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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Quaternary Boro-Carbides to Replace Ceramic Superconductors!

Some new quaternary metallic superconductors containing two metallic elements and boron and carbon are beginning to make waves in the superconducting field, approximately eight years after the Bednorz-Müller discovery of the 30K oxide superconductors, which led to the new high temperature ceramic superconductors. The first paper, published by R. Nagarajan *et al.* (from the Tata Institute of Fundamental Research, Bombay, the Indian Institute of Technology, Bombay, and Centre National de la Recherche Scientifique, Meudon, France) reported that they have discovered bulk superconductivity in two samples having the nominal compositions $YNi_4BC_{0.2}$ (T_c~12.5K) and $YNi_2B_3C_{0.2}$ (T_c~13.5K) [**Phys. Rev. Lett. 72**, 274 (January 10, 1994)]. A few days later, in the January 13, 1994 issue of **Nature 367**, 146, R. J. Cava *et al.* (from AT & T Bell Laboratories, Murray Hill, New Jersey, University of Tokyo, and the Technical University in Delft, The Netherlands) report a superconducting transition temperature of 23K for $YPd_5B_3C_x$ ($0.3 \leq x \leq 0.4$). This T_c value is the highest value ever reported for a *bulk intermetallic* compound. Then a week later, the same research team, headed by R. J. Cava, reported on the existence of superconductivity at ~ 16 and ~ 15K for $LuNi_2B_2C$ and YNi_2B_2C, respectively, [**Nature 367**, 252 (January 20, 1994)]. In addition, when some of the magnetic lanthanides are substituted for Lu (or Y) they are also superconducting but at somewhat lower temperatures, Ho (8K), Er (10.5K) and Tm (11K). In a second paper in this same issue of **Nature** (p. 254), the Bell Laboratories-Delft team headed by T. Siegrist reported on the crystal structure of the $LuNi_2B_2C$ superconductor. Although these quaternary boro-carbides do not pose any immediate threat to the ceramic superconductors, their superconducting transition temperatures are comparable to those of the first known oxide superconductors (T_c~10K), and based on what we have seen over the past eight years, one cannot dismiss these new materials out of hand. The potential is there, and a lot of scientists are turning their attention to this new class of superconductors. Keep reading this newsletter — we will keep you posted if and when anything noteworthy develops.

New Nd-Fe-B Developments

In a three way play, General Motors Corp. (Magnequench), Mitsubishi Materials Corp., and Sumitomo Special Metals Co. have signed a cross-licensing agreement for the manufacture and sale of anisotropic bonded Nd-Fe-B permanent magnets. Effective January 1, 1994 both General Motors and Sumitomo had obtained a license from Mitsubishi to use Mitsubishi's HDDR (hydrogenation, decomposition, dehydrogenation, reaction) process for producing anisotropic Nd-Fe-B powders. For more details on this process see the September 1, 1992 issue of **RIC News** (p. 1, 3rd column). Mitsubishi in turn has been granted permission to manufacture Nd-Fe-B permanent magnets based on the coverage of the General Motors and Sumitomo patents.

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Telephone: (515) 294-2272
Facsimile: (515) 294-3709
Telex: 283359
BITNET: RIC@ALISUVAX

SG Magnets Limited announced that they have brought on the market a new range of plastic bonded Nd-Fe-B permanent magnets. They are using compresssion moulding and injection moulding technology in the manufacturing processes. SG Magnets also noted that they have been appointed as a distributor for San Huan New Materials High-Tech Inc.'s Nd-Fe-B permanent magnets with selling rights in Europe and exclusivity in the United Kingdom.

San Huan New Materials High-Tech, Inc. was founded in 1985 as a subsidiary of the Chinese Academy of Sciences to carry out research, development and manufacturing of rare earth permanent magnets. They obtained licensing agreements on sintered Nd-Fe-B magnets with Sumitomo Special Metals Corp. on April 5, 1993 and with General Motors Corp. on May 10, 1993. San Huan has four joint venture plants to manufacture these magnets. Ningbo Konit Industry, Ltd., Sanhuan Lucky New Materials, Ltd., Xin Huan Tech Development, Ltd. and Jing Yue Magnet Company. In addition to their agreement with SG Magnets Limited in Europe, they have a Los Angeles sales office in the USA operating under the name Tridus International, Inc.

Other Corporate News

Sassoon Brussels s.a. has spun-off their rare earth business to Rare Earths and Minerals (RE & M), which is headed by Mr. Vincent Willemart, a former employee of Sassoon Brussels. RE & M is a distributor of both Russian and Chinese rare earth materials and deals in the electronic, metallurgical, ceramic, glass and magnet markets.

Etrema Products, Inc. and Lord Corp. announced that they are jointly developing a system that will reduce the engine noise level in aircraft by as much as 20 decibels using terfenol actuators. The active noise-suppression system consists of a sonic actuator being developed by Etrema and it will be fitted into engine mounts manufactured by Lord. For more information on active noise control (ANC) see **RIC Insight 4** [11] (November 1991) and **5** [8] (August 1992).

Medical Uses of RE Permanent Magnets

Did you know that medical applications account for a significant portion (> 10%) of the rare earth permanent magnet market? Magnetic resonance imaging (MRI) instruments alone account for the third largest worldwide use of Nd-Fe-B permanent magnets. When one realizes that a typical MRI unit uses *2.6 tons* of Nd-Fe-B, or *5 tons* of Sm-Co, it is no wonder that MRI units account for 10% of the Nd-Fe-B usage. The overall size of a completely assembled MRI unit is 27 tons. The use of rare earth permanent magnets in the medical field was reviewed by E. A. Smith in the February/March 1994 issue of **Elements**, pp. 16-21. In addition to MRI's, the rare earth permanent magnets are used as magnetic removers or retrievers in ophthalmology and gastroenterology, as medical protheses in dentistry, eyelids, and stomach seals, as electromagnetic switches, and in some parts of the world as magnetic neck chains and magnetic bracelets to cure various ailments. Ms. Smith also notes a number of possible new applications, such as magnetic catheterization and in neurosurgery. This interesting, but brief review is worthwhile reading.

Karl A. Gschneidner, Jr.

K. A. Gschneidner, Jr.
Director, RIC