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Etching Time Dependence of Off-Diagonal Magnetoimpedance in Co-Based Amorphous Ribbon

Lan Jin[1,*], N.A. Buznikov[1], S.S. Yoon[2], C.G. Kim[3], and C.O. Kim[1]

[1]Research Center for Advanced Magnetic Materials, Daeduk Science Town, Daejeon 305-764, Korea
[2]Department of Physics, Andong National University, Andong 760-749, Korea
[3]Department of Materials Science and Engineering, Chungnam National University, Daejeon 305-764, Korea

*Corresponding author: lancnu@yahoo.com, Phone: +82 42 821 6227, Fax: +82 42 822 6272

Much attention has been paid to study the origin of giant magnetoimpedance (GMI) effect in annealed ribbons1,2. Even though it has not been completely understood by now and it must be studied further in detail. Co-base amorphous ribbons were annealed in the open air under the condition of 380 °C and applying field of 3 Oe during 8 hours. Then the crystallization layer came into being on the surface of ribbons. In this work, the annealed ribbons were etched by HF acid solution at different etching time. But just one side of ribbon was etched during the other side was covered with plastic tape. With respect to the magnetoimpedance measurements, the induced pick-up coil voltage was analyzed through a lock-in amplifier that allowed the determination of the first and second harmonic contributions with respect to the exciting current flowing through the sample. Helmholtz coils were employed to apply a homogeneous dc field along the longitudinal axis of the ribbons. The peak of off-diagonal magnetoimpedance profile in negative field region for air-side etched ribbon decreased and then increased with etching time, while it increased a little for wheel-side etched ribbon. The off-diagonal magnetoimpedance as a function of etching time will be discussed in detail to clarify the difference effect of etching on the air-side and wheel-side etched ribbon. Moreover, optimum conditions for asymmetric off-diagonal magnetoimpedance will be obtained through theory analysis. It will be helpful for designing magnetic sensor.

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Scaling Down Effect of Soft Magnetic Properties of Patterned Co-rich Amorphous Wires

Chang Bean Park[1], Hyun Kyung Kim[1], Sun Hee Park[1], Bok Yeon Kum1, Do Hun Kim[1], Dong Won Chun[1], Jun Hyun Han[1], Heon Jin Choi[2], Won Young Jeung*[1]

[1]Division of Materials Science & Engineering, Korea Institute of Science and Technology, P.O.Box. 131, Cheongryang, Seoul, 136-650, Korea
[2]Department of Metallurgical Engineering, Yonsei University, Seodaemoon-gu, Seoul, 120-749, Korea

*Corresponding author: wyjeung@kist.re.kr , Phone: +82 2 958 5422, Fax: +82 2 958 6839

Soft ferromagnetic materials have been considered as one of the most promising materials for a variety of electromagnetic devices. Among the two soft magnetic parameters including permeability and coercivity, the size and shape dependence of permeability and coercivity was accentuated so far. Since these properties are dependant on shape anisotropy, to know the size effect on the soft magnetic properties is very significant for fabrication of micro or nano-scale devices. In this work, the Permeability and Coercivity of patterned Co-rich amorphous wires were investigated theoretically and experimentally in various dimensions. Co-rich amorphous ribon was made by melt spinning Method and it was annealed at 500°C for 1 hour for stress relief. Then the Co-rich amorphous ribbon was attached on the silicon wafer by epoxy resin. Various dimensions of patterned wires were fabricated using photolithography and wet etching process. Magnetic properties of the wires were measured using a vibrating sample magnetometer (VSM). In order to explain the size the theoretical and experimental results, scaling down effect of patterned wire on soft magnetic properties could be examined.

In Figure 1, it is shown that the length effect plays an important role on the magnetic properties of the ribbon. This is consistent with the theoretical model in which magnetic properties are dependent on the dimension due to shape anisotropy. especially, permeability of 15mm lengths ribbon is ten times higher than 2mm lengths ribbon. Since aspect ratio of the wire is much higher than ribbon, we have demonstrated the size dependence of magnetic properties, including permeability and coercivity, using patterened Co-rich amorphous wires.

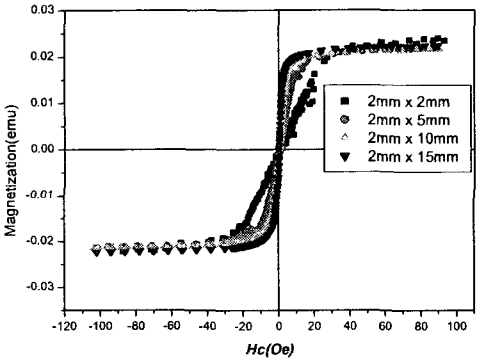

Fig. 1. Hysteresis loop with diverse length from 2mm to 15mm

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