Growth of Co/Cu multilayered thin films by electrodeposition

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Since the discovery of the giant magnetoresistance in anti-ferromagnetically coupled Fe/Cr, Co/Cu multilayers, preparation of metallic multilayered films have attracted much interest in basic science and application technology. The multilayers were prepared under well controlled conditions to obtain high-quality layered structure on atomic scale. Methods of physical vapour deposition, such as MBE and sputtering, have been recognized as most suitable for the preparation of well characterized multilayered films. On the other hand, for the convenience of facilities and easiness in operation, electrodeposition may also be a promising and competitive candidate for the multilayers fabrication.

Cyclic potential change in one electrolytic cell is an easy way to grow periodic layered structure. The multilayered films of Co/Cu grown by the potential change method showed a relatively large GMR ratio and its oscillation against the change of Cu layer thickness, although the Co layer was a Co-Cu alloy[1]. In this study pure Co and Cu layers have been prepared by flowing supporting electrolyte and injecting metal ion containing electrolytes one by one alternately for 15 times. The supporting electrolyte was 0.1 mol/l boric acid aqueous solution, and metal ion containing electrolytes were $1x10^{-3}$mol/l copper sulphate and $5x10^{-3}$ mol/l cobalt sulphate solutions. The substrates used were silicon wafer plated with gold by vacuum evaporation to take electrical contact. In X-ray diffraction at low angle range a long period peak could be observed, and in the middle angle region a single broad peak showing an average lattice spacing of the film was observed. The thickness of the each layer was estimated from the low angle X-ray diffraction peak and the integration of the cathodic current during metal deposition.

The magnetization curve was measured by VSM, and magnetoresistance was measured by Van der Pauw method with current supplying in plane. The magnetization curves obtained showed the characteristics of anti-ferromagnetic coupling, and the electrical resistance showed the GMR characters. The maximum GMR ratio obtained was 6.2% at room temperature for the specimen of [Co 2.1nm/ Cu1.0nm].

Though we need further studies for choosing a suitable deposition potential and improving the electrolyte composition, the flow electrodeposition method is proved to be a promising method for producing magnetic thin films.

Reference

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