Rare-earth Information Center NEWS

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FIBER OPTICS

Glass fibers have the potential of replacing satellites for long distance communications. In 1985, Bell Labs scientists combined 10 laser beams in a single glass fiber to send 2×10^{10} bits of information per second over a 42 mile (68 km) length of fiber without amplification. This is roughly equivalent to sending the data in 200 encyclopedia volumes per second. The drawback was that to go further, amplification and rebeaming was necessary.

Now, researchers at Naval Research Laboratory (NRL) in Washington, D.C., have developed ultra-low-loss optical fibers that can transmit data thousands of miles without the need of repeaters. Dr. Danh Tran, principal investigator, said the fibers are being developed from fluoride glass primarily for transoceanic uses. The fiber Tran developed is composed of various fluorides, including lanthanum, zirconium, barium, aluminum, sodium, and/or hafnium. Tran claims that the fluoride glasses will eventually transmit with a loss rate of 0.001 dB/km, more than a hundred times better than the best silica glass now being used. One reason for the improved transmission is the ability of the fluoride glasses to transmit in the 2-4 micron (infrared) range. Also if the impurities are reduced, there is less scattering and better transmission. Martin Drexhage, chief of the Optical Materials Section at Hanscom Air Force Base (Bedford, Massachusetts), believes chemical vapor deposition can be perfected to make fluoride glasses cleaner and more efficient.

Other possible applications include acoustic and magnetic fiber sensor systems, laser surgery and cauterization, infrared power delivery systems, and remote temperature and chemical sensing systems.

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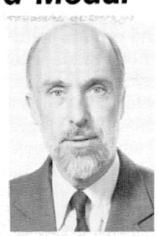
Fluoride glasses are now being made by SpecTran of Sturbridge, Massachusetts; Le Verre Fluore of St. Erblon, France; Furukowa of Tokyo, Japan; and possibly others. It is believed that their full potential will not be realized for at least 5 to 10 years, but already Infrared Fiber Systems of Silver Springs, Maryland, is exploring their uses for laser surgery.

Rutherford Medal



Dr. W. J. L. Buyers has been named as the 1986 recipient of the Rutherford Medal in Physics of the Royal Society of Canada. The medal is awarded for outstanding research in physics and was established in memory of Nobel Prize winner Lord Rutherford of Nelson, a leader in nuclear research.

Dr. Buyers was born in Aboyne, Scotland, in 1937, educated at the University of Aberdeen, and in 1965 joined the staff of the Chalk River Nuclear Laboratories operated by Atomic Energy of Canada, Limited. His most important contributions have been in magnetic excitations and lattice vibrations in both ordered and disordered materials, and structure determination of solids and liquids. He has conducted positron annihilation research into fermi surface dimensions and, more recently, into vacancy formation energies in metals and alloys. He has collaborated with many scientists around the world although most of his work has been carried out at the Chalk River Nuclear Laboratories. Among the rare earth elements and compounds he has worked with are Pr, Gd, Pr_3Tl, NdSb, and RAl_2.

Rare Earth Bicentennial

The discovery of ytterbite (later called gadolinite) in 1787 was the beginning of the rare earth chapter in the history of science. Little did Lieutenant Carl Axel Arrhenius realize his place in history when he picked up that black rock near Ytterby, Sweden, and thus brought lasting fame to the town for which many of the rare earths are named.

The Rare-earth Information Center would like to celebrate the 200th anniversary of the discovery of ytterbite and invite you, the readers, to join us. We would welcome stories from our readers on what they think are some of the important highlights of the first 200 years of rare earths. Unless there is some special significance associated with it we do not want stories of the discovery of the individual rare earths elements. The stories should contain from 200 to 800 words and we will publish one or two stories per issue in 1987. Important references should be included and the stories should be double

(Continued on page 2)

GMELIN HANDBOOK

With the present volume "Rare Earth Elements" **D4**, the description of rare earth coordination compounds is completed. This volume of the *Gmelin Handbook of Inorganic Chemistry* discusses the complexes of the rare earths with organic ligands containing S, Se, Si, P, or As; with biologically important "small" ligands; and with inorganic anions in solution.

Chapters 1 (107 pages) and 3 (197 pages) make up two-thirds of the book. The first chapter deals with ligands containing sulfur while chapter 3 deals with ligands containing phosphorus. Among the sulfur containing ligands are sulfoxides, sulfonamides, tri- and tetrasu!famidates, thiols, and other mercapto compounds, thiocarboxylic acids [$RS(CH_2)_nCOOH$ and RCOSH], dithiocarbamic acids, thiourea, etc. Many of these complexes, as well as those with phosphorus containing ligands, are important in extraction and separation of the rare earths (see volume **D6**, chapter 2, "Solvent Extraction"). Volume **D4** covers their preparation and properties, with emphasis on their stability and structure. The phosphorus containing ligands discussed in chapter 3 include phosphine oxides, phosphinic and phosphonic acids and their esters, esters of phosphoric acid, amides of phosphinic and phosphoric acids, tri- and tetrametaphosphimic acids, thio- and dithiophosphinic acids, and esters of dithiophosphoric acid.

Chapter 2 deals with ligands that contain selenium or silicon while chapter 4 deals with arsenic containing ligands.

The material in chapter 5 is restricted to ligands that can be regarded as "small" and that have been studied because of their importance to biological systems, not from the standpoint of lanthanide coordination chemistry. These ligands may contain several different ligating groups and can bind metal ions in more than one molecular arrangement.

Formation and properties of complexes of RX_n with inorganic anions (OH^-, NO_3^-, F^-, Cl^-, ClO_4^-, SCN^-, SO_4^{2-}, PO_4^{3-}, etc.) in solution are detailed in chapter 6. Tables of stability and formation constants as well as

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thermodynamic functions are presented.

Volume **D4,** containing 377 pages, was published by Gmelin Institute for Inorganic Chemistry of the Max-Planck Society for the Advancement of Science in 1986. It costs DM 1521 (~U.S.$760) and may be ordered from Springer-Verlag, 4005 Marketing Gmelin, Heidelberger Platz 3, D-1000 Berlin 33, West Germany.

Dy

1886

Holmia was separated from erbia in 1879 and was thought to be the oxide of the element holmium. In 1886 Lecoq de Boisbaudran took this "pure" oxide and separated it into two new oxides using fractional precipitation, first with ammonium hydroxide and then with a saturated solution of potassium sulfate. As was the custom with earlier separations of one oxide into more than one, he retained the name homia for one and selected a name for the other one. He chose the name dysprosia, coined from the Greek work *dysprositos,* which means "hard to get at." Lecoq de Boisbaudran never had much material to do research on and supposedly confided to fellow scientist, Professor Urbain, that most of his fractionations had been carried out on the marble slab of his fireplace.

Dysprosium is used as a neutron absorber to measure nuclear reactions, measure exposure to radiation, and in nuclear reactors. A stainless steel with about 3 percent Dy_2O_3 added is used in certain control rods of high-flux-beam reactors. Dysprosium can be used in catalysts, but, except for special uses, is too expensive. Dy_2O_3 on alumina polymerizes ethylene. It is used in ceramics with possible applications to microwave equipment and spark plugs. The versatile element is the most abundant of the heavy rare earths, with the exception of yttrium with which it occurs, and when combined with other elements has possible uses in the future in photoelectric, electronic, semiconducting and thermoelectric materials and in magnetostrictive materials such as "Terfenol," $(Dy_{0.7}Tb_{0.3})Fe_2$.

Russian Notes Lasers 25th Year

A. M. Prokhorov discusses the background research and speculation that led to the discovery of the laser by T. H. Maiman in 1960. He begins with Albert Einstein's work on the quantum theory of light and stimulated emission, the cornerstones of quantum electronics. He then discusses the discovery of masers and then describes some of the difficulties involved in the designing of laser systems.

This short historical review appears in *Usp. Fiz. Nauk,* **148,** 3-6 (1986) [Engl. transl. *Sov. Phys. Usp.* **29,** 1-2, (1986)] as a prelude to Prokhorov's longer article entitled "A New Generation of Solid-State Lasers," [*Ibid.*, 7-33 and 3-19, respectively].

In 1982, 42 percent of lasers sold outside of the socialist countries were solid-state lasers with more than half of these being Nd doped $Y_3Al_5O_{12}$ (Nd-YAG). He claims the solid-state laser's share of the market has grown since then. He describes and references some of the biggest advances in solid-state lasers in the past year or so and some of the new host materials and lasers that have been or are being developed.

The majority of the paper is devoted to the description and discussion of four laser systems, three of which involve rare earths. The four sections are well referenced and the bibliography for this paper contains 153 entries.

RE Bicentennial

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spaced, as one would submit an article to a regular scientific journal.

The author's name(s) will appear in the *RIC News* along with the article unless a wish to remain anonymous is expressed. In the event of duplicate stories, the story judged best by the RIC staff will be published. At the end of 1987 all stories received will be published in a booklet form and will be made available to our readers. So come on and let us know what you think are the outstanding highlights of the 200 year history of the rare earths. If we do not receive stories from you the readers, the editor has threatened to present his own personal views of the great events involving the rare earths that have occurred between 1787 and 1987.

Evgenii Mikhailovich Savitskii

The RIC has only recently learned of the death of Professor Savitskii (Savitsky) of the A. A. Baikova Institute of Metallurgy of the Academy of Science of the USSR, Moscow. He died in 1984 at the age of 72 after a long illness. Born on January 30, 1912, in the village of Colovianenka near the town of Kalinin, he started work at 18 years of age as a factory worker in a nonferrous metals plant. His talents were soon recognized and he became a student and postgraduate student at the Moscow Institute of Nonferrous Metals and Gold.

In 1937, he became a research worker of the Institute of Inorganic Chemistry where he investigated the influence of temperature and composition on the physico-chemical properties of metallic systems. He later founded the Laboratory of Rare and Refractory Metals and Alloys at the A. A. Baikova Institute and was director of the laboratory for 30 years.

Professor Savitskii authored or coauthored over 150 papers on the rare earth metals and alloys.

He was elected an associate member of the USSR Academy of Sciences in 1962 and was a corresponding member of the academy until his death. He won numerous Government Achievement Awards and was a laureate of the N. G. Kurnakov Prize in 1973.

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BUSINESS NEWS

New Master Alloys

Drawing on the experience gained in electrolytic production of aluminum, Sumitomo Light Metal Industries, Limited, has announced the development of a new continuous process for the production of rare earth-transition metal alloys involving fluoride molten salt electrolysis.

The new process is suitable for the mass production of the master alloys with less impurities, including oxygen, and without going through a refinement step. This is done by controlling the raw materials, electrode materials, and electrolytic parameters such as current density. A neodymium-iron master alloy has been produced in a pilot plant at Sumitomo's Technical Research Laboratories at Nagoya, Japan. The neodymium-iron master alloy is suitable for use in Nd-Fe-B permanent magnets. Other master alloys produced by this process are terbium-iron, dysprosium-iron, and lanthanum-nickel. Patents have been applied for these and other alloys.

NEOMET Corporation

The joint venture of REMACOR and Mitsubishi Metal Corporation announced in the last *RIC News* [**XXI**, [3] 2 (1986)] now has a name—NEOMET Corporation—and a president—Thomas Mackey. The joint venture is held 49 percent by REMACOR and 51 percent by Mitsubishi Metal Corporation. In addition, Mitsubishi Metal American Corporation has purchased 25 percent of the common stock of REMACOR.

Neomag Incorporated

Neomag Incorporated (a subsidiary of Polymag, Inc., of Long Island, New York) has announced plans to open a plant in New Castle, Pennsylvania. Ted Watson, a partner in Polymag, said that the International Punchmaster Corporation, of which he is president, would market the products. He expects the new plant to open in January and start production in February if the necessary financing is available.

Neomag plans to use neodymium manufactured by NEOMET to produce magnets that have varied uses to give the business a broad base.

MAGNETIC MATERIALS

In January 1984, the National Materials Advisory Board of the National Research Council, at the request of the Department of Defense, established a Committee on Magnetic Materials with Robert M. White as chairman. The committee was (1) to assess current progress in research and development of magnetic materials in the United States; (2) to identify key problems and factors (economical and technological) that might limit the use of any magnetic material; and (3) to recommend research and development areas, including manufacturing methods, that would most likely return the highest scientific and technological dividends.

The committee's 96-page report (NMAB-426), issued in March 1985 and entitled *Magnetic Materials,* is available from the National Materials Advisory Board, National Research Council, Joseph Henry Building, 21st Street and Pennyslvania Avenue, N.W., Washington, D.C., 20418, at a cost of U.S.$12.00.

After a summary of the committee's conclusions and recommendations and an introduction to magnetic materials, the report is divided into chapters dealing with hard magnetic materials, soft magnetic materials, storage media, transducers, and fine particles for uses other than recording.

Each chapter is further divided into related topics. In most cases they include a description of the materials and principals involved, applications and markets, technical issues, current research and development, and opportunities. For example, in chapter 3 the rare earth permanent magnets' share of the hard magnet market in the United States in 1982 was given as 11 percent of total sales as compared to 0.5 percent in 1972. The report also shows that in 1982 Japan produced 40 percent of the noncommunist world's magnets, the United States 32 percent, Europe 20 percent, and others 8 percent. In 1984, the overall permanent magnet market is given as one billion dollars.

Each chapter is of special interest to certain users of magnetic materials and, although all chapters do not have reference to rare earths, most of them do contain applications or suggested research of materials containing rare earths.

WHAT A QUARTER!!

This year, like last year, the second quarter of our fiscal year was a record maker in that 41 sponsors sent us their contributions, which breaks last year's record of 31. This includes 14 first-time family members. We are very appreciative of this support and thank all our sponsors, old and new, for your heart-warming response to our letters.

The 41 organizations who sent their support during the second quarter are listed below with the number of years they have supported RIC in parentheses.

- Allied Automotive Technical Center, U.S.A. (2)
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- Parkans International Incorporated, U.S.A. (1)
- Permag Corporation, U.S.A. (1)

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- Rhone-Poulenc Incorporated, U.S.A. (7)
- Rhone-Poulenc Minérale Fine, France (17)
- Sassoon Metals & Chemicals Incorporated, U.S.A. (2)
- SG Magnets, England (2)
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- Shin-Etsu Chemical Industry Company, Limited, Japan (17)
- Herman C. Stark Incorporated, U.S.A. (1)
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- Thomas & Skinner Incorporated, U.S.A. (2)
- Transelco Division, Ferro Corporation, U.S.A. (11)
- Treibacher Chemische Werke AG, Austria (15)
- University of West Indies, West Indies (1)
- USR Optonix Incorporated, U.S.A. (16)
- Wheeler Associates, U.S.A. (1)
- Yue Long Chemical Plant, People's Republic of China (6)

YSZ—Silicon Nitride

The addition of 10 percent yttria-stabilized zirconia (YSZ) to silicon nitride increases the strength at high temperatures as compared to that doped with MgO. The strengths of the two are about equal at a little less than 1,200°C, but the YSZ silicon nitride is twice as strong at 1,400°C, only 200°C higher. According to researchers Sunil Patta and Bruno Buzek of the NASA Lewis Research Center, the YSZ doped Si_3N_4 has a higher thermal conductivity than most ceramics, a low coefficient of

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thermal expansion, and a good resistance to thermal shock. It can withstand operating temperatures of 1,650°C (3,000°F), shows little strength degradation at high temperatures, resists creep, and has the best Weibel modulus of any of the Si_3N_4 materials. At 1,370°C, its oxidation resistance is comparable to silicon carbide. It has, according to the researchers, potential applications in aircraft and automotive engines as well as in electric power generating systems.

CONFERENCE CALENDAR

5th Intl. Conf. on Valence Fluctuation
Bangalore, India
January 5-9, 1987
RIC News, **XX**, [4] 3 (1985)

2nd Intl. Conf. on the Basic and Applied Chemistry of the f-Transition (Lanthanide and Actinide) and Related Elements (2nd I.C.L.A.)
Lisbon, Portugal
April 6-10, 1987
RIC News, **XIX**, [4] 3 (1984) and **XX**, [2] 2 (1985)

Intl. Symposium on Magnetism of Intermetallic Compounds (ISMIC)
Kyoto, Japan
April 20-22, 1987
RIC News, **XXI**, [1] 4 (1986)

9th Intl. Workshop on Rare-Earth Magnets and Their Applications and 5th Intl. Symposium on Magnetic Anisotropy and Coercivity in Rare Earth-Transition Metal Alloys
Bad Soden, West Germany
August 31-September 3, 1987
RIC News, **XXI**, [1] 4 (1986)

18th Rare Earth Research Conference (RERC)
Interlaken, Lake Geneva, Wisconsin, U.S.A.
September 11-15, 1988
RIC News, **XXI**, [3] 1 (1986)

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