MAGNETIC MULTI-VALUED MAGNETO-OPTICAL DISK

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To broaden magneto-optical disk application, the most important issue is a remarkable increase of recording density. This paper firstly opens magnetic multi-valued (MMV) MO disk. Especially, here, quadri-valued MO recording was studied by a field modulation overwriting method using a new layer structured disk. Such attempt gives very attractive approach to make double or more higher capacity disk not depending on laser wavelength.

1. Dual Write State MO Media

It was found that rare-earth rich TbFeCo coupled with Pt84Co16 shows dual writing state against external field as shown in Fig. 1(a). This TbFeCo film has a Curie temperature of 200°C and has no compensation point. Even at a erase side field direction (minus sign), there occurs write state as noted by B. Also, at a larger positive field there occurs again write state as C. Such behavior is explained by the similar phenomena with the capping layer effect of PtCo [1].

2. Magnetic Multi-Valued MO Media (MMV)

The quadri-valued MO media was invented combining the above mentioned bi-layer and a conventional TbFeCo. The external field dependence of a conventional TbFeCo is an ordinarily type as shown in Fig. 1(b). The important thing is a thickness which make the film see-through behavior. Typical thickness of conventional TbFeCo is 11nm. The role of PtCo layer is both a magnetic capping layer and a optical reflective layer. Very thin SiN layer was inserted between two TbFeCo layers.

The layer structure is shown in Fig. 1(c). Four level switching field is applied corresponding to the above mentioned 4 area ; A, B, C, D of the dual writing state. As a result, four coupled magnetization states are available on such a combined media. With this MMV media, reproduced signal is shown in Fig. 2(a). Each state is recorded by DC field, -900, -500, +500, +900 Oe respectively with the DC laser beam. Clearly separated 4 signal levels are observed.

It is necessary for certifying a multi-valued media that every new recorded state should be written regardless the previous recorded state. We confirmed this performance by the following experiment. First, the 4 signal DC states like Fig. 2(a) are written on a track. After that, 400 ns pulsed light was irradiated at a fixed DC field on different those 4 signal states. In the Fig. 2(b) each photo shows the re-recorded results for each external fields respectively. You can see that re-recorded state is always transposed to the essential state defined by the external field. This also guarantees the direct overwrite by the field modulation method for multi-valued MO media.

3. Fundamental Experiment of Field Modulation Overwriting

With this MMV media, we actually confirmed the multi-valued recording performance on field modulation method. Four external field levels using a magnetic head was applied irradiating fixed DC laser beam. The reproduced signal is shown in Fig. 3(b), which shows a quadri-valued overwrite recording corresponding to the external field.
This paper opened the principle and basic media design for Multi-Valued MO recording. We expect that such approach can lead the MO disk to the extreme high density over 10 G bit/in² combining with other high-density techniques, also we believe that cost effective drive design can be realized using such disks.


Fig. 1. Disk layer structure and external field response of MMV MO disk.

Fig. 2. Feasibility test of level to level transitions.

Fig. 3. Field modulation recording on the MMV disk.