The Study of Perpendicular Magnetic Anisotropy, Annealing Effect, Coupling Strength in MgO/CoFeB/Nb/CoFeB/MgO

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ABSTRACT

In this study, we deposited MgO / CoFeB / Nb, Nb / CoFeB / MgO and MgO / CoFeB / Nb / CoFeB / MgO by sputtering and grew synthetic antiferromagnetic structure. These three structures were changed ferromagnetic or non-magnetic layer thickness of the material, and in the hysteresis curves measured after annealing to explore the perpendicular anisotropy and magnetic coupling. Studies have shown that the structure after annealing, which found that the perpendicular magnetic anisotropy (PMA) of the top structure only exist in a CoFeB thickness range from 1.2 to 1.6 nm. Squarness, coercivityfield(Hc)and magnetic anisotropy field (Hk) were decreased when thickness increases. In the top structure showing that thickness of the CoFeB structure for perpendicular anisotropy has a great influence. But, in the bottom structure which after annealing, almost all thicknesses are perpendicular anisotropy, and in addition to the value of the coercive field increases with Nb thickness, squareness and anisotropic magnetic field is extremely stable, Nb infer the structure changes in the thickness of the perpendicular anisotropy has little effect. In full structures, perpendicular magnetic anisotropy weredecreases when thickness increases. Nb = 1.0nm, 1.5nm, m1 and m2 trends are consistent with results showing both the upper and lower CoFeB layers produce magnetic dead CoFeB layer is very similar. Nb = 2.0nm, annealing temperature in between 255oC and 345oC, m1 increase with temperature increase, but m2 decrease as temperature increase, as shown in the hysteresis curve of this annealing temperature is different to Nb = 1.0 and 1.5nm. Our experimental data are compared with the reference literature, we found that coupling energy, anisotropy energy and annealing temperature value to Nb as spacer layer synthetic antiferromagnetic structure are lower than with Ru as the spacer layer synthetic antiferromagnetic structure .

Keywords : Synthetic Antiferromagnet、Perpendicular Magnetic Anisotropy、Coercivity、anisotropy constant

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REFERENCES

[1] J. Hayakawa, S. Ikeda, Y. M. Lee, F. Matsukura, and H. Ohno, Appl. Phys. Lett. 89, 232510 (2006).

[2] 陳鴻銘,"Ta/CoFeB/MgO結構之介面對垂直異向性之影響"中正大學物理研究所 碩士論文(2011) [3] M.T. Johnson et al. , Rep. Prog. Phys. 59, 1409 (1996).

[4] A. Manchon, C. Ducruet, L. Lombard, S. Auffret, B. Rodmacq, B. Dieny, S. Pizzini, J. Vogel, V. Uhli?, M. Hochstrasser, and G. Panaccione, J. Appl. Phys. 104, 043914 (2008).

[5] K. Kyuno, R. Yamamoto, and S. Asano, J. Phys. Soc. Jpn. 61, 2099 (1992).

[6] D. Weller, Y. Wu, J. St?hr, M. G. Salant, B. D. Hermsmeier, and C. Chappert, Phys. Rev. B 49, 12888 (1994).

[7] 鄭琮譯,"MgO/CoFeB/Nb(or Ru)/CoFeB/MgO結構之交換耦合及垂直異向性探討"中正大學物理研究所 碩士論文(2012) [8] M.T. Johnson, R. Coehoorn, J.J. de Vries, N. W. E. McGee, J. aan de Stegge, and P. J. H. Bloemen, Phys. Rev. Lett. 69, 969(1992) [9] D. C. Worledge, G. Hu, David W. Abraham, J. Z. Sun, P.L.Trouilloud, J. Nowak, S. Brown, M. C. Gaidis, E. J. O ' Sullivan, and R. P. Robertazzi, Appl. Phys. Lett. 98, 022501 (2011).

[10] 陳建璋,"MgO/CoFeB/Ru/CoFeB/MgO從水平式到垂直式之介面交換耦合"中正大學物理研究所 碩士論文(2013)