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High Density Magnetic Recording Media Technology

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Abstract

The hard disk drive incorporates a disk made of aluminum or glass, the surface of which is coated with a very thin magnetic film called the magnetic recording media. The data is maintained on this media, and the materials and thickness of the film are devised to meet the needs for large capacity and high-speed demand. Different sizes of disk are used: small diameters of 1.8 inches and 1 inch have recently been put into practical use for small music players and cellular phones, as well as 3.5-inch disks for desktop PCs and 2.5-inch disks for notebook PCs. One to five platters are used in a single hard disk drive depending on the use.

Technology

In the current hard disk drives, both the longitudinal and perpendicular magnetic recording methods are utilized, in which the data are recorded, magnetically parallel or normal to the surface of the disk. In order to increase the recording density, the area size of each bit of data on the disk surface needs to be reduced, and it causes the data to disappear slowly under the influence of heat in the ambient environments. Therefore technologies are developed to overcome this effect known as the "super-paramagnetic effect." Since the perpendicular recording method can record more information in a smaller space with stability in comparison with the longitudinal recording, it is expected to be adopted in large-capacity hard disk drives and to find applications in various fields.

Our research and development focus on the next generation medium technologies: discrete track media technology that prevents adjoining recorded track being interfered by making non-magnetic track in between the record tracks, bit patterned media technology with artificial arrays of arbitrary bit patterns. In addition, the heat assisted magnetic recording technology is also studied to help writing signals onto a nano-sized area by momentarily heating the record area by a laser.

Media Structure

- Figure 1 shows a schematic cross section of the media structure of the perpendicular magnetic recording method. Many thin films of nanometer (1/1,000,000,000 of a meter) order are deposited like strata. Each stratum play important roles in recording and maintaining the large amount of data. As shown in the surface observation photograph by transmission electron microscopy on the right, very small magnetic grains are well isolated by the non-magnetic grain boundary. Such natural segregation is controlled to obtain the average grain size of about 10 nanometers in order to improve the areal density of the perpendicular magnetic recording method.
- The media structure of the bit patterned recording method is shown in Figure 2. Arrays of cylindrical patterns are artificially lithographed on the surface of the disk. Each magnetic nano dot correspond to one bit of the data for ultra-high density recording.

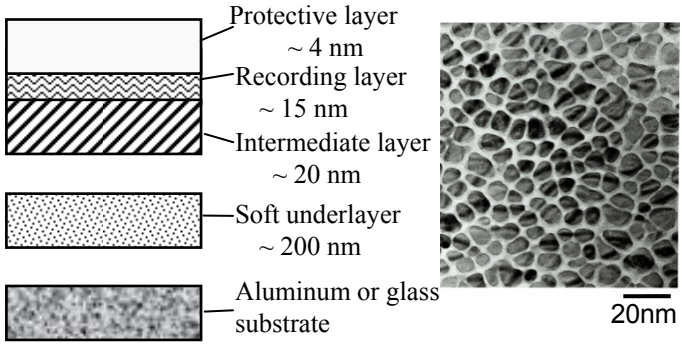

Figure 1. Schematic cross-section of the perpendicular Recording media and surface observation photograph by transmission electron microscopy.

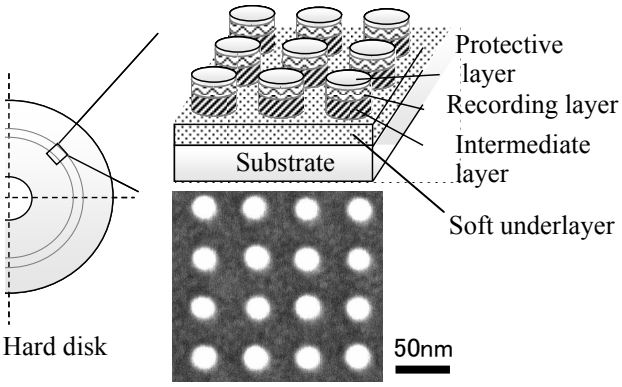

Figure 2. Schematic of a disk and cross-section of the bit patterned recording media. The surface is observed by transmission electron microscopy.

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