RARE-EARTH INFORMATION CENTER NEWS

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

Volume XV | December 1, 1980 | No. 4

Two Giants Die

Within about 24 hours, two scientists who had major impacts on science over the last forty years died. Prof. B. T. Matthias died on Monday, October 27, and Prof. J. H. Van Vleck passed away the following day.

Matthias died of a massive heart attack at the age of 62. He had received his doctorate from the Eidgenössische Technische Hochschule in Zürich in 1943, where he worked on ferroelectric materials. He was associated with the Bell Laboratories since 1948 and held a joint appointment since 1961 with the Bell Laboratories and the University of California-San Diego. He was also closely associated with the Los Alamos Scientific Laboratory for about 30 years where he served as a Laboratory Fellow and consultant. His main research efforts were concerned with superconducting materials, and materials which have exotic and/or novel properties. A year ago he was one of three corecipients of the American Physical Society's International Prize for New Materials.

Matthias was a personal friend of the editor and his passing away is a great loss to his relatives and to those of use who knew him, and his death will be deeply felt by the scientific and technological community.

Prof. J. H. Van Vleck died on Tuesday, October 28, after a short illness at the age of 81. Van Vleck received his doctorate from Harvard University in 1922. From there he went to the University of Minnesota until 1928, then to the University of Wisconsin until 1934, and finally back to Harvard where he was named Emeritus Professor of Mathematics and Natural Philosophy in 1969.

(Continued on Page 3)

1980 IR 100

Rare earth materials are building blocks in five of *Industrial Research's* 1980 list of the top 100 significant new technological developments [21, No. 10 (1980)]. The diversity of the applications described below is notable.

An yttria-stabilized zirconia membrane is the key to a zirconia pH sensor developed by L. W. Niedrach of the General Electric Co. The sensor works for extended periods of time under both high temperatures and pressures. Possible applications are direct pH measurement in nuclear reactor primary water systems, geothermal brines, and in high temperature corrosive processes.

A direct-writing recorder developed at the Bell & Howell Co. by N. E. Samek uses a PLZT (lead lanthanum zirconium titanate) ceramic material as a light gate. When a voltage is applied to the PLZT, its ferroelectric domains rotate the polarization vector 90° allowing light to reach the light-sensitive recording paper. The light gate is controlled by input data signals.

Yttrium hexaboride and erbium dodecaboride have gotten into the solar energy game thanks to J. Schreyer, C. Schmidt, and L. Abbatiello of Union Carbide Corp., Nuclear Division. The fine particle boride powders form a plasma-sprayed coating which traps incoming solar radiation. The coating combines high temperature stability with a 71 to 97% heat recovery efficiency. Applications include solar power stations and furnaces.

R. Holsinger of the New England Nuclear Corp. has used samarium cobalt permanent magents to produce a permanent magnet quadrupole for economically focussing charged particle beams. Advantages over electromagnet focussing include no power consumption, no cooling requirement, and smaller magnet volume per unit of field gradient.

Borides strike again in the form of a high purity single crystal lanthanum hexaboride gun for an analytical electron microscopy. Developed at Hitachi, Ltd. by M. Kubozoe, the electron microscope can be used for microelemental analysis in metallurgy, mineralogy, biology, and medicine. A triple lens system in conjunction with the lanthanum boride gun allows for a wide variety of illumination.

15th RARE EARTH RESEARCH CONFERENCE UPDATE

Several deadlines for the 15th Rare Earth Research Conference are fast approaching. The most immediate deadline is for nominations for the recipient of the second Frank H. Spedding Award. Nominations with supporting biographical data and a cover letter citing specific achievements should be sent to Chairman, Selection Committee, Professor W. E. Wallace, Department of Chemistry, University of Pittsburgh, Pittsburgh, PA 15261, U.S.A. by January 15, 1981.

The deadline for the submission of abstracts is also January 15, 1981. The abstract and two copies should be mailed to Professor G. R. Choppin, Program Chairman, Department of Chemistry, Florida State University, Tallahassee, FL 32306 U.S.A. General catagory, preference for mode of presentation, and desired form of publication should be noted. All papers submitted for publication will be refereed.

The final registration and abstract forms may be obtained by writing to Arts & Sciences Continuing Education, University of Missouri-Rolla, Rolla, MO 65401, U.S.A.

William F. Meggers Award

J. G. Conway has been selected by the Optical Society of America to receive the 1980 William F. Meggers Award for outstanding work in spectroscopy. Conway's accomplishments in measurement and analysis of actinide crystal and atomic spectroscopy are cited. He has been a member of the Los Alamos Scientific Laboratory, a research associate at the University of Pittsburgh, and is presently on the senior staff of the Lawrence Radiation Laboratory. Current research interests include laser excitation determinations of energy levels and ionization energies of lanthanides and actinides.

FERROMAGNETISM

Volume 2 of the projected 4 volume series entitled *Ferromagnetic Materials, A Handbook on the Properties of Magnetically Ordered Substances* has been published in 1980 by North-Holland Publishing Company, Amsterdam and New York. Edited by E. P. Wohlfarth, Volume 2 is 592 pages long and costs $102.50 (DF1. 210.00). Subscription price for the entire series is $87.00 (DF1. 178.50) each for Volumes 1 and 2.

Six of the eight review articles contain information on the rare earths. In chapter one M. A. Gilleo reviews rare earth garnets as ferromagnetic insulators. Crystalline and magnetic structures of the garnets, in particular yttrium iron garnet, are covered along with substitutional efforts on the magneto crystalline anisotropy and the magnetoelastic effect. In chapter three, P. I. Slick briefly touches on the effect of La_2O_3 on the permeability of MnZn ferrites. J. Nicolas' review of microwave ferrites in chapter four contains a section on various polycrystalline garnets. The different types of garnets covered include conventional, high magnetization, low linewidth and high peak power garents. Yttrium iron garnet is emphasized. A. H. Eschenfelder contributed both chapter five, crystalline films for bubbles, and chapter six, amorphous films for bubbles. In chapter five, elementary bubble concepts and the relationship between practical bubble parameters and fundamental magnetic and nonmagnetic parameters are discussed. Garnet film fabrication, lattice mismatch, magnetization, anisotropy, static and dynamic bubble properties, and composition for applications are also covered. The review also touches on rare earth orthoferrites. In chapter six the various binary and ternary alloy amorphous films are presented with emphasis on the Gd-Co-Fe and Gd-Co-Mo alloys. Specific topics include film fabrication, magnetization, anisotropy, range of properties, and practical application. In chapter eight, S. W. Charles and J. Popplewell review the preparation, stability criterion, magnetic properties, ferro-hydrodynamics, and applications of ferromagnetic liquids. Finely divided gadolinium particles suspended in liquid approximate a ferromagnetic liquid.

Valence Instability

An International Conference on Valence Instabilities is being planned for September 28 to October 1, 1981 at the Physics Department of the Swiss Federal Institute of Technology (ETHZ) in Zürich-Hönggerberg, Switzerland. The Conference is open to anyone and will consist of invited and contributed papers on the general topics of electronic structure and associated properties, bulk magnetic properties, lattice properties, and microscopic magnetic measurements. Specific topics would include transport phenomena, photon spectroscopies, thermal properties, magnetization, change of magnetic state, elastic constants, compressibility, phonons, pressure effects, x-ray measurements of lattice symmetry, Mössbauer, NMR and EPR studies, and both elastic and inelastic neutron scattering. The proceedings of the conference will be published. English is the recommended language. For more information contact P. Wacher, Swiss Federal Institute of Technology (ETHZ), Lab. fur Festkörperphysik, CH-8093 Zürich, Switzerland.

Application Prize

The second American Institute of Physics Prize for Industrial Application of Physics has been awarded to A. H. Bobeck of Bell Laboratories. The prize emphasizes industrial applications of physics, publicizes and encourages physics research in industry, and enhances awareness of the role of physics in industrial research. Bobeck is being cited for his leading role in the invention and development of single-walled magnetic bubble memory devices which has stimulated new discoveries and understanding in the field of magnetism. His contributions include the buble propagation techniques of conductors, rotating field and oscillating bias field, the chevron expander detector, and the concept of growth-induced uniaxial anisotropy in epitaxial garnet films. Bobeck initially worked with rare earth orthoferrites before switching to rare earth garnets. Current interests include the development of high density bubble devices.

Chemistry & Spectroscopy

N. M. Edelstein has edited a book entitled *Lanthanide and Actinide Chemistry and Spectroscopy, ACS Symposium Series 131.* Published by the American Chemical Society (ACS) in 1980, the book is based on a symposium sponsored by the Division of Inorganic Chemistry of the ACS and held in Washington, D.C. on September 10-13, 1979. As a result, this collection of papers serves as an introduction to current trends, developments, and applications in lanthanide and actinide chemistry and spectroscopy. Over a third of the papers deal with the rare earths under three general headings. These are organoactinide and organolanthanide chemistry; complex chemistry, thermodynamic properties and transcurium chemistry; and electronic structure and spectroscopy. The clothbound volume contains 472 pages and costs $40.00.

LETTER

TO THE EDITOR:

re: Patent Information

In your September 1, 1980 issue of the *RIC News* you report on a quite recently published compilation of only 270 U.S.A. patents (since 1973) on the subject of rare earth technology (metallurgy and chemistry) and applications by F. Villani.

We wish to acquaint you with the actual, rather formidable size of the international position regarding rare earth patents, which includes since 1973 well over 1000 U.S.A. patents, on all aspects of rare earth technology, etc.

Very truly yours,

R. I. Rosenfelder
Patents Research
and Documentation
7, Alba Gardens
London, NW11 9NS
England

TWO DIE

(Continued from Page 1)

Van Vleck is known primarily for his contributions to the theory of magnetism. He was one of the first to explain the temperature dependence of the magnetic susceptibility of rare earth compounds. His book *The Theory of Electric and Magnetic Susceptibilities,* published in 1931 and reprinted many times, is a classic. In 1977 he was one of three co-recipients of the Nobel Prize in Physics. Van Vleck was often called the father of rare earth magnetism. To his successors he leaves a rich heritage.

RIC News
(USPS 464-960)
Vol. XV No. 4 December 1, 1980
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

HALF TIME

That's right! We are half way through Fiscal Year 1981. The statistics of the second quarter very nearly matched those of the first quarter in that thirteen companies contributed, bringing the total number to 27 for the year. Twelve companies renewed their support and one company joined our family of benefactors for the first time. All of the companies are listed below. The number in parentheses is the number of years the company has supported the Center.

Allied Chemical Corporation, U.S.A. (9)
Atomergic Chemetals, Inc., U.S.A. (9)
A/T Products Corporation, U.S.A. (1)
BBC Brown, Boveri & Company, Switzerland (9)
Cometals, Inc., U.S.A. (4)
Davison Specialty Chemical Co., Subsidiary of W. R. Grace & Co., U.S.A. (13)
Th. Goldschmidt AG, Germany (12)
Indian Rare Earths Ltd., India (12)
MCI-Megon A.S., Norway (10)
Rare Earth Products, Ltd., England (9)
Shin-Etsu Chemical Co., Ltd., Japan (11)
Treibacher Chemische Werke AG, Austria (9)
United States Radium Corporation, U.S.A. (11)

Special recognition is accorded to MCI-Megon A.S., as this year marks their tenth year as a benefactor of the Rare-Earth Information Center which qualifies them for the RIC Honor Roll. It is not an overstatement to say that the success of RIC is a direct result of this type of loyalty and support. To all of the rare earth industry and MCI-Megon in particular this year: Thank you!

Top Inventor

W. A. Thornton, Jr. has been named Inventor of the Year for 1979 by the Association for the Advancement of Invention and Innovation. The association's committee, which consists of scientists, engineers, patent attorneys, and businessmen, chose Thornton for his invention of prime color lamps and for formulating the theory that resulted in their development. Thornton is a research engineering consultant for Westinghouse Electric's Lamp Division. His lamp is based on the fact that the human eye responds better to three specific wavelengths which correspond to the colors blue-violet, green, and orange-red. Different mixtures of these colors approximate white light. Two of the three phosphors used in the prime color lamps contain rare earths.

Editor's Note: Incidentally, the Rare-Earth Information Center has been part of a test by the Ames Laboratory on the effectiveness of the prime color lamps for the better part of a year now. Needless to say, we think they work great!

RE's IN THE NEWS

Improved Coating

Using a less expensive cobalt-chromium-aluminum-yttrium alloy and a special plasma spray technique, researchers at General Electric have developed a new coating for gas turbine buckets. The useful life of the buckets is expected to triple when compared to the higher cost platinum-containing alloy currently being used.

New Stainless Steel

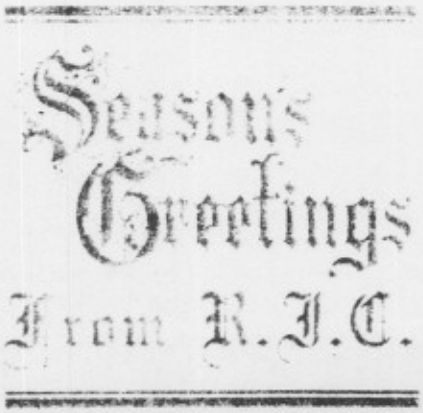
Scientists at Sandvik, Inc. have developed a rare earth-containing stainless steel to replace 18-25 Cr -8-20 Ni type steels. The rare earth addition improves oxidation and carburization resistance up to 1150°C. The new steel is being applied in gas preheaters, heat exchangers, burners, and thermocouple protection tubes.

Russian Acquisitions

New Russian books received by RIC include *Redkozemel'nye Poluprovodniki. Tekushchaya Bibliograficheskaya Informatsiya 10* [*Rare Earth Semiconductors. Current Bibliographic Information, No. 10*], V. P. Zhuze, ed., Fiziko-Teknicheskii Institut im. A. F. Ioffe, Akmii Nauk SSSR, Leningrad (1979). Also we have received Nos. 11 (1979) and 12 (1980) which carry the same title, editor, and publisher as No. 10. The tenth bibliography has 551 citations while the eleventh has 542 and the twelfth 570. References are printed in their original language and a brief subject index is included in each volume. No. 12 also has an author index. Other volumes are: *Fazovye Diagrammy Elementov pri Vysokom Davlenii* [*Phase Diagrams of the Elements at High Pressure*], E. Yu. Tonkov, Nauka, Moscow (1979); *Splavy Redkikh i Tugoplavkikh Metallov c Osobymi Fizicheskimi Svoistvami* [*Alloys of Rare and Refractory Metals with Specific Physical Properties*] N. Kh. Abrikosov, ed., Izdatel'stvo Nauka, Moscow (1979); and *Tugoplavkie Soedineniya Redkozemel'nykh Metallov* [*Refractory Compounds of Rare Earth Metals*], K. E. Mironov, ed., Izdatel'stvo Nauka, Novosibirsk (1979).

REers ON THE MOVE

J. B. Gruber has accepted the position of Vice President for Academic Affairs at Portland State University, Portland, Oregon. The appointment also carries the rank of Professor of Physics and Chemistry. Gruber leaves the position of Dean of the College of Science and Mathematics at North Dakota State University.



LIGHT READING

With the publication of his book entitled *Fluorescent Lamp Phosphors, Technology and Theory*, K. H. Butler sheds a little enlightenment on man-made light. After a brief introduction to the history of lamp requirements and development, the topics covered are current research and development techniques, halophosphate optimization, specialized phosphors, lamp processing methods, lumin maintenance, optics of phosphor coatings, color and color rendition, phosphor and lamp efficiency, phosphors for high-pressure mercury vapor lamps, and applications for phosphors. The second half of the book deals with basic phosphor theory, theoretical background, Sn^{+2}, Pb^{+2}, and Sb^{+2} activators, Mn^{+2} and Mn^{+4} activators, lanthanide and d^{10} activators, complex ion activators and energy transfer. The essential character tables and other tables for subgroups, allowed transitions, direct products with spin representations, and splitting of angular momentum representations are all brought together for the first time. Phosphors of specific interest to rare earthers include rare earth activated phosphates, orthophosphates, borates, gallates, silicates, aluminates, aluminosilicates, and yttrium vanadate.

Published by the Pennsylvania State University Press in 1980, the book is 351 pages in length and costs $39.50.

Caught in the Act

Since the mid 1970's, yttrium-stabilized, cubic zirconium oxide has been widely accepted as a diamond substitute. This is very easy to understand when one compares the index of refraction, dispersion and hardness of each. For yttrium-doped zirconia they are 2.15-2.18, 0.060-0.063, and 7.5-8.5 (the range of values corresponds to different compositions) while for diamonds they are 2.42, 0.044, and 10, respectively. These values are so close that it has become very difficult for even some of the experts to tell the difference if the stone is small and mounted in jewelry. Science and Ceres Electronics Corporation have come to the rescue according to P. Read [*Canadian Jeweller*, (November 1979)]. The Ceres diamond probe distinguishes real diamonds from the imitations by comparing the thermal conductivity of the gems. Cubic zirconia is a poor heat conductor and so it shows up obviously in the imitation column.

An interesting side note is that different rare earths add striking color when added to the yttrium-doped zirconia. Praseodymium imparts a yellow hue, erbium gives a pink color, and adding neodymium results in the color blue. Dysprosium, thulium, holmium, and gadolinium additions result in little or no color at all.

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