Rare-earth Information Center INSIGHT

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Magnetic Reviews

Two extensive reviews on rare earth permanent magnets, written by two of the top scientists in the field, arrived in the Iowa State University library during the last two weeks. The first one written by K. H. J. Buschow, Philips Research Laboratories, Eindhoven, The Netherlands, is entitled "New developments in hard magnetic materials" and appeared in **Rept. Prog. Phys. 54,** 1123-1213 (1991). In this paper Buschow reviews the preparation, crystal structure and magnetic properties of the $R_2Fe_{14}X$ (X = B and C) and the $RFe_{12-x}M_x$ (M = transition metal) intermetallic compounds. A special emphasis is placed on the influence of C and N additions on the magnetic properties of the R_2Fe_{17} compounds. A good portion of the review is concerned with the manufacture of these materials and a description of the coercivity mechanisms found in the magnets. A comparison of the performance and economic costs of the various families of magnets is made. Some novel applications are also discussed.

The second paper by J. F. Herbst, General Motors Research Laboratories, Warren, Michigan, U.S.A., which is entitled "$R_2Fe_{14}B$ materials: Intrinsic properties and technological aspects", **Rev. Modern Phys. 63**, 819-898 (1991), nicely complements the Buschow review. Herbst begins with a brief historical review (the excellent permanent magnetic properties of $Nd_2Fe_{14}B$ were first made public about ten years ago), and then discusses the crystal structures, magnetic properties (about one-fourth of the review) and electronic properties. The next major section deals with isostructural materials, alloy substitutions for the three constituents, and their influence on the properties of the $Nd_2Fe_{14}B$-base material. The last one-fourth of the paper is concerned with technology: melt-spun magnets, sintered-magnets, magnetization reversal and coercivity mechanisms of both melt-spun and sintered materials, other preparative techniques and thin films.

High T_c Advances

The Superconducting Industrial Research Laboratory, Koto-ku, Tokyo recently announced a new record critical current density for a high temperature superconductor: 2.2×10^5 A/cm^2 in a field of 35T at 31K. The $YBa_2Cu_3O_{7-x}$ material (1:2:3) was prepared by a newly developed process in which the 1:2:3 compound is partially sintered, pulverized, and then shaped and sintered one more time. At 4.2K the critical current density of this material is 4×10^5 A/cm^2 in a field of 80T, which is nearly double the old record of 2.2×10^5 A/cm^2 in a field of 30T at 4.2K. The previous record was held by a bismuth oxide superconductor.

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A massive 1:2:3 superconducting disk (4.2 cm diameter by 1.5 cm thick) has been prepared by Nippon Steel Corp., Chiyoda-ku, Tokyo. The critical current for this disk is 3.7×10^4 A/cm^2 in a 1T field at 77K, which is quite good considering the size of the sample and the temperature at which the measurements were made.

Similar advances, although not as dramatic, are being made by other groups throughout the world. It appears that a practical bulk high critical magnetic field -- high critical current density $YBa_2Cu_3O_{7-x}$ superconductor is slowly becoming a reality. The major problem is still the same, how to prevent the critical current density and critical magnetic field from dropping-off rapidly as the temperature is raised toward liquid nitrogen temperature, 77K.

Magneto-optic Storage Update

Sony's General Research Laboratory has been able to double the memory capacity of the amorphous rare earth (Gd, Tb) - ferrous metal (Fe, Co) magneto-optic storage disc. This was accomplished by adding a third layer (aluminum) to the backside of the disc. The aluminum layer helps remove the heat which is generated by the writing and reading laser beams. By reducing the stray thermal effects, the density of the amount of stored information was increased by a factor of two: 1.3 Gb on a 5.25 inch disc. They have found that the reliability is not degraded after one million re-recordings.

In the July issue of **RIC Insight** we told you that chromium (Cr) additions to the TbFeCo alloy greatly reduced the corrosion and oxidation rate of the undoped TbFeCo. More recently, Japanese scientists at Hitachi, Ltd., Central Research Laboratory, Kokubunji, Tokyo, found that a 2-3 at.% addition of Nb to TbFeCo amorphous alloys greatly improved the resistance to wet corrosion and pitting. The corrosion tests were carried out at 60°C in a 90% relative humidity atmosphere for 2000 hours, and no change was found in the carrier-to-noise ratio and the defect error rate, even after 10^7 write/erase cycles. The magnetic properties of the TbFeCo film remained unchanged when doped with Nb. These results were reported by F. Kirino, N. Ogihara and N. Ohta, **J. Appl. Phys. 70**, 2242 (1991).

Galfan Coated Brake and Fuel-line Tubing

Handy and Harman Automotive Group, Inc. (Archbold, Ohio) announced that their brake and fuel-line steel tubing will be coated by using Galfan (a Zn-base alloy containing 5% Al and % 0.05 mischmetal) to enhance the corrosion resistance. Previously they had been using terne (a Pb-Sn alloy) for corrosion protection. This represents a new use for Galfan. Other uses include the use of galvanized steel in the appliance, automotive (paneling) and construction markets, {see **RIC Insight 2** [12] (1990) and **3** [1] (1991)}.

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