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Investigation of Sputtered Tape Media with Ultra-thin Magnetic Layer

Hwan-Soo Lee*, James A. Bain, and David E. Laughlin
Data Storage Systems Center, Carnegie Mellon University, Pittsburgh, PA, 15213, USA
*Corresponding author: hwansoo@ece.cmu.edu, Phone: +1 412 268 4034, Fax: +1 412 268 6978

Along with the advanced metal particle (MP) or advanced metal evaporated (ME) tape media, sputtered tape media can offer very promising long term solution as the next generation tape media [1]. Previously, NiAl/CrMn underlayers (ULs) and CoCrTa intermediate layer (IL) were used in order to induce a smaller grain size and to better promote epitaxial growth of the hcp structure without substrate heating [2]. However, the film structure is relatively complex and expensive to commercialize. Ultimately, for this technology to be transferred to tape media application, reducing the thickness provides benefits not only in the recording side but also in the fabrication side. Fig. 1(a-d) shows thickness dependence of the three non-magntic layers as well as the CoCrPtBN magnetic layer on coercivity, Hc of the CoCrPtBN films. Glass substrates were initially used as a standard substrate because they can make the process simple with better reproducibility. The dotted lines indicate the minimum thickness for each layer to sustain Hc without degradation. The minimum thicknesses for NiAl, CrMn, CoCrTa, and CoCrPtBN are 45, 6, 4, 10 nm, respectively. Note that the deposition dwell time is primarily determined by the NiAl layer. This indicates that the NiAl underlayer should be thick enough to preserve the in-plane coercivity. Samples with the same stack structure was deposited on polymeric substrates. Two stacks A and B having different layer thicknesses (see Fig. 2) were chosen to examine the recording performances. The thicknesses of the three non-magnetic layers were determined not to degrade the coercivity of the CoCrPtBN films. Note that the overall thickness of stack A was nearly halved in comparison with stack B. Fig. 2 shows signal-to-noise ratio (SNR) with respect to recording density for stacks A and B. An improvement in SNR by employing the thinner magnetic layer is obvious. The SNR of stack A is 4 dB higher than that of stack B at a linear density of 140 kfci. We will further discuss the media noise, isolated readback pulse, and overwrite for the samples examined here.

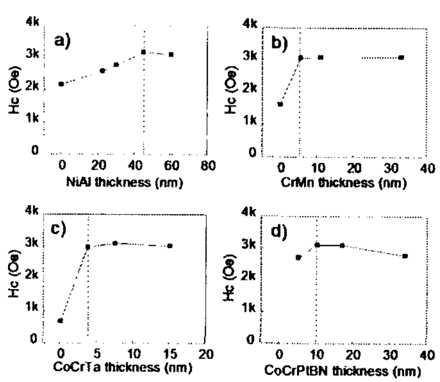

Fig. 1. Hc as functions of a) NiAl, b) CrMn, c) CoCrTa, and d) CoCrPtBN thickness. The reference stack structure: glass/NiAl (60 nm)/CrMn (30 nm)/CoCrTa (8 nm)/CoCrPtBN (16 nm).

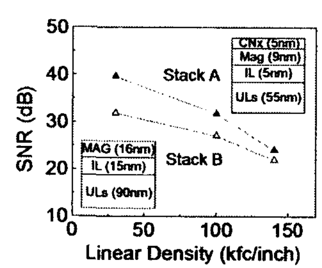

Fig. 2. SNR with respect to linear density. Note that a carbon nitride (CNx) overcoat is on the magnetic layer for stack B.

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PD01

CrP Thin Film: Epitaxial Growth and Magnetic Properties

Jeongyong Choi[1], Sungyoul Choi[1], Jiyoun Choi[1], Soon Cheol Hong[1], and Sunglae Cho*[1,2]
[1]Department of Physics, University of Ulsan, Uslan 680-749, South Korea
[2]Nanodevice Research Center, Korea Institute of Science and Technology, Seoul136-791, South Korea
*Corresponding author: slcho@mail.uslan.ac.kr, Phone: +82 52 259 2322, Fax: +82 52 259 1693

A NiAs-type transition metal based antimonide and arsenide have considerable interests because of the possible half-metallic characteristics in zinc-blende structure. Among them, the zinc-blende growth and ferromagnetic properties of MnAs, CrAs and CrSb were reported elsewhere.[1-6] On the other hand, CrP has a orthorhombic crystal structure belonging to the space group Pnma(62) with lattice constant of a=5.348 Å , b=3.109 Å and c=5.997 Å, which is distorted from the NiAs-type hexagonal structure. Several theoretical studies also predicted the half-metallic properties in zinc-blende CrP. We have grown a CrP thin filmon semi-insulating GaAs(100) wafer by molecular beam epitaxy(MBE). Standard and cracking effusion cells were used for Cr and P evaporations, respectively. The growth temperature was 500℃ and the growth rate of Cr was 0.25 Å/s under the phosphorus ambience. However, the crystal structure of the film on GaAs(100) was orthorohombic with metallic electronic structure. The spiral magnetism was observed with peculiar magnetoresistance data as showen in Fig. 1.

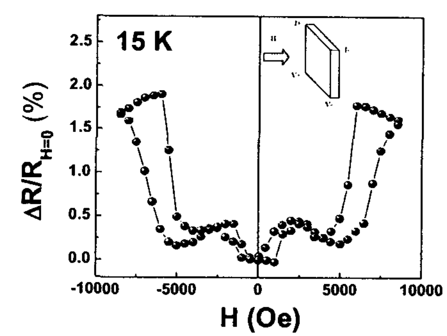

Fig. 1. Magnetoresistance of CrP thin film at 15 K.

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