Effect of Ribbon Thickness on the Soft Magnetic Properties of Powder Cores

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Magnetic permeability of a material is known to depend on the size and shape of materials, and the effective permeability can be computed from the intrinsic permeability and demagnetization factor. Inductor cores produced by a soft-magnetic powder usually have low permeability compared to the wound cores. Our previous studies showed that the coercivity of powder was strongly dependent on the particle size; the coercivity of nanocrystalline alloy flakes became larger with decreasing their sizes. In this study, the influence of ribbon thickness on the permeability and coercivity has been investigated. $Fe_{73}Si_{16}B_7Nb_3Cu_1$ amorphous ribbons were fabricated via a planar flow casting technique with a various thickness ranging from 15 to 30 μm, and then ground by a hammer mill after annealing at 420°C for 1 hour in an argon atmosphere. The powders were classified to –200~+270 mesh (53~75 μm) and –325~400 mesh (38~45 μm) particles. They were mixed with 3wt% of solder glass and 1wt% of Zn-stearate using a V-corn mixer. Consolidation of powder was carried out using a floating-die press to a toroidal shape. The consolidates were encapsulated in aluminum bobbins followed by a nanocrystallization annealing at 550°C for 1 hour in air. The initial permeability and core loss of the consolidates were measured with an impedance analyzer and a B-H analyzer. The intrinsic coercivity of the powder was evaluated using a vibrating sample magnetometer (VSM). The effect of the shape factor of particles on magnetic behavior will be discussed in terms of the original thickness and microstructural changes of the ribbon.