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ABSTRACTS

4P-12. DISTRIBUTIONS OF HYPERFINE PARAMETERS OF NANOCRYSTALLINE $\text{Fe}_{78}\text{Al}_4\text{Nb}_5\text{B}_{12}\text{Cu}_1$ ALLOY. Sung Hyun Yoon (Kunsan National University, Department of Physics, 68 Miryong Dong, Kunsan, Chonbuk, 573-701, South Korea) and Hi Min Lee, Sung Baek Kim, Chul Sung Kim (Kookmin University, Department of Physics, 861-1, Songbuk-Ku, Seoul, 136-702, South Korea)

Magnetic Properties of nanocrystalline $\text{Fe}_{78}\text{Al}_4\text{Nb}_5\text{B}_{12}\text{Cu}_1$ alloy were investigated by Mössbauer spectroscopy. As quenched amorphous ribbon was flash-annealed at temperature range of between 350°C and 700°C to obtain different stages of crystallization. Mössbauer spectra consist of both sharp sextet due to bcc-Fe(Al) phase and two binomially distributed sextets due to amorphous matrix and interface layer, respectively. Distribution of various hyperfine parameters were obtained and related to macroscopic magnetic properties. The flash anneal starts the crystallization at 400°C, and shows Fe_2B phase at 550°C. The fraction of crystalline phase produced by annealing was as high as 46 % at 550°C.

4P-13. EFFECT OF MISCH METAL ON MAGNETIC INDUCTION IN 3% Si-Fe GRAIN-ORIENTED ELECTRICAL STEELS. Cheong-San Lee, Sang-Yoon Cha, Jong-Soo Woo (POSCO Technical Research Lab., Electrical Steel Research Team, 1 Koedong-dong, Nam-ku, Pohang, Kyungbuk, 790-785, South Korea)

In producing grain-oriented electrical steels, the slab-reheating temperature higher than 1400°C is known to be essential to completely dissolve MnS or AlN particles formed during casting and to finely reprecipitate them by subsequent hot rolling which provides the grain growth inhibition needed for {110}[001] oriented secondary recrystallization. In this study, it was attempted to lower the slab-reheating temperature to less than 1250°C by reducing S and N content which are about 0.023 and 0.007wt%, respectively, in conventional methods. To make up for insufficient inhibiting strength due to low the above elements, some Misch metal containing Ce, La, Pr and Al was added. Three kinds of heats containing 0.02, 0.05, 0.10wt% Misch metal respectively were melted and casted in a vacuum induction furnace. The primary annealing for decarburization and nitrogen injection was done at 850 degree C in wet $\text{H}_2+\text{N}_2+\text{NH}_3$ atmosphere and the final annealing for secondary recrystallization was carried out in dry H_2+N_2 atmosphere with 15°C/hr heating rate between 600-1200°C. B_{10} values of the final specimens were changed from 1.75 to 1.97T as the Misch metal content increases. From transmission electron micrographs of the specimens taken at certain intervals during the final annealing, it was found that as the Misch metal content increases, fine AlN precipitates are more distributed during the heating stage of the final annealing and, consequently, primary microstructures remain smaller and more uniform due to the sufficient inhibition leading to more stable secondary recrystallization.

4P-14. MAGNETIC AND STRUCTURAL CHARACTERIZATION OF BALL-MILLED CUPRIC OXIDE. Rodolfo A. Borzi, Ana E. Bianchi, Luis S. Montenegro, Silvana J. Stewart, Roberto C. Mercader, Graciela Punte (Universidad Nacional de La Plata, Departamento de Física, C.C. 67, La Plata, Buenos Aires, 1900, Argentina) and Flávio Garcia (CNPq, Centro Brasileiro de Pesquisas Físicas, Rua Dr. Xavier Sigaud 150, Rio de Janeiro, RJ, 22290-180, Brazil)

The diverse results obtained by different authors when measuring the magnetic properties of cupric oxide have been assigned as originating in the existence of intrinsic defects, like cation or anion vacancies, uncompensated charge effects (Cu^{3+}), etc. In particular, the low-temperature behavior of the magnetic susceptibility has been ascribed, among other causes, to spin fluctuations or particle size effects. Towards evaluating the effect of the particle size in the magnetic properties, systematic ball milling treatments have been performed to cupric oxide samples over a range of milling conditions. The change in the size and residual strain of the obtained particles as a function of the supplied energy has been assessed by room-temperature x-ray diffraction data studies. These show that the material evolves from well-crystallized grains to very finely divided nanoparticles. The magnetic properties measurements performed from 4.2 to 300 K show a paramagnetic-like contribution in addition to the inherent native CuO antiferromagnetic behavior. The observed enhanced value of the magnetization and susceptibility values for the whole range of energies is

in accordance with the degree of structural disorder induced by the mechanical grinding. The irreversible character for the field-cooling (FC) curve and the zero-field-cooling (ZFC) curve is observed down from the maximum temperatures at which the experiments are performed. This is an indication that short-range correlations are operative at temperatures well above the ordering temperature of approx. 230 K. The present results suggest that the maximum differences between the ZFC and FC magnetization curves, of the order of $6 \times 10^{-6} \text{ emu/g.Oe}$, are independent of the average crystallite size and strain.

4P-15. DOMAIN WALL PROPAGATION IN Fe-RICH GLASS COVERED AMORPHOUS WIRES. Horia Chiriac (National Institute of R&D for Technical Physics, Magnetic Materials and Devices, 47 Mangeron Blvd., Iasi, 6600, Romania) and Evangelos Hristoforou (Technological and Educational Institution, Electrical Engineering Department, Psahna, Euboea, Chalkis, 34400, Greece) and Maria Neagu, Iulian Darie (National Institute of R&D for Technical Physics, Magnetic Materials and Devices, 47 Mangeron Blvd., Iasi, 6600, Romania)

The magnetic glass covered amorphous wires present a special interest due to their magnetic properties that make them useful for sensors [1,2]. The aim of this work is to analyze the domain wall propagation in Fe-rich glass covered amorphous wires tested before and after glass removal. The measurements were performed using the Sixtus-Tonks experiment [2,3]. The studied samples have the diameter of the metallic core ranging between 10-27 micrometers and the thickness of the glass cover ranging between 2-15 micrometers. A linear dependence of the domain wall axial velocity on the driving magnetic field was observed. The driving magnetic field is higher for glass covered amorphous wires than for conventional ones (with diameters of 80 up to 200 micrometers) having the same compositions, the critical field of reverse domain nucleation being one up to two order of magnitude higher. This behavior is due to the magnitude and distribution of the internal stresses induced during the wire preparation that strongly depend on the ratio between the metallic core radius and the thickness of the glass cover [1]. The domain wall velocity increases when the diameter of the metallic core decreases and the critical field of reverse domain nucleation decreases with increasing the wire diameter. After glass removal the domain wall mobility increases and the nucleation and drive fields decrease.

[1]. H. Chiriac and T. A. Ovari, Amorphous glass-covered magnetic wires: preparation, properties, applications, Progress in Materials Science, vol. 40, no. 5, 1996, pp. 333-407.

[2]. M. Vazquez and A. Hernando, A soft magnetic wire for sensor applications, J. Phys. D: Applied Physics, vol. 29, 1996, pp. 939-949

[3]. I. Ogasawara and S. Ueno, Preparation and properties of amorphous wires, IEEE Trans. Magn., 31, 2, 1995, pp. 1219-1223

4P-16. MAGNETIC PROPERTIES OF Cu-PERMALLOY GRANULAR ALLOY. Júlio C. Cezar, Hélio Tolentino (LNLS, X Ray Spectroscopy Group, CP 6192, Campinas, SP, 13083-970, Brazil) and Marcelo Knobel (UNICAMP, DFESCM - IFGW, CP 6192, Campinas, SP, 13083-970, Brazil)

Granular magnetic systems have been extensively studied in the last few years because they display a number of interesting physical properties which, besides the prospective technological use, settle a challenge to the physics community to be properly understood. Among these properties one can mention giant magnetoresistance effect, superparamagnetism, spin-glass-like behaviour and the kinetics of growth of nanocrystalline grains. The system studied in the present work displays all the above mentioned properties, and therefore it is a unique setting to investigate the physical properties of granular solids. (FeNi)Cu ribbons were produced by melt-spinning in vacuum on a CuZr wheel. The long as-quenched ribbon was cut into identical pieces which were heat treated in vacuum for two hours at different temperatures ($200^\circ\text{C} < T_a < 600^\circ\text{C}$). Magnetic hysteresis measurements were performed using a MPMS XL-7 SQUID magnetometer. The same system was used to perform Zero-Field-Cooled (ZFC) and Field Cooled (FC) runs on the samples, from 4 to 300 K. From magnetization data it is easy to observe the growth of the magnetic