Rare-earth Information Center Insight

Center for Rare Earths and Magnetics
Ames Laboratory
Institute for Physical Research and Technology
Iowa State University, Ames, Iowa 50011-3020 U.S.A.

Volume 12 | November 1, 1999 | No. 11

Photonic Applications of Rare-Earth-Doped Materials

Over the past few years, numerous papers on the use of the optical transitions of rare earth ions in display applications, data storage, fiber optic amplifiers, and lasers have been covered in the *Insight*. Most of these papers contained more information than a non-specialist in the field would care to understand. However, the September 1999 issue of the *MRS Bulletin* is devoted to *Photonic Applications of Rare-Earth-Doped Materials*. Guest editors, A. J. Steckl and J. M. Zavada, have assembled a group of six papers that survey the field in a manner readily accessible to most technical readers. The first article deals with research aimed at producing solid-state lasers in the visible and ultraviolet range. The most common rare-earth laser, the Nd:YAG, is a near infrared laser, as are Er^{3+} of Tm^{3+} based lasers. The article discusses the frequency shifting of these lasers, as well as more recent advances in lasing directly at the desired short wave length.

Progress in rare-earth-doped semiconductor lasers is reviewed in the next two articles. The articles deal with Si and GaN hosts. These lasers are, at present, more a hope for the future rather than a current reality. The reality of the *Internet* is that an increase in capacity of fiber optic networks is required. This has been met both by adding new cables and by using more of the available bandwidth in currently installed fiber optic networks. Erbium-doped fiber optical amplifiers have been an essential component in increasing the bandwidth. The fourth article in the journal gives a clear description of the physics behind fiber optic amplifiers and the fabrication of the fibers. Spectral hole burning, where multiple data bits can be stored in the same physical location by altering absorption at different wave lengths, is described in the next article. Finally, display applications of rare-earth based materials are discussed.

High Temperature Sm-Co Based Magnets

In a paper presented at the 1999 IEEE International Magnetic Conference, S. Liu et al. presented a new Sm-Co based alloy for permanent magnet use above 400°C. The composition of the alloy is $Sm(Co_{bal}Fe_{0.09}Cu_{0.09}Zr_{0.03})_{7.69}$. An energy product of 14MGOe is reported at 400°C with an intrinsic coercivity ($_MH_c$) approaching 13 kOe. An interesting anomalous temperature dependence of $_MH_c$ is reported for the related composition, $Sm(Co_{bal}Fe_{0.04}Cu_{0.09}Zr_{0.02})_{7.69}$. For this composition, $_MH_c$ decreases, as expected, as the temperature is raised to 150°C, but then it increases with increasing temperature to a maximum of 7.5 kOe at 500°C. In another paper to be presented at the 44th Annual Conference of Magnetism & Magnetic Materials, S. Liu et al. discussed the origin of the abnormal temperature dependence. As with most Sm-Co based magnets, the coercivity in these magnets arises from a cellular microstructure with a cell boundary phase, which has lower magnetocrystalline anisotropy than the cell itself. Domain walls are pinned by this boundary. The temperature dependence of $_MH_c$ arises from the fact that the anisotropy of both phases decreases with temperature, and thermal energy contributes to

-more-

overcoming the pinning energy. In the anomalous material, the relative temperature dependence of the magnetocrystalline anisotropies is such that the difference in anisotropy actually increases in the temperature range of interest, resulting in stronger pinning at higher temperature. Contact: Sam Liu, 937-229-3527; lius@udri.udayton.edu.

Short Notes:

Johnson & Johnson Professional Inc. has announced the development of a malleable titanium coating to protect Y_2O_3-doped ZrO_2 (YSZ) ceramic joints used in hip replacements. The coating reduces localized stresses, thereby preventing fracture of the brittle ceramic. The coating should allow a reduction in the size of the hip joint head. Contact Frank Matthews, Johnson & Johnson Professional Inc., 325 Paramount Drive, Raynham, MA 02767-5110; tel: 508/880-8100; fax: 508/828-3070; www.jnjo.com.

Foster-Miller Inc. has developed a method to make net-shape preforms of single crystal yttrium aluminum garnet (YAG) fibers. The preforms are for use as fiber reinforcements in ceramic and metal-matrix composites. Contact: P. G. Karandikar, Foster-Miller, Inc., 195 Bear Hill Rd., Waltham, MA 02154-1003; tel: 781/272-3250; fax: 781/272-9185; www.foster-miller.com.

The *Honda Insight*, the first gasoline-electric hybrid powered car to be sold in the U.S., is expected to arrive in dealer showrooms in December. The use of NiMH batteries contributed the to Insight earning an EPA city rating of 61 miles per gallon and a highway rating of 70 mpg, 20 mpg ahead of the next nearest competitor.

12th Tagen der Seltenen Erden

The 12th Tagen der Seltenen Erden (Symposium on Rare Earths) will be held in Hamburg, Germany from December 2-4, 1999. It will cover rare earth chemistry, spectroscopy, and crystal structures. As the announcement is in German, I assume that will be the language of the symposium. Contact Prof. Dr. R. D. Fischer, University of Hamburg; fax: 040 42838-6348/2893; e-mail: fischer@chemie.uni-hamburg.de.

Santoku to Acquire Rhodia's Phoenix Plant

Last month, Santoku Metal Industry Co.Ltd. (Kobe, Japan) opened its U.S. subsidiary. Santoku America Incorporated (SAI) has reached an agreement to acquire, through that subsidiary, the rare earth metals and alloys activities of Rhodia Rare Earths, Inc. (RRE), a subsidiary of Rhodia Rare Earths (La Rochelle, France). RRE's plant in Phoenix, Arizona will be transferred to SAI. The main products of the Phoenix plant are alloys for Nd-Fe-B and Sm-Co magnets and alloys for NiMH batteries. In a related transaction, Rhodia Rare Earths will acquire half of Santoku's share in Anan Kasei Co. Ltd., a joint venture between Santoku and Rhodia. Santoku will maintain a 33% share in Anan Kasei with Rhodia owning the remainder. Anan Kasei produces a variety of rare earth chemical compounds.

R. W. McCallum
Director CREM/RIC