RARE-EARTH INFORMATION CENTER INSIGHT

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Inexpensive RE-Fe-B Permanent Magnets

Seiko Epson announced that they have developed an inexpensive manufacturing process for producing rare earth permanent magnets which have magnetic properties comparable to those produced commercially by either the powder metallurgy route or the rapidly cooling method. According to Seiko Epson the rare earth metals (primarily praseodymium), iron, boron and a small amount of copper are mixed and heated to form a molten alloy at 900°C, at which temperature they are pressed and extruded. The method is expected to be cheaper than the conventional processes since it involves fewer steps and is suitable for mass production. This new magnet material is reported to have a higher strength and to be more corrosion resistant than the Nd-Fe-B magnets, while possessing equivalent magnetic properties.

More details were to have been reported at the 4th Joint MMM—Intermag Conference in Vancouver, B.C., Canada, July 12-15, 1988.

More Magnetic News

An extensive review by K. Kumar on the RM_5 and R_2M_{17} permanent magnets was recently published in the J. Appl. Phys., **63**, R13 (1988). This review, which is nearly 50 pages long, is focused on $SmCo_5$-Sm_2Co_{17}. The scientific and technological fundamentals, which have guided workers in the development of these permanent magnet materials, is described. The main areas reviewed by Kumar are: the phase relationships, crystal structures, magnetocrystalline anisotropy, coercivity, fabrication techniques, thermal effects on the stability of the magnet flux and the processing-microstructure-property interrelationships. Over 300 references were cited in this review.

Argonne National Laboratory announced that a new type of magnet array for the world's brightest source of x-rays passed its first tests successfully. This array is called an "undulator" and will be the prototype for dozens of undulators that are to be used in the U.S. Department of Energy's Advanced Photon Source (APS), which is to be built at the Argonne National Laboratory. The prototype undulator contains more magnets (244) than any array previously built for a synchrotron x-ray source. The Nd-Fe-B magnets cause the particle beam to wiggle (or undulate) 122 times over a distance of 2m (6.5 ft) to provide precisely tuned x-ray beams. The APS will accelerate

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packets of positrons to nearly the velocity of light and store them in a ring, ~400 m in diameter. As the positrons pass through the Nd-Fe-B arrays the undulating magnetic field will vibrate the positrons causing them to emit an intense, highly focused x-ray beam. When fully operational the Advanced Photon Source will be 10,000 times more brilliant than any currently operational x-ray source.

New Optical Materials

Rare earth activated ZnS, CaS and SrS phosphors for thin-film electroluminescent (EL) devices have been around for about ten years. Of the various rare earth luminescent centers, Pr^{3+} centers are unique in that the luminescence spectra consist of blue-green and red emissions, which appear white to the human eye. Until recently the intensity of the best Pr^{3+} doped materials were too low for practical applications. Recently Tanaka, et al. [Appl. Phys. Lett. **52** 2102 (1988)] reported on the development of a white-light, electroluminescent thin film of SrS doped with Pr and K, which is sufficiently efficient for commercial utilization. An equal amount of Pr and K are doped into the SrS host, the K^+ ion acting as a charge compensator for the Pr^{3+} ion. This new EL film is five times more luminescent than the standard $ZnSi:PrF_3$ material used here-to-fore.

New blue emitting rare earth phosphors for projection cathode ray tubes have been developed by Philips researchers de Leeuw et al. [J. Electrochem. Soc. **135** 1009 (1988)]. Energy efficiencies, under cathode ray excitation, of 11% have been obtained by substituting Y or Gd for La in LaOBr:Ce. The emission colors are comparable to that of the standard ZnS:Ag phosphor. The authors believe that $La_{0.6}Y_{0.4}OBr:Ce$ and $La_{0.7}Gd_{0.3}OBr:Ce$ will lead to a significant increase in the brightness of projection television systems.

A new continuous wave (cw) Nd upconversion laser has been developed by Macfarland and co-workers [Appl. Phys. Lett. **52**, 1300 (1988)] to emit in the violet to ultraviolet regions of the spectum. Since most lasers emit in the visible and near infrared, this Nd upconversion laser is quite attractive for generating coherent short wavelength radiation. A LaF_3 single crystal doped with 1% Nd was used as the lasing crystal emitting coherent light at 380 nm. An upconversion pumping scheme, involving near infrared (788 nm) and visible (591 nm) pumped photons from cw dye lasers, produces stepwise excitation of the Nd^{3+} ion.

Since most optical devices require high purity rare earth materials (>99.999), these new potential applications can have an important impact on the rare earth industry, even if they use small amounts of the active rare earth dopant. However, one should not overlook the facts that in two of the above devices the host material is also a rare earth material, that the purity requirements for these host elements are the same as for the activator ions, and that much larger amounts (~100-fold) are required.

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