Magnetic properties of Fe-Ni-N/Cu multilayered films by DC magnetron sputtering method

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The microstructure and magnetic properties of Fe-Ni-N/Cu multilayered films, prepared by DC sputtering method, with different thicknesses of Fe-Ni-N have been studied by x-ray diffraction (XRD) and magnetic techniques. XRD shows that (200) orientation of Fe-Ni-N crystallite was enhanced as decreasing Cu layer thickness. It has been found that the magnetization of the Fe-Ni-N layer decreases rapidly as increasing the thickness of Cu layers and keeps approximately constant value from the thickness of Cu layer of 2 nm and above, but decreases as decreasing Fe-Ni-N layer thickness when the thickness of Cu layer is fixed at 2 nm. These phenomena can be explained by means of the dead layer model [1]. From linear fits to data the magnetization of the film without Cu layers M(0) and the dead layer thickness δ were to be 850 emu/cm^3 and 0.7 nm, respectively. The origin of this dead layer can be explained on the basis of the local environment effect on Fe-Ni-N. This also has been attributed to the formation of interdiffusion near the interface, which leads to a reduction of magnetic moment [2]. The temperature dependence of magnetization exhibits the features of Bloch's law. The values of the Bloch coefficient and spin wave stiffness constant depend on the thickness of Fe-Ni-N layer when the thickness of Cu layer is fixed at 2 nm, but hold approximately constant on the variation of the thickness of Cu layer. Furthermore, the magnetic size effect of Fe-Ni-N/Cu multilayered films, such as reduced Curie temperature as a function of the thickness of Fe-Ni-N layer has been discussed.

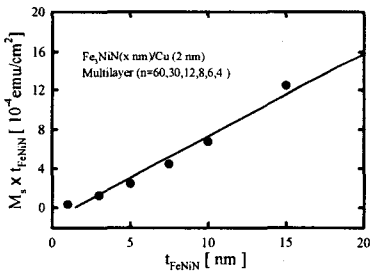

Fig. 1 The variation of the product $M_s \times t_{FeNiN}$ as a function of thickness t at T=300K.

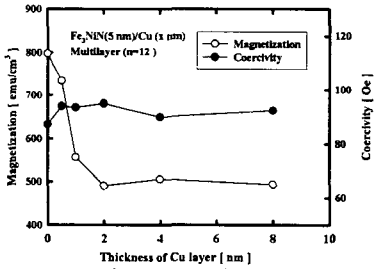

Fig. 2 The magnetization and coercivity per Fe-Ni-N volume of 12[Fe-Ni-N(5 nm)/Cu(x nm)] bilayers as a function of Cu layer thickness at room temperature.

References

[1] L. Driouch, R. Krishnan, M. Porte, K. V. Reo, and M. Tessier, J. Appl. Phys. **81**, 4745(1997).
[2] Chubing Peng, Yang Cao, and Daosheng Dai, J. Appl. Phys. **71**, 3457(1992).