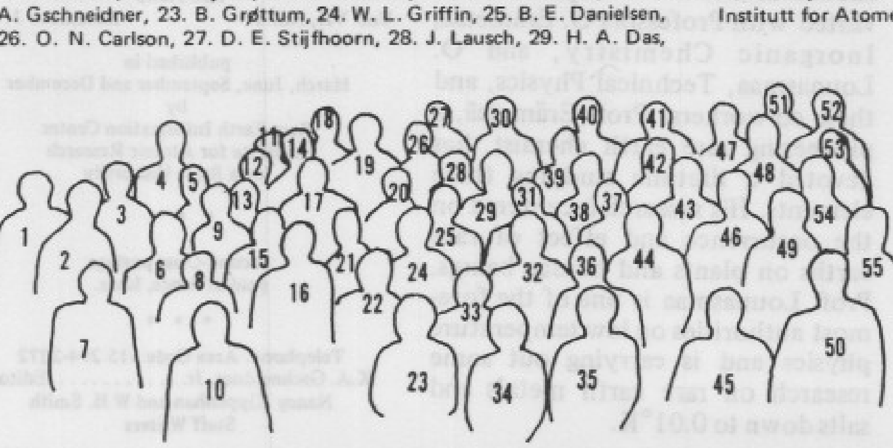
RARE-EARTH INFORMATION CENTER NEWS

SUPPORTED BY INSTITUTE FOR ATOMIC RESEARCH
IOWA STATE UNIVERSITY / AMES, IOWA

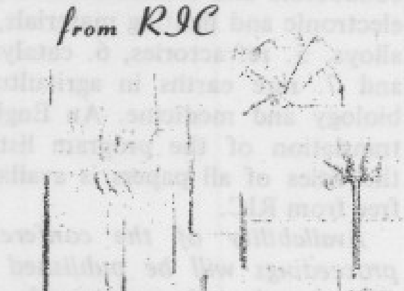
Volume VII | December 1, 1972 | No. 4

NATO Holds RE Advanced Study Institute

NATO Advanced Study Institute participants posed for this group photo. Please refer to the key below to match names with faces. 1. D. A. Hukin, 2. B. Gaudernack, 3. D. W. Jones, 4. J. van Ooyen, 5. K. E. Davies, 6. M. Steinberg, 7. J. Khaladji, 8. S. Larach, 9. J. E. Whitley, 10. E. Andersen, 11. J. E. Mathers, 12. R. E. Shrader, 13. F. Molnar, 14. E. Herrmann, 15. R. A. G. de Carvalho, 16. R. Åmli, 17. M. Ødegård, 18. A. Kvalheim, 19. A. Bjune, 20. H. Stäblein, 21. J. M. P. Cabral, 22. K. A. Gschneidner, 23. B. Grøttum, 24. W. L. Griffin, 25. B. E. Danielsen, 26. O. N. Carlson, 27. D. E. Stijfhoorn, 28. J. Lausch, 29. H. A. Das, 30. I. Hundere, 31. L. A. Haskin, 32. V. A. Fassel, 33. M. Tecotzky, 34. M. R. Grade, 35. M. Bonnevie-Svendsen, 36. P. N. Yocom, 37. E. Steinnes, 38. P. Möller, 39. A. Follo, 40. R. Conzemius, 41. G. Chr. Faye, 42. I. Alstad, 43. J. Haaland, 44. E. L. DeKalb, 45. M. Centincelik, 46. G. Blasse, 47. O. B. Michelsen, 48. M. Skarestad, 49. A. Rannestad, 50. Y. Khan, 51. E. Østgaard, 52. N. Gjelsvik, 53. T. Danielsen, 54. A. C. Pappas, and 55. D. J. Hobbs (Photo courtesy of Institutt for Atomenergi, Kjeller, Norway)



Greetings of the Season from RIC



Rare Earth Glue

The role of rare earth additions in reducing the oxidation rate of high temperature alloys, such as Fe-25% Cr-4% Al, has been investigated by J. K. Tien and F. S. Pettit, *Met. Trans.* 3, 1587-1599 (1972). Although the rare earths, specifically Y or Sc, increase the initial oxidation rates by providing faster diffusion paths for oxygen, they promote the adhesion of the oxide scale to the metal body and prevent spallation of the oxide.

Tien and Pettit found that spallation of the scale is caused by distribution of small voids at the oxide-substrate interface, but those alloys which contained Y or Sc were free of voids. They suggest that Y or Sc either form vacancy complexes with excess vacancies or provide internal oxide boundaries for the condensation of excess vacancies. In either case the rare earths prevent the formation of vacancies at the oxide-substrate interface, and thus eliminate spallation of the protective oxide coating.

Russian RE Meeting

On September 12-17, 1972, the 7th Russian Conference on Rare Earth Metals was held in Moscow. A number of non-Russian scientists were invited to attend. A combination of individual papers and the reporter system (one person summarizing the results of several papers) was used throughout the Conference. Of the 92 presentations about 20 were by non-Russian scientists.

Seven topics were covered in the conference: 1. magnetism, 2. superconductors and semiconductors, 3. electronic and lighting materials, 4. alloys, 5. refractories, 6. catalysis, and 7. rare earths in agriculture, biology and medicine. An English translation of the program listing the titles of all papers is available free from RIC.

Availability of the conference proceedings will be published by RIC after the volume is issued.

Editor Reports–

Scandinavian RE Research

SCANDINAVIA 1972

The editor was fortunate to have attended the NATO Advanced Study Institute on "Analysis and Application of Rare Earth Materials" at Kjeller, Norway (near Oslo) in late summer and to visit four other laboratories in Finland, Sweden and Denmark. The wonderful kindness and generous help of my gracious hosts, and nearly perfect weather made my first journey to the Scandinavian countries a delightful and memorable one. The scientific and technical research being carried out at these laboratories is impressive, and the visits were scientifically quite profitable.

NATO CONFERENCE

My first port-of-call was the Institutt for Atomenergi, Kjeller, Norway, at which the week-long Study Institute was held. A total of 28 invited tutorial-type lectures were presented by experts from Europe, the Near East, and America. In addition, all 66 of the participants had an opportunity to interact with the various experts during three panel discussions and breaks between papers. As the conference title implies, almost all analytical techniques, and all major and some of the exciting on-the-horizon applications were discussed. *The Advanced Study Institute plans to publish in early 1973 all of the papers presented at the Conference. The availability of this Conference proceedings will be announced in the RIC News.*

FINLAND

Two 40-minute flights, with an intermediate stop at Stockholm, took me from Oslo to Helsinki. There I visited the Helsinki University of Technology in the Helsinki suburb of Otaniemi. In particular, I visited with Professors O. Erämetsä, Inorganic Chemistry, and O. Lounasmaa, Technical Physics, and their co-workers. Prof. Erämetsä, a pioneering rare earth chemist, has devoted a lifetime studying these elements. His research is centered on the occurrence and effect of rare earths on plants and human beings. Prof. Lounasmaa is one of the foremost authorities on low temperature physics and is carrying out some research on rare earth metals and salts down to 0.01°K.

SWEDEN

The Institute of Physics at the University of Uppsala was my next stop. Although only a little rare earth research is being done at this Institute, a number of interesting investigations in physics are being pursued, such as solid state physics and electron spectroscopy. The only work involving the rare earths are angular correlation studies under the direction of Dr. Erik Karlsson.

DENMARK

In Denmark I visited the neutron physics group at the Danish Atomic Energy Commission's Research Establishment Risø, about an hour's drive from Copenhagen. Neutron scattering and theoretical work on rare earth materials under the direction of Dr. H. Bjerrum-Møller deals primarily with praseodymium metal. While at Risø I renewed my acquaintance with a former colleague from Iowa State, Dr. A. R. Mackintosh, director of the Research Establishment Risø.

RIC News

Vol. VII, No. 4 December 1, 1972

published in
March, June, September and December
by
Rare-Earth Information Center
Institute for Atomic Research
Iowa State University

* * *

Second-Class postage
paid at Ames, Iowa.

* * *

Telephone: Area Code 515 294-2272
K.A. Gschneidner, Jr. . . . . .Editor
Nancy Kippenhan and W.H. Smith
Staff Writers

MEETING

RARE EARTH METAL PHYSICS

A Europhysics Study Conference on the physics of rare earth metals will be held at the LO-Højskole, Elsinore, Denmark, Aug. 29-Sept. 1, 1973. Sponsored by the Metals and Magnetism Sections of the EPS and by the Danish Atomic Energy Commission, its formal program will consist entirely of invited review papers with attendance limited to 100 persons. However, there will be an opportunity for the informal presentation of recent research.

The conference fee, including meals and accommodations, will be approximately $125. For additional information and a registration form, contact the conference secretary, J. C. G. Houmann, Physics Department, Danish Atomic Energy Commission, Research Establishment Risø, DK-4000 Roskilde, Denmark.

How is Your RCo_5?

Do you have a problem obtaining pure RCo_5 phases? According to F. A. J. den Broeder and K. H. J. Buschow, *J. Less-Common Metals* 29, 65-71 (1972) and Buschow, *ibid.*, 283-288, the RCo_5 phases do not exist at room temperature under equilibrium conditions.

The RCo_5 compounds were found to undergo a eutectoid decomposition forming R_2Co_7 and R_2Co_{17}. The eutectoid temperature increases across the lanthanide series from 600°C for the first four, to 750°C for $SmCo_5$ and then to ~ 1350°C at thulium, the point at which the eutectoid and melting temperatures appear to coincide.

The eutectoid decomposition of the RCo_5 phase results in a diminished coercive force. Fortunately, by rapid cooling from above the eutectoid temperature, the RCo_5 phase may be retained without decomposition. Thus, RCo_5 magnets can be manufactured by maintaining proper conditions.

LOW TEMPERATURE THERMOMETER

Cerium magnesium nitrate (CMN) has a new competitor in low temperature thermometry. J. C. Doran, U. Urich, and W. P. Wolf concluded from a recent investigation that CDP, trisodium tris-(pyridine-2,6-dicarboxylato) cerate (III) pentadecahydrate, is at least as good as CMN for millikelvin thermometry, and it has the additional advantage of smaller demagnetizing corrections because of its weak volume susceptibility, *Phys. Rev. Letters* 28, 103-106 (1972). On the basis of their results the authors stated that a detailed study of the low temperature properties of CDP is now called for.

Before Fermi

As fantastic and incredible as it may seem, there is now evidence that the first nuclear chain reaction did not occur at Stagg Field on Dec. 2, 1942, but in an African uranium deposit 1.7 billion years ago.

The rare earth elements Ce, Nd, Sm and Eu–known fission products of uranium–were found in uranium ore, unusually depleted in ^{235}U, from the Oklo mines in Gabon. Dr. Francis Perrin, former high commissioner of the French Atomic Energy Commission, presented his evidence for nature's first reactor at an October meeting of the French Academy of Science. The deposit would have contained 3% ^{235}U 1.7 billion years ago, enough to support sustained fission. Dr. Perrin proposed that water filtering through the deposit acted as a moderator; when the heat from the reaction became too intense, the water vaporized and halted the chain reaction until the deposit cooled sufficiently for the steam to condense. He estimates that the fossil pile at Oklo functioned intermittently for anywhere from several hundred million to more than a billion years.

Rare Earths In the News

JOINT RE PRODUCTION VENTURE

Molybdenum Corp. of America and Aluminum Co. of America have embarked on a joint venture to produce mischmetal and pure rare earth metals by electrolytic reduction of the oxides.

TWO IN TOP 100

Rare earths were again among *Industrial Research's* 100 most significant products of the year. A repetitively pulsed miniature YAG laser for use in alarm systems, tool alignment and educational kits, and an inexpensive solid state gas sensor employing a LaF_3 electrolyte (see story on p.4) were among those cited.

Rare, Earthly Goofs

RIC News, Vol. VII, No. 3, Sept. 1972: The continuation on p. 3 of the item entitled More Magnets in the "Rare Earths in the News" feature should have read, "...have potential energy products exceeding 60 MG Oe..."

More Contributions

RIC is now receiving support from 28 rare earth companies as a result of contributions from eight more firms since the September issue of *RIC News* went to press. The following companies have made contributions to RIC for the 1973 Fiscal Year; the number in parenthesis behind each contributor's name indicates the total number of years that firm has helped fund RIC.

American Metallurgical Products, Co., USA (4)
American Rare Earth & Foil, Inc., USA (1)
Lunex Company, USA (3)
Rare Earth Industries, Inc., USA (2)
Research Chemicals, USA (5)
Rhone-Progil (formerly Pechiney-Saint Gobain), France (3)
Santoku Metal Industry Co., Ltd., Japan (3)
Shin-Etsu Chemical Industry Co., Ltd., Japan (4)

Lutetium Discoverer

Georges Urbain (1872-1938)

(Editor's note: This is the first of a series of articles commemorating the centennial of those scientists who made great contributions to the field of rare earths.)

Georges Urbain's unquenchable thirst for truth led him at age 23 into a field in which some of the greatest chemists had become badly confused. Rare earths as a field of research may have seemed the most purely technical of all lines open to him, but Urbain deplored the fact that so few chemists were engaged in research on the rare earths despite the attraction of the unknown.

Urbain's 25 years of research on the rare earths included more than 200,000 fractionations—work which was of tremendous importance to the development of rare earth research. By effecting the rigorous separation of Sm, Eu, Gd, Tb, Dy and Ho, Urbain cleared up the confusion which existed in the chemistry of the yttrium series, and, moreover, discovered lutetium in 1907, a previously unknown element in what had been formerly known as ytterbium. The importance of following separations by both physical and chemical means was emphasized by Urbain who used phosphorescent spectra and the coefficients of magnetization of the rare earths to monitor their separation.

Besides his work on the rare earths, Urbain was also known for the discovery of element 72, celtium, in 1922, which was discovered the same year by Hevesy and Coster and named hafnium, and for his contributions to the study of cathode phosphorescence. Deeply interested in philosophy, Urbain also had a taste for the arts and was a talented pianist, composer, musicographer, painter and sculptor.

As Professor of General Chemistry at the Sorbonne, Urbain conducted a series of brilliant lectures which were immensely popular with the students. Urbain was also a Member of the Institute of France, Director of the Institute de Chimie de Paris, Co-director of Institute de Biologie Physico-Chimique and a Member of the International Committee on Atomic Weights.

First X-Ray Laser Employs Neodymium

Pulses of infrared light from a neodymium-glass laser stimulated lasing action in what is believed to be the first x-ray laser. A University of Utah team produced a collimated beam of x-rays by shining the Nd laser light onto a sandwich consisting of a weak copper sulfate solution in gelatin between two microscope cover glasses. The experiment is not reproducible in that x-rays are produced only about 10% of the time.

X-ray lasers have far-reaching applications. Such lasers could be incorporated into x-ray microscopes capable of observing the electronic structure of matter or could be used for heating and diagnostics in plasma physics.

The preliminary x-ray laser experiments were reported by E. M. Eyring, F. W. Cagle and J. G. Kapros, *Proc. Natl. Acad. Sci.* 69, 1744-1745 (1972).

LaF_3 Gas Sensor

A LaF_3 thin film has been incorporated into a solid state sensor for the selective specific measurement of a variety of gases. The device, only a fraction of a square millimeter in area, consists of a gas-permeable membrane, a noble metal grid cathode, a film of the LaF_3 electrolyte as thin as 1000 Å and a metal anode, such as bismuth, which reacts with fluorine and the gas being measured to form a sink for the charge-carrying ions. A variety of gases (oxygen, carbon dioxide, sulfur dioxide and the nitrogen oxides) can be measured over a wide temperature range. Moreover, the low cost ($1) of the LaF_3 gas sensor opens up the possibility of disposable sensors.

B.C. LaRoy, A.C. Lilly and C.O. Tiller of the Philip Morris, Inc., Research Center are responsible for the development of this probe.

25 With Fifteen

W. R. Grace & Co. is celebrating its 25th year in the rare earth industry as a producer of rare earth materials and polishing products.

Rare-Earth Information Center
Institute for Atomic Research
Iowa State University
Ames, Iowa 50010