixty-eight papers are presented. The first half of the book consists of the oral presentations including portions of the lively discussions that followed. The last half contains the information presented at the poster sessions. A novel approach to the valence question, the elephantine version, was unveiled by Nobel laureate P. W. Anderson and should provide a large frame into which many of the problems of valence instability can be incorporated and better appreciated.

Magnetostriction

The proceedings of a workshop on magnetostrictive materials, edited by R. W. Timme, have been published in *U.S. Navy J. Underwater Acoustics* 27, [1] 1-190 (1977). Sponsored by the Underwater Sound Advisory Group and Naval Research Laboratory, the workshop was designed to bring together various disciplines interested in the development of magnetostrictive materials and, in particular, rare earth-iron alloys. Nine of the seventeen articles deal with magnetomechanical coupling, magnetization, microstructure, mechanical properties, availability, cost and development of devices using the rare earth-iron alloys.

RIC has prepared a table of contents which includes the author's addresses. This table of contents is available by writing to RIC and is useful for obtaining reprints of articles presented at the conference since the complete proceedings are not available.

Dates Changed

The dates for the EUCHEM Conference on the chemistry of the rare earths have been changed from June 12-15, 1978 to May 30-June 2, 1978. Sponsored by the Association of Finnish Chemical Societies, the Conference will be held at the Savings Bank Institute located at Matinkylä, Espoo just 15 km west of Helsinki. The program will consist of three main topics: systematics in the properties of the rare earths, coordination and complex formation of the rare earths and rare earth nonmetallic materials. Invited speakers include J. Albertsson, Sweden, G. Blasse, Holland, P. Caro, France, I. Grenthe, Sweden, J. Loria, France, M. A. Porai-Koshits, U.S.S.R., S. Siekierski, Poland, and S. P. Sinha, Switzerland. The official language will be English and the proceedings will not be published. Preregistration is due January 15, 1978 and final registration and submission of abstracts are due April 1, 1978. Foreign participation will be limited to around 80. For more information contact Professor L. Niinistö, Department of Chemistry, Helsinki University of Technology, SP-02150 Espoo 15, Finland.

Cerium Indicates Early Environment

Investigation of the rare earth element content in chert-type rocks of land and deep-sea origins has led H. Shimizu and A. Masuda to portray cerium as a possible indicator of the original environment present during the formation of the rocks [*Nature* 266, 346-8 (1977)]. Using a stable isotope dilution technique they observed a large negative cerium anomaly in all of the deep sea samples while land-exposed cherts showed either a small positive cerium anomaly or no anomaly at all. This difference is attributed to the shallower water environment in which the terrestrial cherts were formed. Therefore, the presence or absence of a cerium anomaly and its extent and direction of deviation becomes a good indicator of the type of aqueous environment present during the formation of the cherty rocks. In addition, the presence or absence of a cerium anomaly would indicate whether the chert was biogenic or volcanic in origin.

Creative Invention Award

Dr. L. G. Van Uitert of Bell Telephone Laboratories has been named the 1977 recipient of the American Chemical Society's Award for Creative Invention.



L. G. Van Uitert

Van Uitert is being cited for the discovery of new materials in five different areas: polycrystalline ferrites, lasers and fluorescent materials, non-linear optical materials, single crystal magnetic materials and optical fibers. His studies have contributed to advances in the fields of laser, fluorescence, magnetics and communications. Van Uitert holds over 60 U.S. patents and has authored or co-authored more than 200 papers.

FERROMAGNETISM VS SUPERCONDUCTIVITY

ErRh_4B_4 has been studied by W. A. Fertig, D. C. Johnston, L. E. DeLong, R. W. McCallum, M. B. Maple and B. T. Matthias to see if it is a compound where superconductivity and long range magnetic order can co-exist [*Phys. Rev. Letters* 38, 987-90 (1977)]. Electrical resistance and ac magnetic susceptibility were measured versus temperature, and magnetization was measured versus applied magnetic field. All measurements indicate a normal-to superconducting state transition at 8.7 K, destruction of superconductivity at 0.9 K and onset of long range magnetic order at 0.9 K although at this time the type of magnetic order was indeterminate. It is noteworthy that the Er ions not only stabilize the superconducting tetragonal phase but also destroy superconductivity by long range ordering of the Er magnetic moments at low temperatures. The authors feel that this is the first evidence associating re-entrant superconductivity with magnetic structure since earlier reports dealt with matrix-impurity systems which exhibited superconductivity and the Kondo effect at the same time.

150 years ago cerium became the first rare earth to be reduced to its metallic state.

WELDING with YTTRIUM

In an effort to improve thin sheet weld reliability of titanium alloys, R. P. Simpson has studied the controlled weld-pool solidification structure and resultant properties with yttrium inoculation of Ti-6Al-6V-2Sn welds [*Welding J.* 56, 67s-77s (1977)]. The major stumbling block in the past has been large beta grain size in the fusion zone resulting in poor weld fracture toughness, ductility and a potential source of catastrophic failure. Yttrium was chosen because of its low solid solubility in the titanium alloy and its high affinity for oxygen. A concentration of 300 ppm yttrium in the welding rod was found to reduce the fusion zone grain size 35% and the large columnar grains in the center of the weld up to 80%. The yttrium acts as a heterogeneous nucleation site and/or restricts grain growth by pinning grain boundaries. Additions from 100 to 300 ppm yttrium were found to improve the welded structural reliability while additions greater than 300 ppm yttrium resulted in serious degradation of mechanical properties.

PLZT. . . MEET PBLN

PBLN stands for lanthanum-modified lead-barium metaniobate. M. Yokosuka has discovered that this transparent hot-pressed ceramic has some interesting optical characteristics [*Japan J. Appl. Phys.* 16, 379-80 (1977)]. Optical transmittance spectra of PBLN were very similar to PLZT. The transverse effective birefringence as a function of electric field was measured and the linear and quadratic electrooptic coefficients were calculated. Linear coefficients are comparable while the quadratic effects for PBLN are a factor of 4 to 5 smaller than PLZT. The Curie point was found to decrease with increasing lanthanum content.

MEETING ORGANOMETALLICS

A NATO Advanced Study Institute on Organometallics of the f-elements has been organized for September 11-22, 1978 at the Sogesta Conference Center, Urbino, Italy. A meaningful and comprehensive picture of the chemical and physicochemical properties of lanthanide and actinide organometallic compounds will be developed via lectures, discussions, seminars and tutorials. All lectures will be in English and attendance is limited to about 80. Application deadline is March 31, 1978. For further information contact Professor T. J. Marks, Dept. of Chemistry, Northwestern University, Evanston, IL 60201, U.S.A. or Professor Dr. R. D. Fischer, Institut für Anorganische Chemie, Universität Hamburg, Martin Luther King Platz 6, 2 Hamburg 13, West Germany.

Oxygen Stabilized RE-Fe Compounds

Structural and magnetic properties of a new series of oxygen stabilized rare earth-iron intermetallic compounds have been reported by M. P. Dariel and M. R. Pickus [*J. Less-Common Metals* 50, 125-37 (1976)]. The compounds of the formula $R_{12}Fe_{32}O_2$ are metallic in nature and have been observed for R = Gd, Tb, Dy, Ho, Er and Y. It is not known if they are thermodynamically stable or just in a metastable state. These compounds were discovered during the preparation of rare earth iron intermetallic compounds by powder metallurgy techniques. The source of oxygen is

Ni Superalloy with Y_2O_3

A mechanically alloyed, Y_2O_3 dispersion strengthened, nickel-base superalloy (MA 753) has been examined by J. H. Weber and M. J. Bomford [*Met. Trans.* 7A, 435-41 (1976)]. The temperature dependence of fatigue properties and the role of microstructural features in deformation and failure were studied and MA 753 was compared with a conventional superalloy of similar composition.

The fatigue properties of Y_2O_3 -doped MA 753 were better than the conventional Ni-base superalloy up to 1227 K, the highest test temperature. The Y_2O_3 dispersoid affected the fatigue behavior by causing more uniform deformation at all temperatures. Higher fatigue ratios in MA 753 were also related to favorable microstructural features of the dispersion strengthened alloy. In addition to good overall resistance to oxidation and sulfidation, MA 753's tensile and rupture behavior resembled thoriated nickel at high temperatures while at low temperatures these properties were similar to those of a conventional wrought Ni-base superalloy.

probably an adsorbed surface layer on the powder since attempts to prepare the compounds by adding oxygen or using rare earth sesquioxides proved unsuccessful.

Magnetic moment and magnetic ordering temperatures were determined for the compounds. These preliminary measurements indicate that $Y_{12}Fe_{32}O_2$ is ferromagnetic while $Dy_{12}Fe_{32}O_2$ and $Ho_{12}Fe_{32}O_2$ are ferrimagnetic.

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Energy and Mineral Resources Research Institute
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Ames, Iowa 50011

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