CB03

Stress Induced Exchange-Decoupling Mechanism in Perpendicular Magnetic Recording Media

Jai-Young Kim*, Sudhir Malhotra, Jackie Jung, Bo Bian, Gerardo Bertero and Tom Yamashita

R & D Center, Komag, Inc., 1710 Automation Parkway, San Jose, CA 95131, USA

*Corresponding author: Jai-Young.Kim@komag.com, Phone: +1 408 576 2033, Fax: +1 408 944 0107

The stress induced interfacial effect between magnetic recording layer (either CoCrPt alloy or FePt L10 intermetallic film) and crystallographic underlayer is overviewed so as to improve a well-isolated exchange decoupled state in perpendicular magnetic recording (PMR) media.

Firstly, stress induced exchange decoupling mechanism is introduced in the CoCrPt biased PMR media to achieve higher signal to media noise ratio (SNRme). The exchange decoupling is controlled by the lattice mismatch (LM) between Co magnetic recording and Ru under layers in terms of the sputtering deposition pressure. As shown in Fig. 1, the increasing LM in the PMR media begins to increase coercivity (Hc) and dramatically improve SNRme up to 4.13 %,and then decreases the both. It is expected that expanded LM creates the residual stress in the Co layer and provides stress induced pinning sites, resulting in the increase of Hc. Also the residual stress enhances the exchange decoupling state [1], and results in the enhancement of SNRme. However, the excess LM makes the coherent-incoherent transition at the interface and partially releases the residual stress in the Co layers [2], giving rise to the reduction in Hc and SNRme.Moreover, since the higher decoupling state with the better SNRme is achieved in the lower sputtering pressure, this mechanism process is free from the disadvantages in higher pressure depositon for the columnar structure, such as low deposition rates, target redeposition, flake particles, etc.

Secondly, stress induced decoupling mechanism is given to the chemicallty ordered L10 FePt media structure. The additive oxygen in the FePt deposition on a Ag underlayer decreases LM between (100) FePt and (200) Ag layers from 6.3 to 3.9 % in the as deposited state. The reduced LM not only suppresses the FePt grain growth below 5 nm in the as deposite state, but also promotes the hetero epitaxial growth with the Ag underlayer, resulting in the achievement of chemically ordered [001] FePt film structure on a conventional glass substrate.

The stress induced decoupling mechanism with the corresponding crystallographic, magnetic and magnetic recording performances will be discussed in detail.

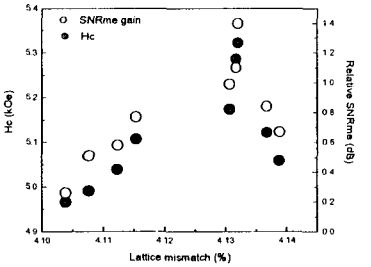

Fig. 1. Hc and SNRme as a function of LM between Co magnetic and Ru under layers.

REFERENCES

[1] T. Suzuki, N. Honda and K. Ouchi, J. Appl. Phys., **85**, 4301 (1999).

[2] E.M. Philofsky and J. E. Hilliard, J. Appl. Phys., **40**, 2198 (1969).

CB04

Investigation of High and Low Mobility Sputter Conditions to Enhance Decoupling in Oxide Composite media

Hwan-Soo Lee*[1], Sok-Hyun Kong[2], Hoo-San Lee[2], Hoon-Sang Oh[2], and David E. Laughlin[1]

[1]Data Storage Systems Center, Carnegie Mellon University, Pittsburgh, PA, 15213, USA

[2]Samsung Advanced Institute of Technology, Yongin-Si, Gyeonggi-Do, 449-712, Korea

*Corresponding author: hwansoo@ece.cmu.edu, Phone: +1 412 268 4034, Fax: +1 412 268 6978

We present an overview of our recent work on producing fine granular mixtures of magnetic media (either Co alloy or $L1_0$) and an oxide which acts to isolate the grains. Low and high mobility sputter conditions, which correspond to two very different regimes in Thornton's well-known film growth model [1], were investigated. High Ar pressure during deposition of recording layer was selected to achieve a well-separated film microstructure in the low mobility conditions whereas bias sputtering was utilized to modify a film microstructure in high mobility sputter conditions.

In Fig. 1, a notable contrast in film morphology for different argon gas pressure is seen from the TEM micrographs of CoCrPt-SiO_2 media. A similar visual grain size of about 7 nm and much better defined SiO_2 on the thicker boundary was observed at higher Ar pressure. However, the magnetic measurements show that there is an optimum Ar pressure in order to have high squareness and negative nucleation. The CoCrPt-SiO_2 media fabricated with a high Ar pressure of 60 mT showed reduced squareness and positive nucleation field.

Another approach to enhancing this grain separation is to utilize bias sputtering [2]. One example (FePt-MgO) of bias sputtered films where biasing aids in achieving decoupling is shown in Fig. 2. For unbiased FePt-MgO deposited at RT, the length scale for the precipitation of oxide is 1-2 nm, and an interconnected network is seen, which is likely to produce a large switching volume. On the other hand, well-defined grains with boundaries are in evidence with biasing. See Fig. 2(b). There is no significant grain growth or coalescence in the biased films even at elevated temperatures of 400°C. Average grain size is 5 nm. In this work, typical microstrucutral characteristics for the two different regimes will be compared and discussed, along with their magnetic properties.

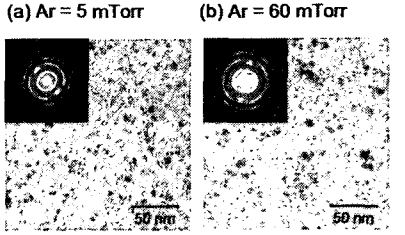

Fig.1. Plan view TEM micrographs of CoCrPt-SiO_2 media for different Ar gas pressure.

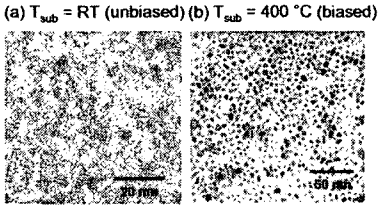

Fig.2. Plan view TEM micrographs of sputtered FePt-MgO media for different substrate temperature. Note the different scale bars.

REFERENCES

[1]J. A. Thornton, J. Vac. Sci. Technol., **A 4**, 3059 (1986).

[2]H. S. Lee, J. A. Bain, and D. E. Laughlin, Appl. Phys. Lett., submitted.