

### A study on the perpendicular media with a thin soft underlayer

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#### 1. Introduction

In the previous report[1], single layered CoCrPt perpendicular media which show negative nucleation field(Hn)[2] and slightly strong exchange coupling were proposed to be candidates for high density in perpendicular recording.

In this presentation we have studied on the effects of thin soft magnetic underlayer on read/write and thermal stability in pseudo double-layered perpendicular media by micromagnetics simulation.

#### 2. Modeling

Two types of 20 nm thick CoCrPt layer(sample 1: Hc = 3000 Oe, Hn = 1800 Oe, sample 2: Hc = 5100 Oe, Hn = 3100 Oe) on 10 nm thick soft underlayer were chosen. The saturation magnetization of soft magnetic layer was set to 800 emu/cc or 1200 emu/cc. Karlqvist type head field distribution was used as the read/write field sensitivity function.

#### 3. Results & Discussion

Fig. 1 shows the written bit pattern of CoCrPt(1) with the thin soft underlayer when ring type writing head with 1.8T deep gap field and 10 nm flying height was used; (a) Mz-component of CoCrPt layer, (b) Mz-component of soft layer and (c) Mx-component of soft layer. It is shown that the magnetization of CoCrPt layer is mainly along z-axis(perpendicular direction) and the in-plane component of the magnetization of soft layer has transitions at the center of bit cells. The pattern of CoCrPt(2) is nearly the same as that of sample 1 except higher writing field used.

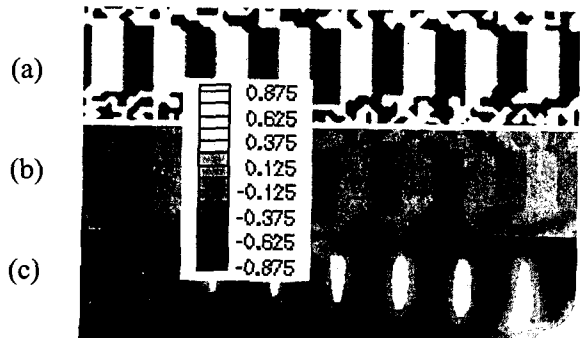


Fig. 1. Written bits pattern of sample 1(Hc = 3000 Oe, Hn = 1800 Oe) with softlayer(Bs ~1.0 T, Hc ~10 Oe) @ 423kfc/ and 190ktpi, (a) Mz of the CoCrPt layer, (b) Mz and (c)Mx of the soft layer

Fig. 2 (a) and (b) indicate that the energy barrier was increased about 30 % in the case with the soft under layer( $M_s=1200$  emu/cc). It has been expected and can be explained that the soft layer induces the decrease of demagnetization field or the add-on of effective uniaxial anisotropy of CoCrPt layer. An interesting problem which can be seen from Fig. 2 (c) is that the vortex structures of domain in soft layer seem to lower the energy barriers of the upper CoCrPt grains. Although SNR of each bit pattern without thermal agitation is 33~40 dB, which is less than that of the single CoCrPt media

#### 4. Conclusion

In view of energy barriers, comparisons of the time decay characteristics in the CoCrPt media with and without thin soft layer were obtained. The soft magnetic vortex structures in the recording with these "pseudo" double layers seem to have bad effects on the neighboring recorded bits that is to say make them weak sites of magnetization reversal.

#### 5. References

- [1] K. J. Lee, "Micromagnetics of thermally assisted switching of magnetization in magnetic recording system", Ph.D. Thesis, Department of Materials Science and Engineering, KAIST, 2000
- [2] I. S. Lee, H. Ryu and H. J. Lee, T. D. Lee, "Role of a paramagnetic amorphous CoZr seed layer in CoCrPt/Ti perpendicular recording media", JAP, V. 85(8) pp. 6133-6135, 1999

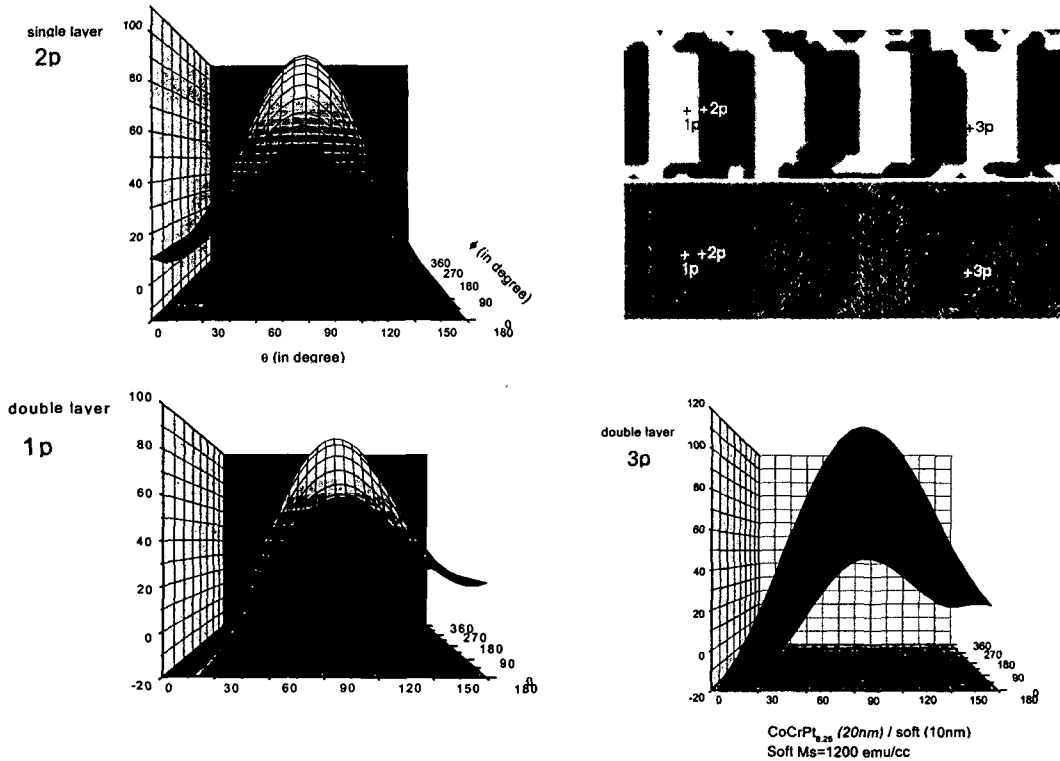


Fig.2 The energy surfaces of various discretized cells(or grains).  $\theta$  and  $\phi$  are parameters at the polar coordinate. ( $\theta$ : the angle between magnetization-direction and z-axis)