R11

Comparison of Soft magnetic Properties of Permalloy and Conetic Thin Films

Jong-Gu Choi[1]*, Do-Guwn Hwang[1,2], Jang-Roh Rhee[3] and Sang-Suk Lee[1,2]
[1]Dept. of Eastern-western Biomedical Engineering, Sangji University, Wonju 220-702, Korea
[2]Dept. of Oriental Biomedical Engineering, Sangji University, Wonju 220-702, Korea
[3]Department of Physics, Sookmyung Women' University, Seoul 140-742, Korea

The organism from imprecation wave number substitute actor of the field which sleeps the minute magnetic field measurement sensors below 1μG are mainly used with SQUID(superconducting quantum interface device)or flux gate where it uses the superconductor thin film[1-3]. Like this elements the bulk of drive system to be big is high price and it has the weak point which is not it will not be able to apply with supply style. In order to use the minute magnetic field measurement sensor below 1μG where it is cheap with the biosensor application, the thin film element has soft magnetism qualities which are higher the permalloy thin film of existing than from the actuality[4-6]. The development of the thin film element is raising its head essentially.

In case of soft magnetism bulk materials of existing which shows high frequency efficiency within the electromagnet transformer, it has the easy axis coercivity of about 100 mG degree and the magnetic susceptibility of about 10^5 from the hard axis[7]. A soft magnetic thin film coercivity bulk becomes larger at possibility times ~ tens times which it sees but the magnetic susceptibility makes the quality have which comes to be small.

In order to get a highly magnetic susceptibility, the new soft magnetism thin films, so called "Conetic"[6], prepared by ion beam deposition (IBD) sputtering method. The magnetic properties of coercivity and saturation field for two films such as permalloy and conetic depending on Ta buffer layer are compared each other.

Fig. 1 shows illustrations of MH loops and definitions of easy coercivity (H_{EC}) and hard saturation field (H_{HS}) from the (a) easy and (b) hard AMR loops for the glass/Ta(5 nm)/conetic(15 nm)/Ta(5 nm) film. Here H_{HS} is used to calculate the magnetic susceptibility (χ = 10MR(remnant magnetization) ÷ H_{HS}). Here 10 is a compensated value of the extrapolated saturation field by Egelhoff's experimental data[6]. Fig. 2 shows thickness dependence of the H_{EC}, H_{HS}, and χ of (a) permalloy and (b) conetic thin films for the glass/Ta(5 nm)/NiFe, NiFeCuMo(t = 3 nm ～30 nm)/Ta(5 nm) film prepared by IBD method. The saturation magnetic field, which is determined the magnetic susceptibilty, is 3.0 Oe in the conetic layer thickness of 3 nm and is decreased to 1.25 Oe as increased to 30 nm. Also, The magnetic susceptibility is obtained 1.3×10^3 ～ 6.5×10^3 as thickness of conetic films increased from 3 nm to 30 nm. The coercivity and magnetic susceptibility of Ta(5 nm)/NiFe(30 nm) film were 0.25 Oe and 6.5×10^3, respectively. The coercivity and the magnetic susceptibility of conetic film decreased and increased 3 times to one of permalloy film, respectively[7].

References

[1] N. A. Stutzke, S. E. Russek, D. P. Pappas, M. Tondra, J. Appl. Phys. **97**, 10Q107 (2005).
[2] M. Tondra, J. M. Daughton, C. Nordman, D. Wang, J. Taylor, J. Appl. Phys. **87**, 4679 (2000).
[3] X. Liu, C. Ren, G. Xiao. J. Appl. Phys. **92**, 4722 (2002).
[4] M. E. McHenry, M. A. Willard, D. E. Laughlin, Prog. Mater. Sci. **44**, 291 (1999).

[5] F, Pfeifer, C. Radeloff, J. Magn. Magn. Mater. **19**, 190 (1980).
[6] W. F. Egelhoff Jr., R. D. McMichael, C. L. Dennis, M. D. Stiles, F. Johnson, A. J. Shapiro. B. B. Maranville, C. J. Popwell, Thin Solid Films **505**, 90 (2006).
[7] J. G. Choi, J. H. Choi, K. A. Lee, D. G. Hwang, J. R. Rhee, S. S. Lee, J. Kor. Phys. Soc. **19**, 142 (2009).

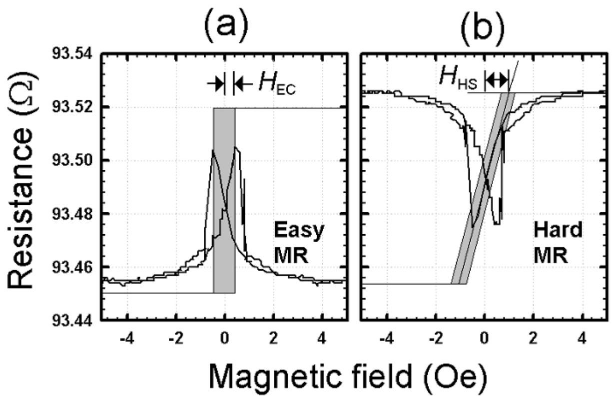

Fig. 1. Illustrations of MH loops and definitions of easy coercivity (H_{EC}) and hard saturation field (H_{HS}) from the (a) easy and (b) hard MR loops for the glass/Ta(5 nm)/Conetic(15 nm)/Ta(5 nm) film.

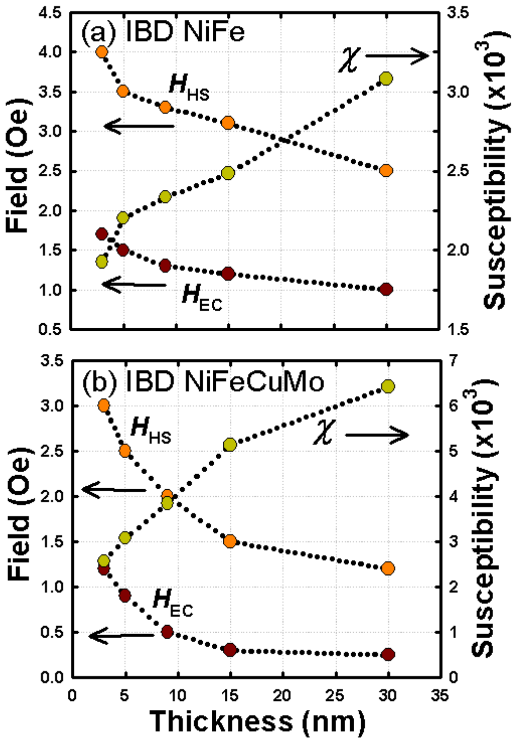

Fig. 2. Thickness dependence of the H_{EC}, H_{HS}, and χ of (a) permalloy and (b) conetic thin films for the glass/Ta(5 nm)/NiFe, NiFeCuMo(t = 3 nm ～ 30 nm)/Ta(5 nm) film prepared by ion beam deposition (IBD) method.