DISK AND DRIVE SYSTEM AND METHODS WITH CARBON OVERCOAT FOR LOAD/UNLOAD APPLICATIONS

BACKGROUND OF THE INVENTION

1. Field of the Invention.

This invention relates generally to data storage devices and systems and methods of making and using the same and in preferred embodiments a data storage device having an increased overcoat thickness at the load region of the device.

2. Description of Related Art.

Modern computers use various forms of persistent storage systems to store electronic information, such as computer data files or program files. One common form of a data storage system is a disk drive. The principal components of the disk drive are the platters or disks and the heads. Data is recorded on the platter electromagnetically, optically or magneto-optically. The head reads data from the platter and/or writes data to the platter.

The platter has a substrate layer, a recording layer (for example, a magnetic layer), an overcoat layer, and a lubricant layer. The platter's capacity for storing information is dependent, in part, on the thickness of the overcoat layer. Thinner coatings typically lead to higher storage capacities per platter. As a result, some manufactures tend to reduce the thickness of the overcoat layer.

Regarding the head, the head is suspended adjacent to the recording surface of the platter during disk drive operations. Immediately before the disk drive enters an operating mode, the head moves from a position offset from the recording surface to a position adjacent to the recording surface. During this movement, the head passes adjacent to the load region of the platter. Experimental evidence reveals that intermittent contact occurs at the platter's load region during this load operation.

Thus, there is a need in the art for data storage mediums and systems that are not damaged during load operations.

SUMMARY OF THE DISCLOSURE

To overcome the limitations in the prior art described above, and to overcome other limitations that will become apparent upon reading and understanding the present specification, the specification discloses a data storage medium and system and method for making the same. The data system has at least one head for reading data from the storage medium and/or writing data to the storage medium. The data

storage medium has at least one platter with at least one recording surface for storing data and a load region.

In preferred embodiments, the recording surface of the platter has a substrate layer, a data recording layer, and an overcoat layer. The data recording layer is positioned between the substrate layer and the overcoat layer and defines a region for storing data.

The overcoat layer is a coating material that is substantially transparent to the head–recording layer communication. The overcoat layer has at least two thicknesses. In one preferred embodiment, a first overcoat thickness covers at least a portion of the region of the data recording layer for storing data, and a second thickness covers the load region. The second thickness is greater than the first thickness. For example, one embodiment involves two discrete thicknesses such that, the first thickness covers substantially all of the recording layer and the second, increased thickness cover the load region. In an alternative embodiment, the thickness progressively increases from the recording layer to the load region.

Various advantages and features of novelty which characterize the invention are pointed out with particularity in the claims annexed hereto and form a part hereof. However, for a better understanding of the invention and its advantages, reference should be made to the drawings which form a further part hereof, and to accompanying descriptive matter, in which there is illustrated and described specific examples in accordance with preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings in which like reference numbers represent corresponding parts throughout:

FIG. 1A illustrates an exemplary hard drive system used to implement a preferred embodiment of the present invention;

FIG. 1B illustrates a top view of the head movement during load operations;

FIG. 2 illustrates a top view of a two thickness carbon overcoat for the preferred embodiment of the invention;

FIG. 3 illustrates a side view of a two thickness carbon overcoat for the preferred embodiment of the invention;

FIG. 4 illustrates a side view of a progressively increasing thickness carbon overcoat for an alternative embodiment of the invention; and

FIG. 5 illustrates a side view of a carbon overcoat that progressively increases the thickness at a specified location on the platter for an alternative embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In the following description of preferred embodiments, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration a specific embodiment in which the invention may be practiced. It is to be understood that other embodiments may be utilized and structural changes may be made without departing from the scope of the preferred embodiments of the present invention.

Overview

The preferred embodiments of the present invention relate to a method and apparatus for coating the surface of drive platters and in particular to increasing the overcoat thickness at the load region of a platter.

Hardware Environment

FIG. 1A illustrates an exemplary hard drive system that could be used to implement embodiments of the present invention. In the exemplary environment, a hard drive system 100 has at least one data storage medium 102, a head assembly 104, a positioner drive device 106, and a mechanical linkage 108, connecting the positioner drive device 106 to the head assembly 104. The heads 112 are supported on the head assembly arm 113 and the head assembly 104 is driven by a positioner drive device 106 that moves heads 112 to selected positions relative to the recording surfaces of each data storage medium 102. During a recording or reading operation, each head 112 is suspended adjacent to an associated recording surface of a corresponding data storage medium 102 and performs the task of reading and/or writing a plurality of signals onto its associated recording surface. In the embodiment shown in FIG. 1A, the data storage media 102 includes magnetic recording platters. However, other embodiments may employ alternative forms of data storage media 102 that operate with suspended heads 112, including, but not limited to optical storage media, magneto–optical media and the like.

In the illustrated embodiment of FIG. 1A, three data storage media 102, in the form of multi–track magnetic recording platters, are supported on a single spindle 111. Each platter has a substrate layer, recording layer, overcoat layer, and a lubricant

layer. The illustrated embodiment involves a magnetic recording medium and the recording layer comprises a magnetic recording material.

Each platter, in the illustrated embodiment has two recording surfaces (double sided) on which data may be written and/or read by the associated head 112 in multiple tracks 114. However, data storage media 102 may be any suitable data storage medium, including but not limited to single sided data storage mediums. In addition, while three platters are shown in FIG. 1A, other embodiments may include or operate with any suitable number of data storage media 102.

FIG. 1B illustrates the motion of the head 112 relative to the storage medium 102. In the preferred embodiment, the head 112 is suspended adjacent to the recording surface of the storage medium 102 during disk drive operations. Immediately before the disk drive enters an operating mode, the head 112 moves from a position offset from the recording surface to a position adjacent to the recording surface. During this movement, the head 112 passes adjacent to the load region 116 of the storage medium 102. In the preferred embodiment of the invention, the load region is located at the outer edge of the storage medium 102. However, the load region can also be located at the center region of the storage medium 102 and in a middle region of the storage medium 102.

Those skilled in the art will recognize that the exemplary environment illustrated in FIGS. 1 and 1A is not intended to limit the present invention. Indeed, those skilled in the art will recognize that other alternative hardware environments may be used without departing from the scope of the present invention.

Overcoat Layer

In accordance with a preferred embodiment of the present invention, an overcoat layer is configured to provide increased protection at the platter's load region. The overcoat thickness is increased at the load region relative to the thickness across the recording layer. Notably, the increased overcoat thickness is relatively small compared to the flight height. Therefore, the flight height at adjacent tracks are unaffected.

The load region is typically located at the outer diameter 200 of the platter 102. However, it can also be located at the inner diameter 202 of the platter 102 and at the middle diameter 204 of the platter 102. In general, data is not written to the load region of platters 102 for precautionary measures.

In an alternative embodiment of the invention, the overcoat thickness progressively increases from the inner diameter 202 of the platter 102 to the outer

diameter 200 of the platter 102, such that the outer diameter 200 of the platter 102 has a thicker coating than the inner diameter 202 of the platter 102.

The foregoing description of the preferred embodiment of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention be limited not by this detailed description, but rather by the claims appended hereto.

WHAT IS CLAIMED IS:

1. A data storage medium for use with a data system comprising:

at least one platter having a recording surface for storing data and a load region; and

said platter comprising a means for coating the load region.

2. A data storage medium for use with a data system having at least one head for reading and/or recording data on the data storage medium and/or writing data to the data storage medium, wherein the head moves from a position offset from said data storage medium to a position adjacent to said storage medium, said data storage medium comprising:

at least one platter having a recording surface for storing data and a load region;

said recording surface of the platter comprises a substrate layer, a data recording layer, and an overcoat layer, wherein the data recording layer is positioned between the substrate layer and the overcoat layer and comprises a region for storing data;

said overcoat layer comprising a coating material, having at least two thicknesses, wherein a first thickness covers the region of the data recording layer for storing data, and a second thickness covers the load region, the second thickness being greater than the first thickness; and

said load region being a region of the platter adjacent to at least one head that passes the load region during movements of the head between the position offset from said recording surface to the position adjacent to said recording surface.

3. The data storage medium of claim 2 wherein, the platter comprises an outer edge and the load region is located at the outer edge of the platter.

4. The data storage medium of claim 2, wherein , the platter comprises a center region and the load region is located at the center region of the platter.

5. The data storage medium of claim 2, wherein the coating material is a diamond like carbon (DLC) material, said material increases the hardness of the platter.

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6. The data storage medium of claim 2, wherein the data recording layer comprises a ferric oxide coating.

7. The data storage medium of claim 2, wherein the data recording layer comprises a cobalt–nickel alloy coating.

8. The data storage medium of claim 2, wherein the data recording layer comprises a chrome–like coating.

9. The data storage medium of claim 2, wherein the data recording layer comprises a polymer coating.

10. The data storage medium of claim 2, wherein the overcoat layer further comprises:

a coating material, having a thickness that progressively increases from the recording surface of the platter to the load region of the platter, such that the overcoat layer at the load region of the platter is thicker than the overcoat layer at the recording surface of the platter.

11. A method for making a storage medium for use with at least one head for reading and/or recording data on the storage medium and/or writing data to the storage medium, wherein the head moves from a position offset from said storage medium to a position adjacent to said storage medium, comprising the steps of:

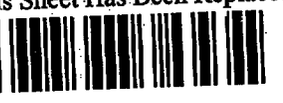
providing a platter having a recording layer, a center region, an outer edge, and a load region, wherein the load region is a region of the platter adjacent to at least one head that passes the load region during movements of the head between the position offset from said recording surface to the position adjacent to said recording surface; and

coating the recording layer of the platter with an overcoat material, such that the overcoat material has at least two thicknesses, wherein a first thickness covers the region of the platter for storing data, and a second thickness covers the load region, the second thickness being greater than the first thickness.

12. The method of claim 11, wherein the step of coating comprises forming the second thickness at the outer edge of the platter.



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13. The method of claim 11, wherein the step of coating comprises forming the second thickness at the center region of the platter.

14. The method of claim 11, wherein the coating step further comprises:

coating a recording layer of the platter with diamond like carbon (DLC), such that the DLC has at least two thicknesses, wherein a first thickness covers the region of the platter for storing data, and a second thickness covers the load region, the second thickness being greater than the first thickness.

15. The method of claim 11, wherein the coating step comprises forming an overcoat layer that progressively increases from the center region of the platter to the outer edge of the platter, such that the outer edge of the platter has a thicker coating than the center of the platter.

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