Rare-earth Information Center

Insight

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Volume 12 | March 1, 1999 | No. 3

Giant Coercivity in Sm(Co, Cu, Ni) Thin Films

In order to meet the increasing demand for large areal recording densities in magnetic data storage devices, the grain size in crystalline media must be ~10 nm, and the coercivity of the media must be 3-4 kOe. The small grain size is required in order to minimize the noise associated with bit to bit variations in the number of grains in a bit and to allow sharp transitions between bits. The coercivity is required to resist magnetization reversals due to stray fields. At the current time, an effort is being made to achieve larger coercivities that that of the Co-Cr-Pt alloys currently in use. In an effort to increase the anisotropy field, rare earth transition metal alloys are being investigated. In other words, can the materials that have been developed for permanent magnet applications be adapted for data storage. C. Prados and G. C. Hadjipanayis {*App. Phys. Lett*., **74**, [3], 430-2 (1999)} have produced nanostructured Sm(Co, Ni, Cu) thin films by annealing amorphous thin films. The films were deposited on water-cooled Si substrates with a 300 nm Cr underlayer. The Cr underlayer was essential to obtain high coercivities and exhibited a (110) texture. The Sm (Co, Cu, Ni) films were 500 nm thick. For $SmCo_2Cu_3$ annealed for 30 min at 550°C, a coercivity of 42 kOe was obtained in contrast to the 100 Oe coercivity for the as-deposited amorphous film. The annealed films exhibit nanocrystallites embedded in a residual amorphous fraction with a grain size of ~10 nm. The switching volume for demagnetization was found to be consistent with the grain size.

Two Hundred Percent Quantum Efficiency

Two hundred percent efficiency appears to be a desirable, but thermodynamically unobtainable goal. However, when you are talking about quantum efficiency, it is the number of quanta; in this case, photons that are being counted and not the amount of energy. Thus, if you have a material, which absorbs a single high energy photon and then emits two low energy photons, you can achieve 200% quantum efficiency. This is particularly desirable if the incoming photon is in the ultraviolet (UV) and the outgoing photons are visible. In a conventional fluorescent lamp, a Hg discharge produces UV radiation, which is converted to visible radiation by the phosphors on the wall of the tube. This process has an energy penalty, as the energy difference between the UV photon energy and the visible photon energy is converted into heat. Of course, there is also an environmental penalty of the Hg. Other discharge sources, such as Xe, have been investigated; but they have even higher energy; and, hence, more energy is converted to heat if only one photon is produced for every one that is absorbed. It is easy to think about a three level system, where the absorption of a photon by an atom in the ground state raises the atom to its second excited level, and the excited state then decays in a cascade, which emits two photons. To date, there has been little success in finding a single ion that produces the desired results. Recently, R. T. Wegh et al. {*Science*, **283**, 663-6 (1999) have reported on a material containing two lanthanides that demonstrate the process. The material is $LiGdF_4:Eu^{3+}$. In this material, the incoming UV photon is absorbed by the Gd. The Gd then transfers energy sequentially to two Eu^{3+} ions that then produce the characteristic red emission. Clearly, a

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fluorescent light based only on a red phosphor has very limited applications, and so the authors are investigating other binary combinations in search of green and blue phosphors. In the upconversion process discussed in previous *Insights*, two photons are absorbed, and a single photon emitted. By analogy, this process has been dubbed downconversion.

Short Note:

As reported {*Adv. Mater. Process*, **155**, [2], 9 (1999)}, Krupp VDM GmbH, Werdohl, Germany, has developed a high temperature nickel based alloy that is claimed to be the first formable material containing 8% tantalum. Designated Nicrotran 6325hAlC m- alloy 2100 GT, the material includes 25% Cr, 3% Al, 0.3% carbon and 0.1% Y. The material is intended for jet engine applications. Contact: Don Wenschof, Krupp VDM Technologies Corp., 10 Sylvan Way, Parsippany, NJ 07054; tel: 973/267-8545; fax: 973/292-4919; e-mail: don@vdmt.com.

The February [1] 1999 issue of *Adv. Mater. Process* also contains an interesting report on molybdenum (Mo) alloys. A brief mention is made of recently developed Mo-La alloys containing 0.5-1.5 wt% La as La_2O_3. The alloy is said to have "remarkable resistance to creep and elevated-temperature deformation, particularly at high temperatures."

A report translated from the February [2] 1999 issue of the *Nihon Keizai Shibun* states that Sanyo Electric Co. will establish a joint venture in China for the manufacture of Ni-MH batteries. The Chinese demand for the batteries results from a rapidly expanding market for cellular phones. The demand for Ni-MH batteries in the Chinese cell phone market is expected to grow 50% this year from the 1998 level. The Chinese joint venture partner is Tianjin Lantain Power Sources Co., which will have a 44% stake in the venture. Toyota Tsusho will have a 5% stake with the balance belonging to Sanyo. (Thanks to K. Shimomura)

Company Notes:

An ad in the February 23, 1999, *Wall Street Journal* invites "expressions of interest" in purchasing the magnetics business of a number of YBM Magnex International, Inc. subsidiaries and affiliates. These include Crumax Magnetics Inc., USA; Crumax Magnetics Rt., Hungary; and Crumax Magnetics Limited in the United Kingdom. The magnetics business of these companies represents a significant production capability for rare earth and other magnets.

Some time ago, Magnequench International Inc. announced that it would be opening a technology center in the US. The location was to be announced at a future date. That location will in Research Triangle Park in North Carolina. The center will be directed by Dr. Peter Campbell, who is well known to the magnet community through his consulting company, Princeton Electro-Technologies, Inc. Dr. Campbell will be discontinuing his consulting activities, but he promises to keep his web site: http://www.magnetweb.com. For those of you who have not visited the site, it is an excellent resource for information related to magnets. Dr. Campbell has informed *Insight* that Magnequench has made a significant commitment to establish a world-class 32,000 sq. ft. laboratory facility.

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