RARE-EARTH INFORMATION CENTER INSIGHT

Institute for Physical Research and Technology
Iowa State University / Ames, Iowa 50011-3020, U.S.A.

Volume 1 | April 1, 1988 | No. 2

High Temperature Superconductivity

A third type of high temperature superconductor, $Tl_2Ca_2Ba_2Cu_3O_{10+x}$ (2:2:2:3), with even a higher transition temperature than that of the $Bi_2Sr_{3-x}Ca_xCu_2O_{8+y}$ (2:2:1:2) phase (zero resistance at ~90 K) and the $YBa_2Cu_3O_{7-x}$ (1:2:3) phase (zero resistance at 90 K), has been discovered. The highest zero resistance value reported for the 2:2:2:3 compound is 125 K, a significant increase over the 1:2:3 and 2:2:1:2 phases. Scientists report that this material is about as easy to prepare as the Bi (2:2:1:2) superconductor in that it does not need a low temperature oxygen anneal as for the rare earth (1:2:3) superconductors. Furthermore, the Tl phase is apparently as stable as the Bi compound (the Y and lanthanide compounds have been reported to deteriorate upon long term exposure to air in some instances). The major drawback for the 2:2:2:3 superconductor is that Tl is highly poisonous, but at this stage this presents no serious problem as long as the researchers follow standard safety procedures for toxic materials. As noted in the last issue of RIC Insight, the values of the upper critical field and critical current will probably determine which superconductor will dominate in the market place, since they all have zero resistance at liquid nitrogen (77 K).

It is interesting to note that all three of these high temperature superconductors have some common characteristics. They all involve: Cu oxide, a divalent alkaline earth metal (Ca, Sr or Ba), and a trivalent ion $Y^{3+}(R^{3+})$, Bi^{3+} or Tl^{3+}. The ionic radii of Y^{3+} and Tl^{3+} are nearly the same (1.032 and 1.020Å, respectively) while that of Bi^{3+} is about 10% larger, 1.16Å. It may be possible to substitute, at least partially, rare earths for Tl; it is less likely for Bi, however. There may still be some interesting chemistry and physics ahead involving the rare earths in these two new superconductors.

Other developments involving the 1:2:3 phases are much more positive for those of us rooting for the rare earths materials. Scientists at U.S. National Bureau of Standards (Boulder) and Westinghouse Research and Development Center (Pittsburgh) have developed a method for making low resistance contacts on the $YBa_2Cu_3O_{7-x}$ superconductors — a big step towards the practical use of these materials. While at the Los Alamos National Laboratory scientists have achieved a five-fold increase in the size of a single crystal of the 1:2:3 phase, with the largest dimension about 0.6 cm (0.25 inch).

(over)

Telephone: (515) 294-2272
Facsimile: (515) 294-3226
Telex: 269266
BITNET: RIC@ALISUVAX

Meeting Announcements

RIC received announcements of two workshops dealing with rare earths too late for the March issue of the RIC News and they will be over before the June issue is available. And so, we have decided to alert you to these workshops.

A two-day workshop on the "Basic and Applied Aspects of Rare Earths" will be held May 26-27, 1988 in Venice, Italy. The workshop is for scientists and operators interested in the science and technology of rare earths and will cover the following: production, purification and analytical methodologies; preparation and properties of new compounds and materials; research and industrial applications; and chemical, biological and medical studies. For more information contact Drs. P. Guerriero or L. Meregalli, Istituto di Chimica e Tecnologia del Radioelement; Corso Stati Uniti, 4-35020 Padova, Italy.

A one-week short course, "Modern Permanent Magnets-Materials, Application and Design", will be held June 6-10, 1988 at the University of Dayton, Dayton, Ohio. This course will cover a wide range of devices and machines that employ magnets, magnet materials available, and their engineering properties and methods of manufacture. Particular attention will be given to the newer permanent magnets such as $SmCo_5$-Sm_2Co_{17} and Nd-Fe-B alloys. For more information contact Ms. Teresa Bohlander, School of Engineering, University of Dayton, 300 College Park, Dayton, OH 45469-0001.

K. A. Gschneidner, Jr.

K. A. Gschneidner, Jr.
Editor and Director RIC