

## 나노 크기의 알갱이가 있는 Co/Pt 다층박막에서 2개의 자화 용이 축을 가지고 있는 이방성에 관한 첫 번째 관측

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### First Observation of the bi-axial anisotropy of Co/Pt multilayer in which nano-particles are embedded

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#### 1. Introduction

In recent years magnetic clusters have attracted considerable attention for their storage applications such as high-density magnetic memory devices, non-volatile magnetic random access memories, etc. For control and exploitation of nanoscale clusters in technological applications, it is important to know their physical property. Theoretical and experimental investigation for nanoclusters has been extremely made.

In PLD it is well known that particulates are produced [1]. We describe the study on the magnetic anisotropy in Co/Pt multilayer (ML) when Co clusters produced by a pulsed laser are randomly embedded.

#### 2. Experiment

Using a new normal-incidence PLD (NIPLD) [2], (Co/Pt)<sub>15</sub> ML was fabricated on a native oxide Si (100) under a base pressure of  $\sim 1 \times 10^{-6}$  Torr . The number of bilayers is 15. The top layer is Pt layer to protect the surface against oxidation. The target manipulation system can hold up to 4 targets. A d.c. motor is attached to a substrate holder to rotate a substrate. The sample-target distance was 7 cm and the off-axis

up to 4 targets. A d.c. motor is attached to a substrate holder to rotate a substrate. The sample-target distance was 7 cm and the off-axis distance from the laser beam to the center of sample was 2.7 cm. The second harmonic of Nd:YAG pulsed laser (pulse width 5nsec FWHM, 532nm at repetition rate of 10Hz) was used to ablate target materials. The laser fluence on target was about 0.38 J/cm<sup>2</sup> for Co and 0.42 J/cm<sup>2</sup> for Pt. The thickness was then divided by the total numbers of laser pulse used. The deposition rate was about 2.3 x 10<sup>-4</sup> nm/shot for Co and 4.3 x 10<sup>-4</sup> nm/shot for Pt. The substrate was held at room temperature during deposition.

### 3. Result and discussion

A field emission scanning electron microscopy (SEM) shows the existence of Co clusters of different size in ML. The magnetic anisotropy induced by Co clusters has been investigated using a null-type torque measurement and a vibrating sample magnetometer (VSM) measurement. The data show the ML has two easy directions and minor hysteresis loops around the critical field. Along the direction perpendicular to the film surface, the magnetic anisotropy energy has the absolute minimum and an additional minimum along the in-plane direction. We propose that the bi-axial anisotropy comes from the combined effect of two anisotropies of different physical origins, the PMA induced by interfaces texture and the shape anisotropy induced by the Co clusters texture.

### 4. Conclusion

The shape anisotropy induced by Co clusters tends to put magnetization in the plane and PMA induced by the interfaces tends to align magnetization perpendicular to the plane. The effects from both interfaces texture and the Co clusters texture combine to produce the biaxial anisotropy [3]. The roles of Co clusters are as follows : 1) in-plane magnetization; 2) antiparallel domain configuration and 3) no coercivity field in spite of a well defined ML structure.

### References

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