



RARE-EARTH INFORMATION CENTER NEWS

ENERGY AND MINERAL RESOURCES RESEARCH INSTITUTE
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Who is 'The Rare Earth Industry'?



CERAC, Incorporated

CERAC, incorporated was formed in April of 1964 by Dr. Ervin Colton as an outgrowth of his R & D activities in inorganic materials, and in particular refractory materials, at Allis-Chalmers in Milwaukee. At that time, there was a demand by R & D scientists doing research related to space, nuclear science, optics and electronics, for a comprehensive source of rare inorganic chemicals actually produced and not merely resold. Beginning in the corner of a small industrial building, CERAC today occupies a three-story building with 45,000 square feet of working area and currently employs 35 people. Dr. Colton is the company's President and Research Director.

CERAC's rare earth product line and R & D activities encompass the following areas:

1. *Syntheses.* An extensive program of preparing rare earth derivatives is under way. Products include:

- A. Salts, both hydrated and anhydrous.
- B. Refractory compounds, such as borides, carbides, nitrides and silicides.
- C. Non-metallic compounds, such as sulfides, selenides, phosphides and tellurides.
- D. Alloys, such as aluminides, nickelides and cobalt combinations.

2. *Hot-pressing.* All rare earth derivatives are being hot-pressed, without added binders, to form dense bodies in the form of discs, rods, crucibles and custom shapes. These include LaB_6 and Gd-Co alloys.

3. *Arc melting.* The rare earth oxides are arc melted to produce fully dense, free-flowing powders for use in flame spray applications, e.g. Y_2O_3 - and CeO_2 -stabilized ZrO_2 .

4. *Vacuum melting.* Rare earth compounds, particularly the fluorides, are vacuum melted to produce granular forms.

Many of these materials such as CeS, CeO_2 , PrF_3 , and Gd-Co alloys are sputtered and evaporated to give optical, electronic and amorphous films on various substrates.

A unique aspect of the CERAC manufacturing program is the use of X-ray diffraction for quality control.

EDITORIAL

With this issue we begin a new feature entitled "Who is The Rare Earth Industry?" We have become increasingly aware over the years that the industrial and commercial areas play a large and significant role not only in the rare earth community but also in many parts of the total scientific and technological world. In recognition of this, the new series will be given equal status to our long standing feature "Rare Earthers Around the World." Indeed, as is found in this issue, we anticipate many future newsletters will carry both features.

Shortly before this issue went to press we informed all of our current benefactors of this new series and furnished them guide lines and rules which will govern submissions to the *RIC News* for inclusion in this feature. If you and/or your company are interested in this series please write me and we will furnish you additional information.

Karl A. Gschneidner, Jr. Editor

All preparations are subjected to X-ray diffraction, spectrographic and wet chemical analysis to complete the Certificate of Analysis sheet that accompanies each shipment at no additional cost to the buyer.

Comprehensive catalogs are available by writing to CERAC, incorporated P. O. Box 1178, Milwaukee, Wisconsin 53201, U.S.A. CERAC can also be reached by telephone at 414-289-9800 or by telex at 269452 (CERAC Mil).

EDITOR'S NOTE:

This is one of a continuing series of features on rare earth industry. The information contained herein was supplied by the company featured and its publication should not be construed to constitute an endorsement by RIC or Iowa State University of the products or services offered by the company.

CONTRIBUTORS

'FULL SPEED AHEAD' seems to be the trend for rare earth industry this year if the response RIC has received is any indication. Nine companies have renewed their support to the Center this quarter and two new companies joined their ranks for the first time. Contributors are listed below (the number in parentheses is the number of years the company has supported RIC).

- Allied Chemical Corp., USA (5)
- British Flint and Cerium Manufacturers, England (5)
- Cerac, Incorporated, USA (1)
- Companhia Industrial Fluminense, Brazil (5)
- General Electric Company Quartz & Chemical Products Section, USA(2)
- GTE Sylvania, USA (5)
- Nuclemon-Nuclebras de Monazito e Associados Ltda., Brazil (5)
- Research Chemicals, USA (9)
- Rhone-Poulenc-Chimie Fine, France (7)
- Union Carbide, Linde Division, USA (1)
- U. S. Radium Corp., USA (7)

Atomic Data Tabulated

Comprehensive descriptions, at the Hartree-Fock level, of all the elements of the Periodic System and many of their positive ions have been tabulated by S. Fraga, J. Karwowski and K. M. S. Saxena in their book *Handbook of Atomic Data*, Elsevier Scientific Publishing Co., Amsterdam and New York (1976). The book is 551 pages in length and costs \$49.75.

The book begins with a brief review of atomic structure theory and a description of the tabulated data. The balance of the book consists of tables of configurations, functions, energies, spectra, coupling constants, external interactions, integrals and parameters, expectation values and data for additional configurations. Data is tabulated by topic to aid in comparison. For the rare earths information on the neutral atom, all the positive ions but one of scandium, the first eleven positive ions for the elements yttrium and lanthanum thru ytterbium, and the first four positive ions of lutetium and the actinides is given. This work establishes a permanent point of reference for theoretical calculations and is useful to the experimental researcher as a reference or a basis for future work.

Dy Sheds Light on Psoriasis Treatment

In developing an effective photochemotherapeutic treatment of psoriasis, T. Fischer and J. Alsins have used dysprosium lamps [*Acta Dermatovener (Stockholm)* 56, 383-90 (1976)]. The Dy lamps are of the gas discharge type, operate at approximately atmospheric pressure and have a high emission of visible light and high intensity in the UV-A region. The result of treatment with trioxsalen baths and dysprosium lamplight was found to be equal or superior to the currently used Ingram method in all but one case when tried on 26 patients. The authors found this treatment practical and easily managed, giving good cosmetic results, and it avoids the risk of toxic side effects sometimes connected with peroral treatment.

RE's in the News

Tiny 3D

Soon it will be possible not only to see microscopic objects but to see them in three dimensions if Hitachi, Ltd., Japan, is successful in its development of a stereoscopic attachment for scanning electron microscopes. The device contains a PLZT (Pb, La, Zr Titanate) electro-optical shutter.

Possible Earthquake Detection

NASA's Goddard Space Flight Center, Greenbelt, MD, has incorporated a Nd:YAG laser into a spaceborn earthquake detection monitor. The laser bounces light off of cubic reflectors placed along quake-prone faults and measures shifts in the earth's crust with an accuracy of 2 to 5 cm.

New Milling Process

Th. Goldschmidt A. G. has joined with Maschinenfabrik Wiener and Co. of Amsterdam to develop a gas-proof attritor for milling rare earth cobalt alloys. The new equipment yields powder which has a constant oxygen content and reduces the milling time considerably.

RARE! EARTHLY GOOF

In the last issue of *RIC News*, Volume XI, [4] 2 (1976), we incorrectly reported that A. J. Rard was the editor of *Encyclopedia of Electrochemistry of the Elements*, Vol. 6, Marcel Dekker, Inc., New York (1976). It should have read A. J. Bard. Sorry 'bout that!

MEETING

13th Rare Earth Research Conference CALL FOR ABSTRACTS

The organizers of the 13th Rare Earth Research Conference to be held October 16-20, 1977 at Ogleby Park, Wheeling, West Virginia, have issued a call for abstracts. Solid state chemistry, chemistry, physics, industrial and spectroscopy are the general categories of topics. This year there will be a choice of the mode of presentation, either by poster session or oral delivery. Abstracts are due by April 15, 1977 and should describe original, unpublished work except for invited review papers. For more information contact Dr. G. J. McCarthy, Program Chairman, 205 Materials Research Laboratory, The Pennsylvania State University, University Park, PA 16802 USA.

Rare Earths and Actinides Conference

The invited speakers and their topics have been named for the Conference on Rare Earths and Actinides which will take place July 4-6, 1977 at the University of Durham in the United Kingdom. They are, respectively, K. A. Gschneidner, Jr., Introductory Address; D. W. Jones, Materials and Crystal Growing; D. K. Ray, Crystal Fields; B. Johansson, Structural and Elastic Properties; A. J. Freeman, Band Theory and Fermi Surfaces; P. A. Lindgard, Excitations-Spin Waves; G. H. Lander, Magnetic Properties; H. Kirchmayr, Intermetallics; H. Zilstra, Permanent Magnets; and J. R. Fairholme, Magnetic Bubbles.

Contributions concerning physical properties of the rare earths and actinides including materials with potential applications are solicited. Abstracts are due by April 1, 1977. For more information contact Dr. W. D. Corner, Physics Department, University of Durham, South Road, Durham DH1 3LE, United Kingdom.

XVIII ICC TO MEET

The XVIII International Conference on Coordination Chemistry will take place July 18 to 23, 1977 at the University of São Paulo, São Paulo, Brazil. The official language of the conference is English. One of the five sessions is devoted to lanthanide chemistry. For more information write to Prof. Paschoal Senise, Instituto de Química, Universidade de São Paulo, Caixa Postal 20780, São Paulo, Brazil.

LaF₃ DETECTS IR

A prototype device for infrared detection has been developed by A. Sher, C. L. Fales and J. F. Stubblefield which employs LaF₃ [*Appl. Phys. Letters* 28, 676-8 (1976)]. LaF₃ is an ionic conductor with a capacitance which varies exponentially with temperature. This temperature sensitivity is the basis for the infrared detector. Based on observations from the prototype, the authors predict that an operational device could be constructed which would have a detectivity comparable to the currently available pyroelectric detectors. However pyroelectric devices are often limited by piezoelectric noise which would not be the case with LaF₃ detectors.

GMELIN Handbook Series Adds Two

With the publication of Books B4 and C2 of *System 39, Rare Earth Elements, the Gmelin Handbuch der Anorganischen Chemie* comes two volumes nearer to completion. Books which are currently available include Section A, 1 and 2, Section B, 1, 3 and 4 and Section C, 1 and 2.

Book C2 deals with compounds of scandium, yttrium and the lanthanides with hydrogen and oxygen, and with nitrogen. Preparation and various properties are given for the rare earth hydrido-oxides, hydroxides, oxide hydroxides, peroxy compounds, oxometallates, hydroxometallates, nitrides, imides, amides, azides, hydroxide azides, nitrites and nitrates. Published in 1974, this book is 299 pages in length, costs \$196 and features an English table of contents and margin notes.

Book B4 is devoted to describing atomic scandium, yttrium and the lanthanides. The properties of rare earth atomic nuclei and diatomic molecules are discussed along with the properties of the atoms and ions including electron configuration, optical spectra, energy levels, ionization energies, electron affinity, atomic scattering factors, binding energy of inner shell electrons, cross sections, level widths, X-ray absorption and emission spectra, Auger spectra, Mossbauer spectra, Coster-Kronig transitions, and atomic and ionic radii. In addition to the regular table of contents and margin note features



Rare earth workers in the Solid State Physics Group at Durham University. Left to right, F. J. Jones, G. F. Clark, F. M. Saad, B. K. Tanner, W. D. Corner, A. A. Joraide, R. L. Smith and R. F. Warnock.

DURHAM UNIVERSITY

Magnetic Properties of Rare Earths

Over the past two decades there has been a continuing interest at Durham in the magnetic properties of rare earth metals, alloys and compounds. Current work is concerned both with investigating magnetic domain structures and making basic magnetic measurements. The group is led by Dr. W. D. Corner and under his direction research student R. L. Smith has been re-measuring the magnetocrystalline anisotropy of Gd by torque magnetometry, using ultrapure crystals produced by solid state electrolysis (SSE) at the Centre for Materials Science, Birmingham University. R. F. Warnock and A. A. Joraide are respectively measuring the anisotropy and magnetostriction of a series of Gd-Tb alloys in an attempt to distinguish between single and two ion contributions to the anisotropy. Low temperature domain configurations in the SSE Gd have been revealed by F. M. Saad using a technique of evaporating iron in a low pressure of helium. Detailed interpretation of the patterns is in progress.

Dr. B. K. Tanner joined the group in 1973 on the appointment of Dr. K. N. R. Taylor to a chair in Australia.

His expertise is in the field of X-ray diffraction topography, a technique usually used for assessment of crystal perfection but also suitable for imaging magnetic domains via the magnetostriction. Studies of the perfection of the rare earth compounds RVO₄, RPO₄, RAsO₄ and RAlO₃ have been performed. With G. F. Clark, Dr. Tanner is developing X-ray topographic techniques using synchrotron radiation. Ferromagnetic domains in Tb and (Ho_{1-x}Tb_x)Fe₂ crystals have recently been revealed by X-ray synchrotron topography. F. J. Jones is developing a technique for magnetostriction measurements using double crystal X-ray diffraction.

Russian Book

The Russian book *Redkozemel'nye Metally i Splavy (Rare Earth Metals and Alloys)*, E. M. Savitskii and V. F. Terekhova, eds., Izdatelstvo Nauka, Moscow (1971) has been translated to English as Report No. AEC-tr-7408 and is available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA, U.S.A. 22161. The cost is \$6.00.

approximately 58% of this volume is written in English. Book B4 is 427 pages long, costs \$324.40 and was published in 1976.

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Rare Earthers Promoted

T. A. Henrie has been appointed Chief Scientist of the U. S. Department of Interior's Bureau of Mines. He will serve as the principal advisor to the Bureau of Mines Director on research policies and goals and will give technical leadership to innovative research by the Bureau on minerals and materials technology. Henrie formerly served as Bureau of Mines Deputy Director for Mineral Resources and Environmental Development.

M. J. Lalich has been named Manager of Cast Iron Research and Development for the Ferroalloys Division of Foote Mineral Company, Exton, PA. His responsibilities will include the development and application of Foote products for the cast iron industry. Prior to his appointment, Lalich served as Foote's Senior Research Metallurgist and Research Associate for Ferrous Metallurgy.

BULLETIN AVAILABLE

A new bulletin entitled "Rare Earth Reviews" has been initiated by Rare Earth Products Limited, Waterloo Road, Widnes Cheshire WA8 0QH, United Kingdom. The bulletin will generally describe properties of individual rare earths and their applications. Anyone interested in receiving this bulletin should contact Rare Earth Products, Limited or their U. S. representative, United Mineral & Chemical Corporation, 129 Hudson Street, New York, NY 10013.

Yttria Molds Ti Alloys

Yttria has found an application in a program to develop titanium alloy casting technology conducted by D. R. Schuyler, J. A. Petruska, G. S. Hall and S. R. Seagle [AFML-TR-76-80 (August 1976)]. New low melting titanium alloys were developed and new crucibles had to be designed which would not react with the molten titanium. Two crucibles showed favorable results. The compositions which were successful were Y_2O_3 -15% Ti and Y_2O_3 with a Y_2O_3 - K_2SiO_3 face coat. Typical casting contamination levels were 0.2-0.4% oxygen and 0.2-0.5% yttrium. The authors note that these materials provide a good foundation for the development of a low-cost investment casting process for producing titanium alloys.

ANOTHER RE VOLUME

Volume 30 of *Structure and Bonding*, edited by J. D. Dunitz, P. Hemmerich, J. A. Ibers, C. K. Jørgensen, J. B. Neilands, D. Reiner and R. J. P. Williams, is now available and contains considerable information for rare earthers. The book is 197 pages long, costs \$27.90 and was published by Springer-Verlag, Heidelberg (1976). A brief synopsis of the articles follows.

In "A Systematic Correlation of the Properties of the f-Transition Metal Ions" S. P. Sinha reviews the history and development a systematic classification of various lanthanide properties. The Inclined W hypothesis is presented and used in the correlation of separation factors, formation constants, thermodynamic properties, oxidation potentials, ionization potentials, spectroscopic properties and several miscellaneous properties. The hypothesis is shown to incorporate the gadolinium break and the tetrad effect and also finds application in correlation of actinide properties. (98 ref.)

Excited states and energy transfer from donor cations to rare earths in the condensed phase is the topic of a review by R. Reisfeld. Various transfer probabilities are discussed including resonance energy transfer, macroscopic energy transfer, migration of energy, inhomogeneous broadening and phonon-assisted energy transfer. A correlation is then drawn between the optical properties of ions having strong absorption and the host medium. (74 ref.)

In "Spectroscopy of Homogeneous Mixed Valence Rare Earth Compounds," M. Campagna, G. K. Wertheim and E. Bucher review the application of X-ray photoemission spectroscopy (XPS) to the study of the

FIND MORE RE'S

This past summer a U. S. Geological Survey team discovered granite-like rock in Western Alaska which contained possibly useful amounts of thorium, uranium and rare earths. Samples from this deposit which is located 15 miles northeast of Golovin, a small town 50 miles east of Nome, contained up to 0.15% uranium oxide, 1.05% thorite and more than 2% rare earths.

Solubility Data Project

Prof. A. S. Kertes of the Institute of Chemistry of The Hebrew University of Jerusalem, Jerusalem, Israel has called our attention to IUPAC'S Solubility Data Project of which he is chairman. In this project all available literature data for a given system are being compiled and will undergo critical thermodynamic evaluation. The most reliable data are selected for the final compilation which includes data sheets of numerical and/or graphical data from the literature, critical evaluation and recommended solubility data. Several of the expected fifty volumes will include solubility information on rare earth compounds. For more information interested persons should contact Prof. Kertes.

electronic structure of mixed valence rare earth compounds. A history of the development of XPS is given and homogeneous mixed valence compounds are defined. Application of XPS to specific mixed valence systems is discussed. (76 ref.)

The fourth article is by C. K. Jørgensen and deals with deep-lying valence orbitals and problems of degeneracy and intensities in photoelectron spectra. Information on the rare earths is included. (224 ref.)

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