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Quantitative Analysis for Crystal Structure of $CoPtCr\text{-}SiO_2$ Perpendicular Magnetic Recording Media

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$CoPtCr\text{-}SiO_2$/Ru thin films are known as potential materials for high-density perpendicular recording media due to their well-isolated, fine grain structure with high magnetic anisotropy constant K_u [1, 2]. We reported that the fcc phase in the film increases at 30 at. % Pt, and that fcc phase formation is an influential factor of K_u reduction [3]. In this report, we show a study of quantitative analysis to evaluate volume fraction of hcp and fcc phases in the $CoPtCr\text{-}SiO_2$ films.

A 20 nm thick $CoPtCr\text{-}SiO_2$ film was deposited on a glass disk by co-sputtering method. Ru (20nm) and Pt (10nm) layers were employed as seed and pre-seed layers, respectively [2]. Ru and Pt single layers were evaluated as references, respectively.

Figure 1 shows a schematic diagram of experimental setup. The grazing incidence angle was 0.17° in a total reflection condition, and diffracted x-rays were recorded on an imaging plate. The photon energy was 14keV.

Figures 2(a) and 2(b) show x-ray diffraction patterns for Ru and Pt films, respectively. Hcp(101) and hcp(102) diffractions from the Ru film and fcc(111) and fcc(200) diffractions from the Pt film were observed clearly. The diffraction intensities of these phases were calculated by subtracting the background. The intensity ratio of hcp(101)/hcp(102) and fcc(111)/fcc(200) were in agreement with those reported on the ICDD powder diffraction data.

This technique was used to evaluate the volume fraction of hcp and fcc phases in the $CoPtCr\text{-}SiO_2$ films. Detailed analysis is in progress.

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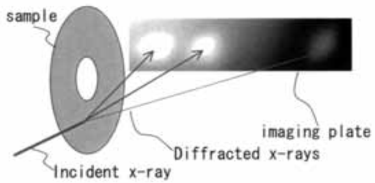

FIG. 1. Schematic diagram of experimental setup.

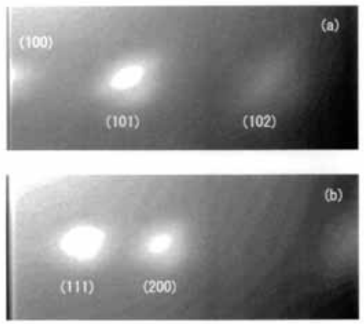

FIG. 2. X-ray diffraction patterns for (a) Ru film, (b) Pt film.

Reference

[1] T. Shimatsu *et al.*, IEEE Trans. Magn. 40, 2483 (2004)

[2] T. Shimatsu *et al.*, IEEE Trans. Magn. (in press)

[3] T.Kubo *et al.*, J. Appl. Phys. (in press)

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XRD Analysis of Polysilicon Gate Electrode for LSI under Different Deposit Conditions of Substrate Temperature

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Polysilicon is one of the important interconnect materials for MOS transistor in the semiconductor processes. Polysilicon is used as gate electrodes in MOS transistor (Figure 1). Reliability of interconnects has been recognized as crucial issue in electric device fabrication under recent dramatic shrink of feature size of the electric devices. Reliability of interconnects depends on etched shapes of interconnect structures. X-ray Diffraction (XRD) is one of the most effective techniques for crystal structure study of interconnect materials.

Polysilicon films were formed on gate dielectrics at MOS transistor by CVD. We have applied XRD to polysilicon gate electrodes which have different deposit conditions of substrate temperature. If the substrate temperature becomes lower, the etched shape of polysilicon gate electrodes becomes worse. XRD measurement has been performed on the undulator beamline BL16XU with X-ray energy of 8.5keV.

Figure 2 shows XRD patterns obtained from polysilicon films under different substrate temperatures. The film thickness of the polysilicon is thin with 100nm. However, the change in the peaks is clearly detected by the $\omega/2\theta$ scanning. This change is hardly detectable by the $\omega/2\theta$ scan with laboratory XRD equipments, since its brilliance of Xray is insufficient. In the order of A, B, and C, the substrate temperature of the sample was low. The substrate temperature of the sample C was highest. The main peak (around 27.1°) corresponds to Si(111). A shoulder peak (around 25.7°) can be observed for sample B and C. The shoulder peak has increased, corresponding to an increase of substrate temperature.

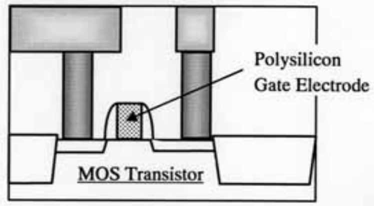

Figure 1 Cross section of polysilicon gate electrode for LSI

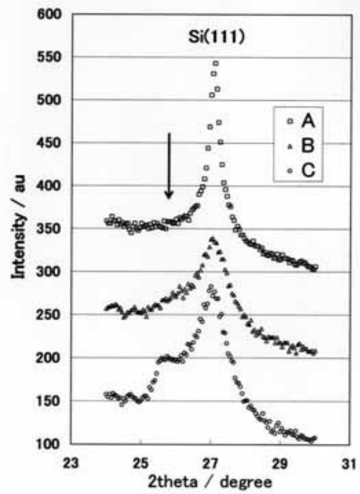

Figure 2 XRD patterns by $\omega/2\theta$ scan obtained from polysilicon films under different substrate temperatures.