Rare-earth Information Center INSIGHT

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

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RIC, A GLIMPSE AT THE FUTURE

Last month, Karl Gschneidner wrote his farewell issue of **RIC Insight** and introduced me as the new director of both the RIC and its expansion, the Center for Rare Earths and Magnetics (CREM). As Karl has already provided the biographical introduction, I will limit myself to what might be called a philosophical introduction. As may be expected in any expansion and change of directorship, there will be a certain amount of change going on within the RIC but we will do our best to insure that those changes are viewed by our supporters as positive. Over the course of the next year we will be soliciting your input on a number of expanded services that we are considering to offer our supporters. High on our priority list is to take advantage on the tremendous improvements in data base technology to allow faster entry and expanded coverage of the RIC data base. In this same context we are considering offering automatic monthly literature search updates to our supporters at the Sustaining level and above. In addition, we are working on bringing the **RIC News** to the World Wide Web to enhance the visibility of the rare earths. Please feel free to contact me with respect to these and other ideas to support the rare earth community.

A VIEW OF RARE EARTH ACTIVITIES IN JAPAN

At the current time, I am a guest of the Superconductivity Research Laboratory of the International Superconductivity Technology Center in Tokyo. As I will be using this opportunity to become familiar with rare earth related activities in Japan, my observations in Japan will be included in the next few issues of **RIC Insight**. The first of these observations is the subject of the first paragraph on the next page.

GIANT MAGNETORESISTANCE, GMR

Magnetoresistance, the change in the electrical resistivity of a material when a magnetic field is applied, is not a new topic but in recent years there has been an increased interest in the materials for applications such as magnetic field sensors and read heads for magnetic data storage. Unlike conventional magnetoresistive materials, giant magnetoresistance materials have changes in the resistivity which are of order 10% or larger. In the field of GMR, as well as high temperature superconductors, there are rare earth perovskite materials with very interesting properties. An international group of scientists {R. D. Snachez et al., **Appl. Phys. Lett. 68** [1], 134-136 (1996)} has reported on a sol-gel method of preparing $La_{0.67}Ca_{0.33}MnO_3$ using relatively low annealing temperatures. By varying the annealing temperature between 540 and 1000°C they were able to produce monodispersive particles in the range from 20 to 110 nm. A magnetoresistance above 10% was obtained in a field of 1 kOe for all particle sizes. The ability to produce such uniform fine grained material should simplify the study of magnetoresistance in polycrystalline materials.

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Telephone: (515) 294-2272
Facsimile: (515) 294-3709

[redacted]
Internet: RIC@AMESLAB.GOV

LEVITY?

Under titles ranging from "Superconductor lifts woman" to "Levitation without religious training" the news media in Japan covered a demonstration of magnetic levitation at the Superconductivity Research Laboratory of the International Superconductivity Technology Center in Tokyo on February 19th. The newspaper coverage was highlighted by pictures of a 50-kg woman seated on a 70-kg disc containing Nd-Fe-B magnets floating 5 cm above an array of $YBa_2Cu_3O_7$ high temperature superconductor disks. Both Japanese and Korean TV carried news stories featuring various researchers being levitated on the disk. The purpose of the demonstration was to publicize the advances in bulk materials for such purposes as magnetic bearings which have occurred since the demonstration was first performed five years ago and a height of only 5 mm was achieved. The improvement in levitation force results from significant advances in both the growth of large single domain samples and the control of pinning centers for magnetic flux within the domains.

PHOTOLUMINESCENCE OF Er^{3+}

Er^{3+} ions are used in commercial long distance fiber-optic telecommunications in all-optical erbium fiber amplifiers. The dimensions of such devices are forced to be quite long (> 10m) due to the fact that Er concentrations in GeO_2-SiO_2 fibers are limited to low values (~500 at ppm) in order to avoid clustering effects of the Er^{3+} ions in the glass. Pairs or clusters of of Er^{3+} ions show nonradiative decay of the excited state as well as resonant energy transfer and excited state absorption. All of these effects detract from amplifier performance since energy is dissipated into non-productive channels. Using crystalline materials with well defined substitutional sites for the Er^{3+} ions, high concentrations of Er ions may be obtained without clustering effects. AT&T Bell Laboratories {Ch. Buchal et al., **Appl. Phys. Lett. 68** [4], 438-440 (1996)} report that RF_3 compounds with R=Y, Lu, and particularly La, appear to be promising hosts for high concentrations of Er. The RF_3 materials are easily deposited as thin films on heated substrates, have high melting temperatures and are not hydroscopic. The optical index of LaF_3 is reasonably matched to optical fibers and there is a wide transparency range. Films with 5 at.% ErF_3 and 95 at.% LaF_3 have been prepared. These polycrystalline films showed long photoluminescence lifetimes and permit optical amplification over a 8000 GHz band width.

DISPERSION HARDENING OF AMORPHOUS MATERIALS

Ultrahigh tensile strength has been reported in rapidly solidified $Al_{88}Ni_{10-x}(Nd,Gd)_2Fe_x$ (x=0 or 1at.%) amorphous alloys aged for brief periods of time below the precipitation temperature of the compounds. G.S. Choi et al., **Scripta Met. Mater. 33** [8], 1301-1306 (1995) report that the aged alloys have a structure consisting of 10 nm sized Al particles in an amorphous matrix. The interparticle spacing is reported to be 3 to 7 nm. The mechanical properties of the partially crystallized alloys vary as function of the volume fraction, V_f, of crystalline phase. The micro-Vickers hardness increases roughly linearly with V_f, while the fracture strength and fracture elongation go through a maximum at a V_f of ~18%. The fracture strength is increased by 60% and the fracture elongation is increased by 50% for the optimum V_f. The ultimate tensile strength for alloys with and 8% V_f is reported to be about a factor of 15 higher than that of typical age-hardened Al alloys. An interesting aspect of the report is that the precipitation of the Al particles thermally stabilizes the remaining amorphous phase.

R. William McCallum

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Director, RIC/CREM