The control of in-plane magnetic anisotropy by ion irradiation

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Recently, great efforts have been devoted to understanding the physics of magnetism in extremely small dimensions in order to develop new techniques for decreasing bit size below current limits and thus increasing the data storage density in magnetic storage media [1,2]. In common unidirectional recording, magnetic dipole interaction between adjacent bit areas with opposite magnetization can lead to the reversal of data bits and the cross track interference that limit the ability to attain ultrahigh storage density [3]. Since the magnetostatic energy between adjacent domains is proportional to the cosine of the angle between magnetization directions, the coupling between data bits can be largely reduced by controlling the magnetic easy axis between neighbors to be orthogonal. In this research, we intend to manipulate the direction of magnetic easy axis in a ferromagnetic thin film. For that purpose, Co/Pt multilayered films are grown by e-beam evaporation and then ion-irradiated with 80 keV Ar^+ ions in an external magnetic field. CoPt alloy films with chromium have been widely used as a magnetic storage media due to their large magnetic anisotropy energy, high coercivity, and high corrosion resistance. In addition, ion irradiation has an advantage to change film structure so as to get metastable alloy or amorphous film [4]. In this experiment, magnetic field is applied to the sample in order to support the easy axis change process during ion irradiation. The easy axis direction is confirmed by measuring the magnetic hysteresis loop of the film with magneto-optical Kerr spectrometer. The results are plotted to the remnant magnetization ratio versus azimuthal angle. As a result, the easy axis is formed along the external field direction and the formation is varied proportional to the dosage increase, while the as-grown sample has no preferred magnetic orientation. It can be said that the irradiated energetic ion beam reorganize the film structure and the external magnetic field make or change the easy axis during ion irradiation. Ion irradiation with magnetic field is a technique of promise for controlling magnetic easy axis in magnetic recording media.

References

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