RARE-EARTH INFORMATION CENTER NEWS

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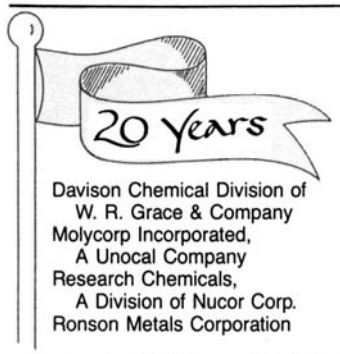

Davison Chemical Division of
W. R. Grace & Company
Molycorp Incorporated,
A Unocal Company
Research Chemicals,
A Division of Nucor Corp.
Ronson Metals Corporation

The March 1, 1968 issue of the *RIC News* carried the headline, **RIC Closes.** Funding from the Atomic Energy Commission had been halted and it looked like the end. However, the June 1, 1968 issue of the *RIC News* carried the headline, **RIC News To Continue.**

The continuation of the *RIC News* was made possible by industrial grants to the RIC by five companies active in the rare earth field. The sponsors were American Potash & Chemical Corporation, a subsidiary of Kerr-McGee; W. R. Grace & Company; Molybdenum Corporation of America; Research Chemicals Division of Nuclear Corporation of America; and Ronson Metals Corporation.

Four of those companies are still sponsors and in 1988 became 20 year members of our family. We give our special thanks to these faithful sponsors.

IS-RIC-9

IS-RIC-9, *Source Book on Neodymium-Iron-Boron Permanent Magnets,* first announced in June 1986 [*RIC News,* **XXI,** [2] 1 (1986)], is now available for half price (U.S.$25.00). It can be ordered from RIC and will be shipped by the most economical method unless $2.00 for first class postage or $4.00 for airmail postage is also included.

New Mag Material?

D. B. de Mooij and K. H. J. Buschow [*Philips J. Res.* **42,** 246-51 (1987)] studied new ferromagnetic, iron-rich rare earth ternary compounds, some of which they believe may be considered as new starting materials for permanent magnet applications. The new compounds have the general formula, $RFe_{10}V_2$, and crystallize in the tetragonal $ThMn_{12}$ structure. The actual composition can vary from $RFe_{9.5}V_{2.5}$ to $RFe_{10.5}V_{1.5}$ with higher Curie temperatures for those containing more iron. For the $RFe_{10}V_2$ compounds, T_c varied from 480 K for Lu to 635 K for Gd. Preliminary measurements have shown several of the compounds to have anisotropy fields comparable to those found in the $R_2Fe_{14}B$ series. They found that La and Pr do not form this compound and they did not try Sc, Pm, Eu, or Yb.

They also have extended the study [*J. Less-Common Met.* **136,** 207-15 (1988)] to include rare earth-iron ternary compounds with Si, Ti, V, Cr, Mo, or W. Among the $ThMn_{12}$ type compounds they found $NdFe_{10}Mo_2$ and showed that the Mo atoms occupy only one of the three available crystallographic sites in this structure type. In $YFe_{12-x}V_x$, x-ray studies showed a homogeneity range for x between 1.5 and 3. Other systems have different ranges for x and for Ti and W the x value is substantially smaller than 2. For $YFe_{12-x}Ti_x$ and $GdFe_{12-x}Ti_x$, the correct stoichiometry of the $ThMn_{12}$ type phases was found to be x = 1.2. Within any system, the Curie temperature increased with a decrease in x.

In order to assess the effect of M on the Curie temperature, T_c, of the different $RFe_{10}M_2$ compounds, $GdFe_{10}M_2$ and $YFe_{10}M_2$ compounds were made and their T_c's determined. In the Gd compounds, T_c varied from 570 to 610

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SPEDDING AWARD

Professor Brian R. Judd, of the Johns Hopkins University's Department of Physics and Astronomy, has been named winner of the fifth Frank H. Spedding Award. The award, sponsored by Rhone-Poulenc, will be presented at the 18th Rare Earth Research Conference on September 13, 1988, in Lake Geneva, Wisconsin.

It seems appropriate, in light of Dr. Spedding's intense interest in rare earth spectroscopy, that the award given to those who best exemplify his ideals goes this year to Brian Judd for his many contributions to rare earth spectroscopy. These include: the development of the "standard model" in which effective operators are used to represent the various higher-order interactions that affect the energy levels of rare earth atoms and ions; and the development (simultaneously with Ofelt) of a method of parameterization of the intensities of *f-f* transitions in crystals and solutions that allows one to systematize intensity data. His work provides the language used by all scientists in the field of rare earth spectroscopy. The Judd-Ofelt theory is fundamental in

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PROCEEDINGS
Halide Glasses

The proceedings of the Fourth International Symposium on Halide Glasses, held January 26-29, 1987 in Monterey, California, U.S.A., have been published in *Materials Science Forum*, Volume **19-20,** Parts I and II. The two hardcover volumes, edited by M. G. Drexhage, C. T. Moynihan, and M. Robinson, contain 701 pages and may be ordered from Trans Tech Publications, P.O. Box 10, CH-4711, Aedermannsdorf, Switzerland, or in the U.S.A. from Brookfield Publishing Company, Old Post Road, Brookfield, VT 05036. The price is SFr 280.00 (~U.S.$160.00).

Since 1974, when, quite by accident, Michel Poulain produced a heavy fluoride fluorozirconate glass, the field of halide glasses has been and still is maturing. This proceeding contains 85 papers on many discoveries in the areas of new systems, structure, purity requirements and analytical methods, preparative techniques, applications, and physical properties.

Metal Hydrides

Volumes **129, 130,** and **131** of the *Journal of the Less-Common Metals* contain the proceedings of the Fifth International Symposium on the Properties and Applications of Metal Hydrides held May 25-30, 1986 in Maubuisson, France. The three volumes were published in 1987 and are available from Elsevier Sequoia S.A., P.O. Box 851, CH-1001 Lausanne, Switzerland, for SFr. 825 (~U.S.$611.00). The editors for the proceedings were A. Percheron-Guegan and M. Gupta.

One hundred ninety papers were presented with roughly a fifth on applications and a third on fundamental research on hydrogen in metal systems. Volume **129** contains sections entitled Structural Properties and Dynamics of Hydrogen. Volume **130** contains sections on Physical Properties, Electronic Structure, Thermodynamic Properties, and Surface Effects. Volume **131** contains sections on Reaction Kinetics, Novel Hydride Systems, and Applications.

2nd ICLA

Inorganica Chimica Acta, volumes **139** and **140,** edited by K. W. Bagnall,

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ISOMES '89

The International Symposium on Magnetoelasticity and Electron Structure of Transition Metals, Alloys and Films (ISOMES '89) will be held March 20-22, 1989, in Duisburg, West Germany. Scientists who have achieved recent progress in the understanding of the interplay between magnetic, especially magnetoelastic, behavior and electronic structure of transition metals and alloys will be brought together for an exchange of their discoveries. Among the topics to be included are magnetoelasticity, Invar effects, spin fluctuations and electronic structures of 3*d* elements, and alloys, Laves phase compounds, and heavy fermion and Kondo systems.

For further information on registration write to ISOMES '89, Dr. M. Acet, Universität Duisburg, Postfach 10 15 03, D-4100 Duisburg, West Germany.

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J. Marcalo, and A. Pires de Matos, contain the papers presented at the 2nd International Conference on the Basic and Applied Chemistry of f-Transition (Lanthanide and Actinide) and Related Elements (2nd ICLA), held in Lisbon, Portugal on April 6-10, 1987. Part 1 (volume **139**) contains invited papers and poster papers on history of the f-elements, coordination chemistry, organometallic chemistry, and theory and spectroscopy. Part 2 (volume **140**) has the papers on reactivity and catalysis, solid state chemistry, analytical and environmental chemistry, industrial applications, and f-elements in biology and medicine. The price of the 2-volume set is SFr. 500 (~U.S.$407.00) and may be obtained from Elsevier Sequoia S.A., P.O. Box 851, 1001 Lausanne, Switzerland. Readers in the U.S.A. and Canada may order from Elsevier Science Publishing Company, Attention: Journal Information Center, 52 Vanderbilt Avenue, New York, NY 10017.

ISMIC 1987

The proceedings of the International Symposium on Magnetism of Intermetallic Compounds, held April 20-22, 1987, in Kyoto, Japan, have been published in volume **70** of the *Journal of Magnetism and Magnetic Materials*. The proceedings, edited by

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CONFERENCE CALENDAR

1st International School on Excited States of Transition Elements
Ksiaz Castle, Wroclaw, Poland
June 20-25, 1988
RIC News, **XXII,** [3] 2 (1987)

6th International Conference on Crystal Field Effects and Heavy Fermion Physics
Frankfurt, West Germany
July 18-21, 1988
RIC News, **XXII,** [2] 2 (1987)

4th International Conference on Physics of Magentic Materials (ICPMM)
Szczyrk-Bila, Poland
September 4-10, 1988
RIC News, **XXIII,** [1] 2 (1988)

18th Rare Earth Research Conference (RERC)
Interlaken, Lake Geneva, Wisconsin, U.S.A.
†September 12-16, 1988
RIC News, **XXII,** [3] 3 (1987)

*2nd International Conference on Giant Magnetostrictive Alloys and Their Impact on Actuator and Sensor Technology
Marbella, Spain
October 12-14, 1988
This issue (see below)

1st International Conference on Metallurgy and Materials of Tungsten, Titanium, Rare Earths, and Antimony (W-Ti-RE-SC'88)
Changsha, People's Republic of China
November 5-8, 1988
RIC News, **XXII,** [4] 2 (1987)

TMS-AIME Rare Earth Symposium
Las Vegas, Nevada, U.S.A.
February 27-March 3, 1989
RIC News, **XXII,** [2] 2 (1987)

*International Symposium on Magnetoelasticity and Electron Structure of Transition Metals, Alloys and Films (ISOMES '89)
Duisburg, West Germany
March 20-22, 1989
This issue (see column to left)

†Date Change
**New Listing*

Magnetostriction

The Second International Conference on Giant Magnetostrictive Alloys and Their Impact on Actuator and Sensor Technology will be held October 12-14, 1988 in Marbella, Spain. The use of terbium and dysprosium in many of these alloys makes this conference interesting to rare earth scientists and material engineers. For more information, contact Ms. Suzette Havens at Terfenol KB, Research Park Ideon, S-223 70 Lund, Sweden.

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Spedding Award

the study of rare earth transitions.

Brian Judd was born February 13, 1931, in Chelmsford, England, and educated at Brasenose College and Oxford University in Oxford, England. He received his doctorate in 1955 and spent the next 11 years at Magdalen College in Oxford, the University of Chicago, the University of California at Berkeley, and the University of Paris. In 1966, he became a professor of physics in the Johns Hopkins University's Department of Physics and Astronomy. He has been there since, except for short stays as visiting professor at many foreign universities. He was chair of the Department of Physics and Astronomy from 1979-1984. He became a fellow of the American Physical Society in 1981.

Judd's work falls under the general heading of the application of group theory to spectroscopy, most of it directed toward the analysis of rare earth and actinide levels and transition intensities. Starting in 1957, he investigated ways to treat the influence of crystal fields on the energy levels of rare earths with more than two *f*-electrons. This work culminated in 1963 in his book, still the definitive text for anyone working in this area, *Operator Techniques in Atomic Spectroscopy.* It makes Racah algebra accessible to spectroscopists and shows explicitly how Racah's techniques can be applied to the study of rare earth ions in crystals.

In his 1962 paper "Optical Absorption Intensities in Rare Earth Ions," Judd described, for the first time, an effective model for the quantitative description of electric dipole transition intensities in condensed phases. This work, a "Citation Classic" [*Current Contents,* **15,** No. 14, 20 (1984)], is quoted by chemist-spectroscopists almost as often as by physicists, and is responsible for a whole school of rare earth solid state and solution spectroscopy focusing on site symmetries and bonding. It has become a basic tool in our understanding of rare earth laser transitions. This model or theory has also proved useful in making assignments of transitions in situations where magnetic or polarization data are unobtainable.

No analysis of rare earth spectra is done today without making use of part of the framework established by

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HOWARD KREMERS

We have learned of the death of Howard Earl Kremers on March 11, 1986. He died in Winfield, Illinois, after a long battle with lung cancer. He was born September 21, 1917, in Urbana, Illinois, and was educated at Western Reserve University, Syracuse University, and the University of Illinois. He received his Ph.D. from Illinois in 1944 and went to work for Lindsay Light and Chemical Company. He remained with the company as it became a division of American Potash and Chemical Corporation, which later was purchased by Kerr-McGee Chemical Corporation. He worked extensively on the separation and production of the rare earths and thorium. One of his last jobs was supervision of the dismantling and disposal of the West Chicago plant where he began his professional work [*RIC News,* **XVIII,** [2] 4 (1983)].

Rare Earthers

Frank Y. Fradin has been named associate laboratory director for physical research at Argonne National Laboratory. He is responsible for all research and development on high temperature superconductivity. Fradin, formerly director of the Laboratory's Material Science Division, is well known for his work in materials science, physics, and superconductivity. He was active in the study of the magnetic properties of scandium and its alloys with rare earths. He later became active in the study of superconducting terary borides and molychalogenides, RM_4B_4, and RMo_6S_8.

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Judd's theory. His work has been applied to interpretation of free atom or ion spectra, to analyses of hyperfine structure, Zeeman effect, and EPR data, as well as to *f-f* transition intensities. Unlike many theorists, he works closely with experimentalists, taking up the challenge of explaining puzzling aspects of many particular spectra and pointing the way to application of his theoretical work.

There is no one currently working in the field of rare earth or actinide spectroscopy who has not been influenced in some way by the work of Brian Judd. His work has essentially defined the field of rare earth spectroscopy for the past 20 years. Most of the standard theory would not be available if it were not for his continuing interest in this field. He is an ideal and distinguished choice for this award.

Permanent Magnet Survey

Wheeler Associates Incorporated has published a two-volume report containing information, statistics, observations, and projections on all aspects of the international magnet business.

According to the report, the total Western World magnet production in 1987 was valued at $1.455 billion, an increase of 12.4 percent over 1986. By geographic area Japan had 52.2 percent of the market with the U.S.A. at 19.9 percent, Europe at 16.5 percent, and others at 11.4 percent.

The 202-page Volume 1 contains sections on Magnetics; Magnetic Materials; Applications and Markets in General; Research and Development; Industrial Structure; Producers and Production; Imports-Exports; The China Factor; Projections/Predictions; and Observations/Opinions. A special section containing remarks by contributing authors is 48 pages long. Contributing authors include Mr. Rollin Parker, president, Parker Associates; Dr. Alan Clegg, director, Magnet Centre, England; Dr. Hi Dong Chai, professor, San Jose State University; Dr. Fred G. Jones, president, F. G. Jones Associates; and Mr. John G. W. West, consulting engineer, England.

A special section on neodymium-iron-boron magnets is 43 pages long. In addition to the subjects covered in the general report it deals with history, developments, patents, conferences, and the future more deeply than is done for some other magnetic materials.

The 275-page second volume will include supplementary information used to write the first volume. Copies of many of the reprints and company reports on which certain opinions are based are included. A list of companies involved in magnet manufacture and some of their literature are also included along with selected news releases and trade journal reports.

The price of the report is U.S.$2,450.00 and may be obtained by writing Wheeler Associates, Inc., 120 N. Mulberry Street, Elizabethtown, KY 42701, U.S.A.

HONORS

Aminoff Gold

In May of 1986, the Royal Academy of Sciences of Sweden awarded its Aminoff Gold Medal to Erwin Felix Bertaut "for . . . his eminent work in theoretical and experimental crystallography, particularly concerning magnetic structures." At the same time, he received a doctor of science honoris causa from the University of Uppsala. Dr. Bertaut is a director and scientist at the National Center for Scientific Research in Grenoble, France, and a scientific consultant for the French Atomic Energy Commission.

Henry J. Albert

Dr. Christof Julius Raub, director of the Forschungsinstitut für Edemetalle und Metallchemie in West Germany, has won the Henry J. Albert Award. The award is presented annually to recognize an individual whose work in theoretical or experimental precious metals metallurgy has contributed to the advancement of the precious metals area. Among Dr. Raub's interests are superconductivity involving rare earth alloys and intermetallic compounds.

Williams-Wright

The 1988 Williams-Wright Award was presented to Dr. Darwin L. Wood of AT&T Bell Laboratories. The award is sponsored by the Coblentz Society and is presented annually to a person who has made significant contributions to vibrational spectroscopy while working in industry. Much of his work has been with solid state laser materials, magentic crystals, and most recently with optical fiber materials, some of which involved rare earth materials.

Engineering Academy

David A. Thompson has been honored by being elected in 1988 to membership in the National Academy of Engineering. Thompson, of the IBM Thomas J. Watson Research Center, was honored for pioneering work in magnetics technology for data storage products, including the invention of thin-film and magnetoresistive devices, some of which made use of rare earths.

Polymer Chemistry

Dr. Pierre G. de Gennes has been named to receive the American Chemical Society's 1988 ACS Award in Polymer Chemistry. Yes rare earthers, this is the man for whom the de Gennes factor is named. He is currently director of the Ecole de Physique et Chimie in Paris and has successfully bridged the gap from physics to chemistry.

Eisenman

In October of 1987, Robert B. Herchenroeder received the 1987 William Hunt Eisenman Award from ASM International. The award recognizes unusual achievements in industry and in the practical application of metallurgy and materials science to the production of metals and materials or their engineering use. Mr. Herchenroeder was recognized for his development and application of alloys vital to the manufacture of gas turbine engines for the aerospace industry. Many of these alloys contain rare earths. Mr. Herchenroeder is new products manager of Haynes International, Inc.

Japan Chemical Society

Shigeyuki Somiya received the Chemical Society of Japan Award for 1987. The honor recognizes his studies of hydrothermal reactions and their applications for the synthesis of inorganic materials. Somiya is professor and director of the Laboratory for Advanced Ceramics at the Tokyo Institute of Technology. He first worked with CeO_2 and later coauthored articles on other rare earth oxides and on rare earth chromates, orthoferrites, and tantalates.

Analytical Chemistry

Professor Henry Freiser was named by the Society for Analytical Chemists of Pittsburgh to receive the 1988 Pittsburgh Analytical Chemistry Award. He has been a leading and influential educator in analytical chemistry and has made significant contributions to the science and profession. His research areas have included metal chelate chemistry, solvent extraction processes, and ion selective electrodes. His metal chelate and extraction chemistry included rare earth studies.

GMELIN HANDBOOK

Volume C 10 of System number 39 of the *Gmelin Handbook of Inorganic Chemistry* deals with rare earth compounds with tellurium and polonium with all but six pages on those involving tellurium. Among the compound types covered are tellurides, oxytellurides, tellurates, telluride and tellurate halides, sulfide and selenide tellurides, and alkali rare earth tellurates.

The sections on the chemical and physical properties of solid tellurides, of which SmTe, EuTe, and TmTe are most important, dominate the book. The most prominent feature of SmTe is the pressure induced valence transition from divalent Sm to the intermediate valence state, similarly to SmSe. A pressure induced valence change also is observed in TmTe with Tm^{2+} being present under normal conditions. The valence change also occurs with Tm(Se,Te). Main features of the section on EuTe are magnetic and spectroscopic investigations, which show only antiferromagnetic ordering at low temperatures, unlike the complex magnetic properties of EuSe. EuTe's magnetic phase diagram, magnetic resonances, exchange interactions, and anisotropies have been extensively studied. Other tellurides studied include R_2Te_3, R_3Te_4, R_4Te_7, and pseudobinary tellurides.

The oxytellurides have not been studied as intensively as the other oxychalcogenides and only the R_2O_2Te type is known. Data on preparation, and crystallographic and magnetic propeties dominate this section. The main emphasis in the tellurate section is on their preparation and their crystallographic and optical properties. The whole concentration range of the M_2O_3-TeO_2 systems have not been studied and the reported compositions of some compounds are still under discussion. Interesting compounds among the tellurates(IV) are the so-called antiglass phases, which are metastable nonstoichiometric compounds with a crystal structure related to that of fluorite.

The generally used formula RPo for the polonides is not really accurate; the R:Po ratios of the prepared compounds vary. Data on preparation, crystallographic properties, and the thermal stability are

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Nd-Fe-B Magnet Review

M. Sagawa, S. Hirosawa, H. Yamamoto, S. Fujimura, and Y. Matsuura of Sumitomo Special Metals have written a comprehensive review of Nd-Fe-B based permanent magnet materials [*Japanese Journal of Applied Physics*, **26**, 785-800 (1987)].

The article starts with a short historical review of commercial magnetic materials. This is followed by a description of the crystal structure and magnetic properties of all $R_2Fe_{14}B$ compounds except Eu and Yb. Evidence for the existence of $Yb_2Fe_{14}B$ is reported in an ingot heat-treated under 200 Mpa pressure in unpublished work by M. Shimotomai and H. Yamamoto.

The next section deals with $Nd_2(Fe_{1-x}T_x)_{14}B$ systems where T = V, Cr, Mn, Co, Ni, Cu, Al, or Si. Included are some $R_2Co_{14}B$ systems where the iron has been completely replaced by cobalt. Also described is the $Nd_2Fe_{14}B_{1-x}C_x$ system. $Nd_2Fe_{14}C$ does not form but the $Nd_2Fe_{14}B$ structure has been observed up to x = 0.9 after annealing at 1173 K for about 75 hours.

This is followed by a section on the ternary Nd-Fe-B phase diagram. Next the powder metallurgical manufacturing process and properties of the Nd-Fe-B based sintered magnets are discussed. This includes the practice of the addition of other rare earths or other elements in the basic materials to improve their magnetic properties. The review closed with a discussion of possible improvements in the magnet field and possible uses of the Nd-Fe-B magnets.

New Magnet

(Continued from page 1)

K, except for M = Mo, where T_c = 400 K. For the Y compounds the T_c for M = Mo was 350 K while for the others, T_c ranged from 500 to 540 K.

K. Ohashi, Y. Tawara, R. Osugi, J. Sakurai, and Y. Komura [*J. Less-Common Met.* **139**, L1-L5 (1988)] report on an iron-rich phase containing Sm and Ti and find that the $ThMn_{12}$ type structure is present in the $SmFe_{11}Ti$ compound similarly to the Gd and Y compounds discussed above in the paper by de Mooij and Buschow. They also measured the magnetization of $SmFe_{11}Ti$ parallel and perpendicular to the c axis at 77 and 290 K.

Insight

In order to alert the scientific community to new developments in the rare earth field more quickly than we can through the *RIC News*, RIC began publishing on March 1, 1988, a monthly one- to two-page newsletter entitled *RIC Insight*. This limited distribution bulletin is available at a subscription price of U.S.$300.00. Subscription to *RIC Insight* automatically qualifies the person or institution as a RIC benefactor.

The emphasis in *RIC Insight* is different from the *RIC News* in that the former contains more editorial comments, provocative opinions on the future directions of rare earths, and late-breaking news. Some news items may appear in both newsletters, but if so, with a different slant. For a complimentary copy of the first issue and more information on *RIC Insight* contact RIC.

LUMINESCENCE

George Blasse has written a 93-page review entitled "Luminescence of Inorganic Solids: From Isolated Centres to Concentrated Systems" [*Progress in Solid State Chemistry*, **18**, 79-171 (1988)].

Luminescence of solids has been studied extensively and many important applications have been developed. While a reasonable level of understanding has been achieved, some problems still remain. Luminescence is a property related to the difference between two electronic states, vis. the emitting state and the ground state. This makes a general approach difficult, especially if we consider changes in the surroundings of a luminescent center. It must be realized that both the ground state and the excited state are influenced by such a change and that one is interested in their difference.

This review deals with the physical models used to describe luminescent processes in an isolated center and the interaction between luminescent centers. It describes the way in which the luminescence properties depend on the chemistry of the system; i.e., the crystal structure and/or the surroundings of the center. It is clear that this dependence can be very strong indeed.

The four main areas of discussion are entitled: The Isolated Luminescent Center; Energy Transfer Between Unlike Centers; Energy Transfer Between Identical Centers; and Delocalization vs. Relaxation in the Excited State. A short closing section deals with the many applications of luminescence.

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The rare earths are extensively used as dopant ions as well as being part of many of the host compounds.

George Pake Prize

Dr. Praveen Chaudhari of the IBM Thomas J. Watson Research Center, Yorktown Heights, New York, U.S.A., was awarded the 1987 George Pake Prize by the American Physical Society. He was selected ". . . for his outstanding management in enhancing the role of basic research in the electronics industry, for his leadership in materials and processing science in the scientific and technological community at large, and for his scientific insight and creativity in understanding the structure and properties of amorphous thin films and fine lines."

Chaudhari was born in India, received his B.S. (1961) from the Indian Institute of Technology, and his M.S. (1963) and Ph.D. (1966) from the Massachusetts Institute of Technology. He went to work at the IBM Center and since 1981 has been director of the Physical Sciences Department, and since 1982, vice president for science of the IBM Research Division.

In 1973, he and his co-workers showed that amorphous films of the rare earth-transition metal alloys could find application in magnetic bubble domain and magneto-optic information storage devices. Most recently he has been involved in the search for magnetic monopoles and the measurement of the neutrino mass.

In 1988, Praveen Chaudhari was further honored by being elected to membership in the National Academy of Engineering. Academy membership honors those who have made important contributions to engineering theory and practice or those who have demonstrated unusual accomplishments in new and developing fields of technology.

Ionic Conduction

Dispersions of insulating phases in solid electrolytes enhance their conductivity. The enhancements in ionic conductivities of such solid electrolytes in the low-temperature regimes are much larger than those observed at higher temperatures. Such enhancements in conductivities are of interest to material scientists designing solid electrolyte devices.

V. Vaidehi, R. Akila, A. K. Shukla, and K. T. Jacob studied the dispersion of Al_2O_3 and CeO_2 in CaF_2, [*Mater. Res. Bull.* **21**, 909-16 (1986)]. At 650 K, CaF_2 with 2 mol% CeO_2 has about three times the ionic conductivity of pure CaF_2. An increase to 4 mol% CeO_2 does not increase the conductivity further. Some aspects of the increase in the ionic conductivities of CaF_2-CeO_2 electrolytes can be explained by recently proposed theoretical models. It is proposed that a substantial enhancement in the vacancy concentration of CaF_2, brought about by the attraction of F^- ions to the surface of CeO_2, is responsible for the low temperature increase in the ionic conductivity of CaF_2 when CeO_2 is added. Scanning electron microscopy showed that the oxide particles are mainly present along grain boundaries in the sintered samples.

New Newsletter

Rhone-Poulenc has begun the publication of a company newsletter entitled *Rare Earths Monitor.* The purpose of the publication is to present "innovations, news, and applications," according to the secondary title. To get on the mailing list, send your address to the local Rhone-Poulenc agent or write directly to Rare Earths Monitor, Rhone-Poulenc Chimie Minerale Fine, Rare Earths Department, B.P. 29, 92097 Paris La Defense, France.

NEOMET

Neomet, the joint venture of REMACOR and Mitsubishi Metal Corporation, was formed in September 1986 with basically two employees. In January 1988, 16 months later, the total employment was 32 and a major expansion was under way to create a new 25,000 square foot production, maintenance, shipping, and receiving area at the West Pittsburgh facility.

High T_c Superconductivity

Material Aspects

In order to promote the idea that the *Journal of Crystal Growth* is a suitable outlet for papers on preparation and characterization of superconductors, a complete issue was dedicated to such papers. Volume **85,** No. 4 of *J. Cryst. Growth,* entitled "High-T_c Superconductors, Materials Aspects," was published in December 1987. The 120-page journal contains 20 papers on single crystals, thin films, ceramics, and characterization of high T_c superconductors. Edited by D. Elwell, M. Schieber, and L. Schneemeyer, the special issue may be obtained for Dfl 124.00 (~U.S.$67.00) from Dr. Bas van der Hoeck, acquisition editor, North-Holland Publishing Company, Sara Burgerhartstraat 25, P.O. Box 103, 1000 AC Amsterdam, The Netherlands.

ACS Symposium

Chemists, physicists, and materials scientists who work with superconductors will find *Chemistry of High Temperature Superconductors* an interesting and helpful book. The 29-chapter, 373-page book was developed from a symposium sponsored by the Divisions of Physical Chemistry and Inorganic Chemistry at the 194th Meeting of the American Chemical Society (ACS) in New Orleans, Louisiana, on August 30-September 4, 1987. ACS Symposium Series **351** was edited by D. L. Nelson, M. S. Whittingham, and T. F. George. It may be ordered from ACS Distribution Office, Department 390, 1155 16th St. N.W., Washington, DC 20036, U.S.A. The cost is U.S.$64.95 in the United States or Canada and exports elsewhere for U.S.$77.95.

The first three chapters present overviews of the theory of superconductivity; the next section, Materials Preparation and Characterization, contains nine chapters. Nine chapters also are devoted to Structure-Property Relationships, five to Processing and Fabrication, and one each to Surfaces and Interfaces, Applications, and Research Needs and Opportunities.

Adriatico Conference

Progress in High Temperature Superconductivity, Volume **1** [*Intern. J. Mod. Phys. B,* **1,** 3/4, 651-1156 (1987)] contains the proceedings of the Adriatico Research Conference on High Temperature Superconductors held July 5-8, 1987 in Trieste, Italy. Edited by S. Lundqvist, E. Tosatti, M. P. Tosi, and Yu Lu, the 508-page book published by World Scientific Publishing Company contains 62 papers on high T_c superconductivity presented at Trieste.

Beijing Workshop

Progress in High Temperature Superconductivity, Volume **2** [*Intern. J. Mod. Phys. B.,* **1,** 2, 169-648 (1987)] contains the proceedings of the Beijing International Workshop on High Temperature Superconductivity held June 29-July 1, 1987, in Beijing, People's Republic of China. Edited by Z.-Z. Gan, G.-Z. Yang, G.-J. Cui, and Q.-S. Yang, the 482-page book published by World Scientific Publishing Company contains 92 papers on high T_c superconductivity presented at Beijing.

Drexel Conference

Progress in High Temperature Superconductivity, Volume **3** [*Rev. Solid State Sci.* **1,** 2, 149-427 (1987)] contains the proceedings of the Drexel International Conference on High Temperature Superconductivity held July 29-30, 1987, in Philadelphia, Pennsylvania, U.S.A. Edited by S. M. Bose and S. D. Tyagi, the 281-page book published by World Scientific Publishing Company contains 27 papers presented at Philadelphia.

The preceding three books (journals) were all published by World Scientific and represent an attempt to keep up with the fast expanding field of high T_c superconductors. They are available in book form (U.S.$72.00, $52.00, and $68.00 respectively) or journal (U.S.$34.00, $24.00, and $34.00 respectively). They may be ordered from World Scientific Publishing Company, 687 Hartwell Street, Teaneck, NJ 07666, U.S.A. or World Scientific Publishing Company Pte. Ltd., Farrer Road, P.O. Box 128, Singapore 9128.

RE Handbook #10

For the first time, a special co-editor, Professor S. Hüfner, joined regular editors, K. A. Gschneidner, Jr., and L. Eyring, in the production of a volume of the *Handbook on the Physics and Chemistry of Rare Earths: High Energy Spectroscopy.* Volume **10,** which was published as part of the world-wide bicentennial celebration of the discovery of rare earths, was dedicated to all who have contributed to our knowledge of the rare earths since 1787.

The experimental techniques described in this volume involve a major perturbation of the rare earth ions in that they change the number of electrons. The interpretation of these experimental results led to some controversies in the early years of high-resolution spectroscopy. These issues can now be considered settled, but a careful analysis of the processes involved remains important and this is reflected in four theoretical chapters. The remaining seven chapters are based on experimental data and deal with various spectroscopic techniques or with special materials. The question of *f*-electron delocalization due to hybridization is a recurring theme in a number of chapters dealing with theory as well as in experiments carried out on mixed-valent compounds.

The chapter titles and authors are as follows: High-Energy Spectroscopy of Lanthanide Materials—An Overview, by Y. Baer and W.-D.

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(Continued from previous column)

Schneider; *f*-Electron Hybridization and Dynamical Screening of Core Holes in Intermetallic Compounds, by M. Campagna and F. U. Hillebrecht; Many-Body Formulation of Spectra of Mixed Valence Systems, by O. Gunnarsson and K. Schönhammer; Local Density Supercell Theory of Photoemission and Inverse Photoemission Spectra, by A. J. Freeman, B. I. Min, and M. R. Norman; Photoemission in Ce and Its Compounds, by D. W. Lynch and J. H. Weaver; Photoemission in Chalcogenides, by S. Hüfner; Calculation of 4*f* Excitation Energies in the Metals and Revelance to Mixed Valence Systems, by J. F. Herbst and J. W. Wilkins; Thermodynamic Aspects of 4*f* Levels in Metals and Compounds, by B. Johansson and N. Mårtensson; Bremsstrahlung Isochromat Spectroscopy of Alloys and Mixed Valent Compounds, by F. U. Hillebrecht and M. Campagna; X-ray Absorption and Emission Spectra, by J. Röhler; and Inelastic Electron Scattering Measurements, by F. P. Netzer and J. A. D. Matthew.

Published in 1987 by North-Holland Physics Publishing, the 611-page volume is available for Dfl. 350.00 from Elsevier Science Publishers B.V., P.O. Box 103, 1000 AC Amsterdam, The Netherlands or for U.S.$170.00 from Elsevier Science Publishing Company, Inc., 52 Vanderbilt Avenue, New York, NY 10017, U.S.A. Subscription prices are Dfl. 300.00 and U.S.$146.00.

ISMIC 1987

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Y. Nakamura and J. J. M. Franse, is available for Dfl. 314.00 (~U.S.$170.00) from Elsevier Science Publishers B.V., P.O. Box 103, 1000 AC Amsterdam, The Netherlands.

The symposium covered almost all subjects related to the basic magnetism of intermetallic compounds. Rare earth material is present in all eight chapters or sections. The chapter headings are "Spin Fluctuations," "Electronic Structure and Related Properties," "Spin Structure," "Laves Phase Compounds and Related Theory," "3*d* Transition Metal Compounds," "Rare Earth Compounds," "Actinide and Ce Compounds," and "3*d* Metals and Alloys." Roughly two-thirds of the papers deal with rare earth compounds.

LANTHANIDE BONDING

In a review entitled, "Chemical Bonding in Compounds of Lanthanides," V. A. Gubanov and M. V. Ryzhkov examine the principal phenomenological models and results of the theoretical investigations of the chemical bonding in compounds of rare earth elements; systematize data from band and cluster calculations of the structure and nature of the interatomic interactions in 4*f* systems; discuss the magnitude of the partial contributions of different electronic states to the chemical bonding and the role of the *f*-subshells in the bonding; and examine the influence of interatomic distances and the degree of filling of the 4*f* orbitals on lanthanide bonding.

Some of the conclusions of the review are: (1) covalency plays a significant role; (2) significant hybridization with valence orbitals of ligands occur with 4*f* orbitals as well as with the delocalized 5*d*, 6*s*, and 6*p* orbitals; (3) the *f* states play an important part at the start of the series but this effect decreases rapidly with increasing atomic number; (4) the 4*f* and 5*p* orbitals both help determine interatomic distances; and (5) the 5*p* orbitals hybridize with the n*s* orbitals of ligands and it seems more correct to classify them among the valence states, rather than among the core states.

Among the questions raised and not answered are: what is the influence of a particular many-electron state on the chemical bonding of the compound under investigation; how can we improve the methodical basis for the analysis of interatomic interactions and make more correct and meaningful evaluations of the energy or force characteristics of chemical bonds; and how do we determine the limits of the applicability of the representation of a bond in the form of a set of additive partial contributions of different electronic states.

The review can be found in *Zh. Struk. Khim.*, **27,** No. 5, 123-35 (1986) [English translation, *J. of Struct. Chem.*, **27,** 781-94 (1986)].

Superconducting Materials

RIC is maintaining a list of producers of superconducting materials. If you wish to receive a copy, please contact us.

SPONSOR RECORD

With a month left in fiscal 1988, we have 122 members in our family of sponsors. This breaks last year's record by nine. Our heartfelt thanks to each of our sponsors for their wonderful support. During this last quarter we have received support from 47 benefactors with 14 being new additions to our family. The sponsors are listed below, with the number of years they have been supporting RIC in parentheses.

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Gmelin Handbook

(Continued from page 4)

reported.

Volume C 10, containing 362 pages, was published in 1987 for the Gmelin Insitute for Inorganic Chemistry by Springer-Verlag. It costs DM 1493 (~U.S.$890.00) and may be ordered from Springer-Verlag, 4005 Marketing Gmelin, Heidelberger Platz 3, D-1000 Berlin 33, West Germany.

Sorption Refrigerator

Lawrence Wade and Kurt Karperos of the Aeroject ElectroSystems Company in Azusa, California, are developing a sorption refrigerator that could have a big impact on many fields from aerospace to electronics. Sorption refrigerators differ from conventional ones in that the refrigerant is compressed thermally, rather than mechanically.

The Aerojet approach employs a Joule-Thomson refrigerator system using hydrogen as the refrigerant and $LaNi_5$ as the sorption material. By heating the system from 300 K to 400 K (127°C) the pressure goes from 1 to 40 atm. High pressure hydrogen, released from the compressor, flows through precoolers and recuperative heat exchangers to the Joule-Thomson valve where it is expanded, cooled, and partially liquefied.

After absorbing the heat load, the gas flows back via heat exchangers to a second compressor where the cooled, low pressure gas is absorbed. The only moving parts are check valves operating at the warm end of the cooler. The four compressors are pressure vessels equipped with a means to heat and cool them. As one unit delivers high pressure hydrogen, another absorbs the expanded low pressure gas. Another one is being pressurized by heating and the other is being cooled back down so it can absorb the low pressure gas from the next cycle.

For space operations, this approach offers high reliability—also the goal is to ensure 5 to 10 year lifetimes, and compactness—all the key parts could fit into a 6-inch tube.

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