Magnetic Properties of FeCuNbSiB Nanocrystalline Alloy Powder Cores Using Atomized Powder by Cold Pressing

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Fe-based nanocrystalline alloy cores have shown excellent soft magnetic properties because of their small crystalline anisotropy and nearly zero magnetostriction [1]. However, the use of ribbons usually limit shapes of cores to toroidal wound or stacked types, while powder cores can be produced in various shapes. In case of nanocrystalline alloy powder cores, flake-type powders produced by milling ribbon were mainly studied by using special compaction method such as explosive compaction, hot pressing and shock-wave compaction method because of the difficulties of compaction, Also on cold pressing, it can give poor green strength and low magnetic properties at high frequency regions [2]. In this study, we have investigated high frequency properties of nanocrystalline alloy powder cores using atomized powder by conventional cold pressing.

$Fe_{73.5}Cu_1Nb_3Si_{13.5}B_9$ amorphous powders were prepared utilizing atomization process. The powder cores were produced with ceramic binder by cold pressing at high pressure. Annealing of these powder cores was carried out for crystallization in the temperature range from 500 to 600 ℃ for 1h in N_2 gas. Fig 1 shows the frequency dependence of the effective permeability μ_e and the quality factor Q for nanocrystalline powder core using atomized powder comparing with flake-type powder. The effective permeability of atomized powder cores nearly does not change up to 2 MHz. And it shows maximum level 40 of the quality factor at 200 kHz. However, the permeability of the ribbon milled powder cores is lower and it decreases at 100 kHz, and the quality factor exhibits a peak level of 15 at frequency of 20 kHz. In addition, as compared with ribbon milled powder cores, atomized powder cores showed the improvement in the green strength. We will present in more detail magnetic properties as a function of annealing temperature and particle size for nanocrystalline powder cores.

References

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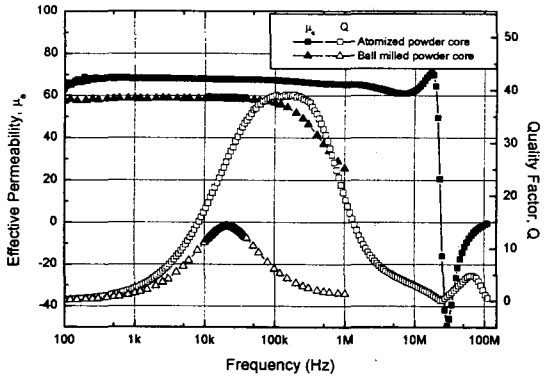

Fig. 1. The effective permeability and quality factor as a function of frequency for nanocrystalline powder cores made from under 45 ㎛ using atomized powder and ribbon ball-milled powder annealed in N_2 gas for 1h at a temperature of 550 ℃.