MAGNETIC MATERIAL BASED ON NANOSIZE AMORPHOUS METAL POWDER

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Amorphous metal powder compaction has been tried as a route to achieve non-conventional magnetic core shapes. The first was to mechanically consolidate powder made by crushing amorphous metal ribbon embrittled by heat-treatment. It was found that consolidation condition, powder size and type, binder material, and shape of the core, all affect the magnetic properties of the consolidated core. Although technically acceptable performances were obtained from these cores [1], the process was relatively costly, which discouraged commercial development. Direct formation amorphous metal powder by gas atomization [2] and by spark erosion [3] were reported, but no significant development resulted. Borohydride reduction has been shown recently to be a means of providing amorphous metal powder [4]. By the chemical reduction of $FeSO_4/CoCl_2$ and $FeSO_4/NdCl_2$ salt solutions, Fe-Co-B and Fe-Nd-B based powders were produced, respectively. The powders were found to be in amorphous states, having nanosizes and showing a wide range of apparent coercivities of 20-600 Oe. The metal powders were then fabricated into ring-shaped magnetic cores by mixing with a small amount of epoxy resin. It has been found that these powers form chain-like structures in the compacted cores, resulting in low linear permeabilities of the order of 10. These properties have lead to magnetic implements of considerable interest, which is the subject of the present report.

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[3] A. E. Berkowitz and J. L. Walter, J. Mater. Res., 2, 275 (1987)
[4] See, for example, S. G. Kim and J. R. Brock, Colloid & Interface Science, 116, 431 (1987); and A. Yedra, L. F. Barquin, R. L. Calderon, Q. A. Pankhurst, J. C. Gomez-Sal, J. Non-Cryst. Solids, 287, 20 (2001).