

DESCRIPTION

Title of Invention: METHOD FOR MANUFACTURING DISK-SHAPED SUBSTRATE, DISK-SHAPED SUBSTRATE, AND MAGNETIC RECORDING MEDIUM

Technical Field

[0001] The present disclosure relates to a method for manufacturing a disk-shaped substrate, a disk-shaped substrate, and a magnetic recording medium.

Background Art

[0002] Disk-shaped substrates are used for magnetic recording mediums used for hard disk drives (HDDs), and aluminum substrates or aluminum alloy substrates are generally used as the disk-shaped substrate. In recent years, there is an increasing demand for a glass substrate.

[0003] The disk-shaped substrates are each processed into a donut shape having a circular through-hole at a center thereof, and main faces and end faces thereof are ground using a grinding fluid. In the next step, the ground disk-shaped substrates are each subjected to surface treatments using a plating solution for an aluminum substrate and an aluminum alloy substrate (see, for example, Patent Literature 1), and using a chemical strengthening solution or the like for a glass substrate (see, for example, Patent Literature 2). After these treatments, a magnetic layer is formed.

Citation List

Patent Literature

[0004] Patent Literature 1: Japanese Patent Application Laid-Open (JP-A) No. 2020-107382
Patent Literature 2: International Publication No. WO 2015/041301

SUMMARY OF INVENTION

Technical Problem

[0005] A plated layer and a chemically strengthened layer obtained by the surface treatments may have low thickness uniformity.

In a case where the plated layer has the low thickness uniformity and bad flatness, the magnetic layer provided on the plated layer has low flatness conforming to a surface shape of the plated layer, and writability and readability by a magnetic head element decrease.

When the chemically strengthened layer has low thickness uniformity, and the chemically strengthened layer has a thin area, a problem arises in that the glass substrate is likely to be broken from the area. Particularly in recent years, there is a demand for thinning

of a magnetic recording medium, and glass substrates are likely to be broken.

In this respect, an object of the present disclosure is to provide a method for manufacturing a disk-shaped substrate, a disk-shaped substrate, and a magnetic recording medium, in which a plated layer has excellent flatness, and a chemically strengthened layer has excellent thickness uniformity.

[0006] The present disclosure includes the following embodiments.

<1> A method for manufacturing a disk-shaped substrate, the method comprising:
performing, on the disk-shaped substrate with a grinding fluid, at least one treatment selected from the group consisting of (1) heating, (2) cleaning with an organic solvent, and (3) ultraviolet irradiation treatment, to remove at least some polymer components of the grinding fluid on a surface of the disk-shaped substrate.

<2> The method for manufacturing a disk-shaped substrate according to <1>, wherein the grinding fluid contains at least one selected from the group consisting of an oily agent, an extreme-pressure additive, a surfactant, a preservative, and an antifoaming agent.

<3> The method for manufacturing a disk-shaped substrate according to <1> or <2>, wherein the disk-shaped substrate is an aluminum substrate, an aluminum alloy substrate, or a glass substrate.

<4> The method for manufacturing a disk-shaped substrate according to any one of <1> to <3>, wherein a water contact angle of the surface of the disk-shaped substrate after the treatment is performed is 45° or less.

<5> A magnetic recording medium comprising:

the disk-shaped substrate obtained by the method for manufacturing a disk-shaped substrate according to any one of <1> to <4>; and

a magnetic layer provided on the disk-shaped substrate.

<6> A disk-shaped substrate comprising a main face that is a ground surface, wherein a water contact angle of a surface of the main face is 45° or less.

<7> A magnetic recording medium comprising:

the disk-shaped substrate according to <6>; and

a magnetic layer provided on the disk-shaped substrate.

Advantageous Effects of Invention

[0007] According to the disclosure, there are provided a method for manufacturing a disk-shaped substrate, a disk-shaped substrate, and a magnetic recording medium, in which a plated layer has excellent flatness, and a chemically strengthened layer has excellent thickness uniformity.

BRIEF DESCRIPTION OF DRAWINGS

[0008] Fig. 1 is a schematic cross-sectional view showing an example of an assist magnetic recording medium to which a disk-shaped substrate according to the disclosure is applied as a substrate for a magnetic recording medium.

Fig. 2 is a perspective view showing an example of a magnetic storage device using the magnetic recording medium according to the disclosure.

DESCRIPTION OF EMBODIMENTS

[0009] The embodiments of the present disclosure are described below in detail. It is noted here, however, that the disclosure is not restricted to the below-described embodiments. In the below-described embodiments, the constituents thereof (including element steps and the like) are not indispensable unless otherwise specified. The same applies to the numerical values and ranges thereof, without restricting the disclosure.

In the disclosure, those numerical ranges that are expressed with "to" each denote a range that includes the numerical values stated before and after "to" as the minimum value and the maximum value, respectively.

In a set of numerical ranges that are stated stepwisely in the disclosure, the upper limit value or the lower limit value of a numerical range may be replaced with the upper limit value or the lower limit value of other numerical range. Further, in a numerical range stated in the disclosure, the upper limit or the lower limit of the numerical range may be replaced with a relevant value indicated in any of Examples.

In the disclosure, a component may include a plurality of different substances corresponding thereto. When there are plural kinds of substances that correspond to a component of a composition, the indicated content ratio or content amount of the component in the composition means, unless otherwise specified, the total content ratio or content amount of the plural kinds of substances existing in the composition.

In the disclosure, particles corresponding to a component may include a plurality of different kinds of particles. When there are plural kinds of particles that correspond to a component of a composition, the indicated particle size of the component in the composition means, unless otherwise specified, a value determined for a mixture of the plural kinds of particles existing in the composition.

In the disclosure, the term "layer" includes, when observing a region where a layer is present, a case in which the layer is formed only on a part of the region in addition to a case in which the layer is formed on the entirety of the region.

[0010] <Method for Manufacturing Disk-Shaped Substrate>

In a method for manufacturing a disk-shaped substrate of the disclosure, the disk-shaped substrate ground with a grinding fluid is subjected to at least one treatment selected from the group consisting of (1) heating, (2) cleaning with an organic solvent, and (3) ultraviolet irradiation treatment, to remove at least some polymer components of the grinding fluid on a surface of the disk-shaped substrate.

Reasons why the above problem is solved in the manufacturing method having the above configuration are considered to be as follows.

[0011] It was found that polymer components contained in the grinding fluid were attached to the surface of the disk-shaped substrate ground with the grinding fluid. It is expected that the presence of the polymer components affects wettability of a plating solution and a chemical strengthening solution or physical properties thereof other than the wettability in the next step, and flatness of the plated layer and thickness uniformity of a chemically strengthened layer deteriorate.

In this respect, before the plating solution or the chemical strengthening solution is applied, the ground disk-shaped substrate is subjected to at least one treatment selected from the group consisting of (1) heating, (2) cleaning with an organic solvent, and (3) ultraviolet irradiation treatment. The disk-shaped substrate is heated, whereby at least some of the polymer components present on the surface are burned off. The disk-shaped substrate is cleaned with the organic solvent, whereby at least some of the polymer components present on the surface are cleaned away. The disk-shaped substrate is subjected to the ultraviolet irradiation treatment, whereby at least some molecular chains of the polymer components are broken to reduce a molecular size, and at least some polymer components are removed.

It is expected that, in the disk-shaped substrate from which the polymer components are removed from the surface thereof by these treatments, the flatness of the plated layer or the thickness uniformity of the chemically strengthened layer formed in the next step is improved.

[0012] The disk-shaped substrate may be an aluminum substrate, an aluminum alloy substrate, or a glass substrate. Hereinafter, the aluminum substrate, the aluminum alloy substrate, and the glass substrate are also collectively referred to as a "substrate". The aluminum substrate and the aluminum alloy substrate are also collectively referred to as an "aluminum substrate".

[0013] As the aluminum substrate, a substrate commonly used in the field can be applied, and an aluminum alloy of JIS-A5086 is preferably used from the viewpoint of strength, plating properties, grindability, and the like.

[0014] As the glass substrate, a substrate made of amorphous glass, crystallized glass, or the

like used as a glass substrate for a conventional magnetic recording medium can be used. Specific examples of the glass substrate include glass substrates made of soda-lime glass, aluminosilicate glass, lithium silicate glass, lithium aluminosilicate glass, and aluminoborosilicate glass. An example of the crystallized glass includes glass obtained by reheating glass under controlled conditions to precipitate and grow a large number of minute crystals. Examples of the crystallized glass include $\text{Al}_2\text{O}_3\text{-SiO}_2\text{-Li}_2\text{O}$ -based glass and $\text{B}_2\text{O}_3\text{-Al}_2\text{O}_3\text{-SiO}_2\text{-Li}_2\text{O}$ -based glass.

A thickness of the glass substrate for the magnetic recording medium is not particularly limited, and the glass substrate having a thickness of about 0.4 mm to 1 mm is usually used.

[0015] A main face and an end face of a substrate having a circular through-hole at a center thereof are ground using a grinding fluid. The grinding processing of the main face and the grinding processing of the end face may be performed collectively, in series, or separately. The grinding processing of the end face may be performed on inner and outer circumferential end faces of the substrate, and chamfering may be further performed.

The grinding processing and the end face processing may be performed, for example, in order of a main face grinding step and an inner and outer circumferential end face grinding step.

[0016] In the main face grinding step, grinding processing is performed on both main faces of the substrate (surfaces that finally become recording surfaces of the magnetic recording medium). In the grinding step, the substrate is sandwiched between a pair of surface plates rotating in opposite directions, a grinding fluid is supplied, and both the main faces of the substrate are ground by grinding pads provided on the surface plates. A plurality of substrates may be located between the pair of surface plates, and the plurality of substrates may be ground collectively. Abrasive grains such as diamond are fixed to the grinding pads by a binder, and both the main faces of the substrate are ground by the abrasive grains.

[0017] The grinding fluid is preferably an aqueous solution using water as a medium from the viewpoint of reducing the environmental burden and may contain at least one selected from the group consisting of an oily agent, an extreme-pressure additive, a surfactant, a preservative, and an antifoaming agent from the viewpoint of lubrication, cooling, removal of chips, or the like during grinding. At least some thereof may remain as polymer components on a surface of the ground disk-shaped substrate. In particular, the oily agent, the antifoaming agent, or the like tends to remain as polymer components on the surface of the ground disk-shaped substrate.

[0018] The oily agent is not particularly limited as long as the oily agent is commonly used

in a grinding material, and examples of the oily agent include animal or vegetable oil and a hydrogenated product thereof; fatty acid and salt thereof; fatty acid ester; a sulfide of unsaturated carboxylic acid; and a polyoxyalkylene compound.

The oily agents may be used singly, or in any combination of two or more kinds thereof.

[0019] The fatty acid is not particularly limited as long as the fatty acid is commonly used in a grinding material, and examples of the fatty acid include fatty acids having 14 carbon atoms or more, and preferably 16 to 24 carbon atoms. The fatty acid may be a saturated fatty acid or an unsaturated fatty acid. The fatty acid may have a straight-chain shape or a branched-chain shape. Specific examples of the fatty acid include oleic acid, linoleic acid, stearic acid, isostearic acid, palmitic acid, lauric acid, and maleic acid.

The fatty acids may be used singly, or in any combination of two or more kinds thereof.

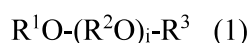
[0020] Examples of the salt of the fatty acid include alkali metal salt, alkaline earth metal salt, and amine salt. Examples of alkali metal include sodium and potassium, and examples of alkaline earth metal include magnesium, calcium, and barium.

[0021] Examples of the fatty acid ester include esters of the fatty acid and alcohol. Examples of the alcohol include methanol and ethanol.

[0022] Examples of the sulfide of the unsaturated carboxylic acid can include sulfides of oleic acid.

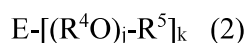
[0023] An example of the polyoxyalkylene compound can include a compound represented by the following General Formula (1) or (2).

[0024]



[0025] In Formula (1), R^1 and R^3 each independently represent a hydrogen atom or a hydrocarbon group having one to thirty carbon atoms, R^2 represents an alkylene group having two to four carbon atoms, and i represents an integer with which the number-average molecular weight of the compound defined by General Formula (1) becomes 100 to 3500.

[0026]



[0027] In Formula (2), E represents a residue obtained by removing some or all of hydrogen atoms of hydroxyl groups of polyhydric alcohol having three to ten hydroxyl groups, R^4 represents an alkylene group having two to four carbon atoms, R^5 represents a hydrogen atom or a hydrocarbon group having one to thirty carbon atoms, j represents an integer with which the number-average molecular weight of the compound defined by General Formula (2)

becomes 100 to 3500, and k represents the same number as the number of hydrogen atoms removed from the hydroxyl groups in E.

[0028] Examples of the extreme-pressure additive can include a sulfur-based extreme-pressure additive such as sulfurized fatty oil, a chlorine-based extreme-pressure additive such as chlorinated paraffin or chlorinated fatty acid ester, and a phosphorus-based additive such as zinc dialkyldithiophosphate.

The extreme-pressure additives may be used singly, or in any combination of two or more kinds thereof.

[0029] Examples of the surfactant include an anionic surfactant, a cationic surfactant, an amphoteric surfactant, and a nonionic surfactant. The surfactants may be used singly, or in any combination of two or more kinds thereof.

As the surfactant, the anionic surfactant may be preferably contained, or the anionic surfactant and the nonionic surfactant may be used in a combination.

[0030] The anionic surfactant is not particularly limited as long as the anionic surfactant is commonly used in a grinding material, and examples of the anionic surfactant can include higher alkyl sulfate salt (for example, sodium lauryl sulfate and potassium lauryl sulfate) and alkyl ether sulfate salt (for example, POE-lauryl sulfate triethanolamine and POE-sodium lauryl sulfate, here, POE represents polyoxyethylene).

[0031] The nonionic surfactant is not particularly limited as long as the nonionic surfactant is commonly used in a grinding material, and examples of the nonionic surfactant can include sorbitan fatty acid ester (for example, sorbitan monooleate, glycerin or polyglycerin fatty acid (for example, glyceryl monostearate), and sucrose fatty acid ester.

[0032] The preservative is preferably an organic amine, and more preferably an organic amine containing a hydroxyl group.

The organic amine is not particularly limited as long as the organic amine is commonly used in a grinding material, and examples of the organic amine can include trialcoholamines such as trimethanolamine, triethanolamine, tripropanolamine, and tributanolamine.

The preservatives may be used singly, or in any combination of two or more kinds thereof.

[0033] Examples of the antifoaming agent can include a silicone-based antifoaming agent, a polyoxyalkylene-based antifoaming agent, and a mineral oil-based antifoaming agent. Examples of the silicone-based antifoaming agent can include dimethylpolysiloxane and modified polysiloxane. Examples of the polyoxyalkylene-based antifoaming agent can include polyoxypropylene and polyoxybutylene. Examples of the mineral oil-based

antifoaming agent can include a naphthene-based antifoaming agent and a paraffin-based antifoaming agent.

The antifoaming agents may be used singly, or in any combination of two or more kinds thereof.

[0034] At least one treatment selected from the group consisting of (1) heating, (2) cleaning with an organic solvent, and (3) ultraviolet irradiation treatment is performed on the substrate ground with the grinding fluid.

[0035] The substrate is heated preferably at 250°C or higher, more preferably at 270°C or higher, still more preferably at 290°C or higher. The upper limit of the heating temperature is not particularly limited and is preferably 360°C or lower, more preferably 340°C or lower, still more preferably 310°C or lower in the case of the aluminum substrate, and is preferably 700°C or lower, more preferably 600°C or lower, still more preferably 500°C or lower in the case of the glass substrate from the viewpoint of damage due to heating of the substrate.

[0036] A heating time is preferably 10 minutes or more, more preferably 15 minutes or more, still more preferably 20 minutes or more. From the viewpoint of reducing the energy load, the heating time is preferably 60 minutes or less, more preferably 45 minutes or less, still more preferably 30 minutes or less.

[0037] A heating device is not particularly limited as long as the heating device can perform heating at a target temperature, and a known heating device can be used. Specifically, an oven, an electric furnace, or the like can be used as the heating device.

[0038] The organic solvent used for cleaning is preferably a non-polar solvent because the grinding fluid in the previous step is an aqueous solution. Examples of the non-polar solvent include isopropyl alcohol (IPA) and hydrofluoroether (HFE).

[0039] A cleaning method with the organic solvent is not particularly limited, and a conventional cleaning method and a conventional cleaning apparatus can be applied. An example of the cleaning method is a method of spin-rinsing at ambient temperature using a spin rinse device.

[0040] The ultraviolet irradiation treatment can be performed using a light source such as an excimer laser, a high-pressure mercury lamp, or an arc lamp.

[0041] The irradiation illuminance of the ultraviolet irradiation treatment is preferably 300 mW/m² or more, more preferably 600 mW/m² or more, still more preferably 1200 mW/m² or more from the viewpoint of effectively breaking the molecular chains of the polymer components remaining on the surface of the disk-shaped substrate.

[0042] An irradiation time of the ultraviolet irradiation treatment is preferably two seconds or more, may be five seconds or more, or may be seven seconds or more from the viewpoint

of equalization of an irradiation range.

[0043] From the viewpoint of enhancement of wettability of the plating solution or the chemical strengthening solution in the next step, the water contact angle of the surface of the disk-shaped substrate subjected to at least one treatment selected from the group consisting of (1) to (3) is preferably 45° or smaller, more preferably 30° or smaller, still more preferably 20° or smaller, and particularly preferably 15° or smaller.

[0044] The water contact angle is measured as a contact angle (after 0.2 seconds) of a water droplet (pure water, $2.0\ \mu\text{L}$) on the substrate surface at 25°C using a contact angle meter.

[0045] An amount of the polymer components on the surface of the disk-shaped substrate is preferably reduced to 0.001% by mass or less and may be 0% by mass after the treatment of (1) to (3) with an amount thereof before the treatments of (1) to (3) as a reference (100% by mass).

The amount of the polymer components on the surface of the disk-shaped substrate can be measured by time-of-flight secondary ion mass spectrometry (TOF-SIMS).

[0046] After the treatment of (1) to (3), the plated layer is formed by the plating solution on the aluminum substrate, and the chemically strengthened layer is formed by the chemical strengthening solution on the glass substrate.

[0047] A known method can be used as a plating method, and preferably an electroless plating method is used. In general, a NiP-based nickel alloy plated layer is formed. Examples of the plating solution used for forming the NiP alloy plated layer include a plating solution containing nickel sulfate as a nickel source and hypophosphite as a phosphorus source. Mo salt or W salt may be further added to the plating solution to form a NiMoP alloy plated layer or a NiWP alloy plated layer.

[0048] A chemical strengthening treatment is a treatment in which a glass substrate is immersed in a chemical strengthening solution to exchange ions in the chemical strengthening solution with ions in the glass. As the chemical strengthening treatment, a known method performed on a glass substrate can be used. The chemical strengthening solution can be high-temperature molten salt and preferably contains KNO_3 , NaNO_3 , or the like.

[0049] The disk-shaped substrate obtained by the manufacturing method of the disclosure can be suitably used for a magnetic recording medium used in a hard disk drive (HDD).

[0050] <Disk-Shaped Substrate>

One aspect of the disk-shaped substrate of the disclosure has a main face that is a ground surface, and a water contact angle of a surface of the main face is 45° or smaller. The water contact angle of the surface of the main face that is the ground surface, is preferably in a range of the water contact angle described in the method for manufacturing a disk-shaped

substrate. The other conditions can also be defined by referring to the conditions described in the method for manufacturing a disk-shaped substrate.

[0051] <Magnetic Recording Medium>

The magnetic recording medium of the disclosure includes the disk-shaped substrate obtained by the method for manufacturing a disk-shaped substrate of the disclosure, and a magnetic layer provided on the disk-shaped substrate.

The disk-shaped substrate obtained by the method for manufacturing a disk-shaped substrate of the disclosure has excellent thickness uniformity of the plated layer or the chemically strengthened layer in a case in which these layers are formed.

An aspect of the magnetic recording medium of the disclosure includes the disk-shaped substrate having the main face that is ground, wherein a surface of the main face has a water contact angle of 45° or less, and a magnetic layer provided on the disk-shaped substrate.

[0052] When the magnetic layer is provided on the plated layer having excellent flatness, flatness of the magnetic layer is excellent, and excellent writability and readability are obtained by a magnetic head element. The number of pit defects of the plated layer on the disk-shaped substrate can be 500 or less in one surface, and is preferably 50 or less, more preferably 30 or less, still more preferably 4 or less. The number of pit defects in the plated layer can be checked by observation with an optical inspection machine (for example, OSA7100 manufactured by KLA Tencor Corporation).

[0053] According to the method for manufacturing a disk-shaped substrate of the disclosure, since the thickness uniformity of the chemically strengthened layer is excellent, partial decrease in strength of the glass substrate is curbed, and a frequency of occurrence of breakage defects is reduced.

[0054] The magnetic recording medium may further include a carbon protective layer, a lubricant layer, or the like on the magnetic layer.

The magnetic recording medium may further include an adhesion layer, a soft magnetic base layer, a seed layer, an orientation control layer, or the like between the substrate and the magnetic layer. Each of these layers may be one layer or two or more layers.

A general material used for the magnetic recording medium can be used as a material for forming the magnetic layer, the carbon protective layer, the lubricant layer, the adhesion layer, the soft magnetic base layer, the seed layer, the orientation control layer, or the like.

[0055] Fig. 1 is a schematic cross-sectional view showing an example of an assist magnetic recording medium to which the disk-shaped substrate according to the disclosure is applied as a magnetic recording medium substrate 1. As shown in Fig. 1, an assist magnetic recording

medium 40 includes the magnetic recording medium substrate 1, a seed layer 41, a first base layer 42, a second base layer 43, a magnetic layer 44, a protective layer 45, and a lubricant layer 46 which are layered in this order. The magnetic recording medium 40 can be used for a magnetic storage device.

[0056] Fig. 2 is a perspective view showing an example of the magnetic storage device using the magnetic recording medium according to the disclosure. As shown in Fig. 2, a magnetic storage device 50 includes the assist magnetic recording medium 40, a magnetic recording medium drive unit 51 for rotating the assist magnetic recording medium 40, a magnetic head 52, a head moving unit 53 for moving the magnetic head 52, and a recording/reproducing signal processing unit 54. The magnetic head 52 includes a recording head and a reproducing head (not shown), and the recording head includes a laser light generation unit for heating the assist magnetic recording medium, and a waveguide for guiding laser light generated from the laser light generation unit to a near-field light generation element.

The magnetic storage device 50 attaches a central portion of the assist magnetic recording medium 40 to a rotation shaft of a spindle motor and writes or reads information to or from the assist magnetic recording medium 40 while the magnetic head 52 floats and travels above a surface of the assist magnetic recording medium 40 that is rotationally driven by the spindle motor.

Examples

[0057] Hereinafter, the disclosure will be specifically described with reference to examples, but the scope of the disclosure is not limited to these examples.

[0058] [Comparative Example 1]

(Manufacturing of Aluminum Alloy Substrate)

As an aluminum alloy sheet material, a product equivalent to A5086 (Mg: 4% by mass, Mn: 0.5% by mass, Fe: 0.3% by mass, Cr: 0.2% by mass, Si: 0.2% by mass, Zn: 0.2% by mass, and balance Al) was used. The sheet material was manufactured by obtaining an aluminum alloy ingot by a semi-continuous casting method and then rolling the obtained aluminum alloy ingot.

[0059] Next, a sheet material having a thickness of 1.2 mm was punched into a donut disk shape to obtain an aluminum alloy substrate having a diameter of 97 mm with a central hole, and then the aluminum alloy substrate was annealed at 380°C for one hour. Thereafter, both main faces and end faces of the aluminum alloy substrate were ground by a diamond bit to obtain an aluminum alloy substrate having a diameter of 95 mm and a thickness of 0.8 mm.

[0060] Next, while a plurality of aluminum alloy substrates held in opening portions of respective carrier plates were caused to move in sun-and-planet motion using a grinding

device, both the main faces of the aluminum alloy substrate were ground with grindstones provided on an upper surface plate and a lower surface plate.

[0061] As the grinding device, a four-way type double-sided grinding machine (16B type manufactured by HAMAI CO., LTD.) was used, and grinding was performed for five minutes at a rotation speed of the surface plate of 30 rpm and a processing pressure of 110 g/cm². As the grinding fluid, a water-soluble grinding fluid containing 30% by mass of oleic acid was diluted with water to become 1.0% by mass, and the diluted fluid was used.

[0062] (Measurement of Water Contact Angle)

The contact angle (after 0.2 seconds) of the water droplet (pure water, 2.0 μ L) with the substrate surface of the ground aluminum alloy substrate at 25°C was measured using DM-501 manufactured by Kyowa Interface Science Co., Ltd.

[0063] (Formation of Plated Layer)

The obtained aluminum alloy substrate was immersed in a NiP-based plating solution, and a 88Ni-12P(P content: 12% by mass and balance Ni) layer was formed as a NiP-based plated layer on a surface of the aluminum alloy substrate by using the electroless plating method.

[0064] As the NiP-based plating solution, a solution containing nickel sulfate (nickel source) and sodium hypophosphite (phosphorus source) and having amounts of components adjusted to obtain a NiP-based plated layer having the above-described composition was used. A liquid temperature of the NiP-based plating solution used to form the NiP-based plated layer was adjusted to 90°C. An immersion time of the aluminum alloy substrate in the NiP-based plating solution was set to two hours.

[0065] Next, the aluminum alloy substrate on which the NiP-based plated layer was formed was heated at a required temperature for a required time to obtain an aluminum alloy substrate with a NiP-based plated layer.

In order to remove irregularities of the NiP plated layer, the substrate surface was polished by making the upper and lower surface plates move in sun-and-planet motion while a polishing agent containing alumina, zirconia, titania, colloidal silica, or the like was ejected using a polishing device having polyurethane foam polishing cloth on the upper and lower surface plates.

[0066] (Evaluation of Pit Defect of Plating Layer)

An entire surface of the aluminum alloy substrate was observed with the optical inspection machine (OSA7100 manufactured by KLA Tencor Corporation), and the number of pit defects in the entire surface of the substrate was counted. Evaluation criteria are as follows based on the number of pit defects in one surface of the substrate. A and B are

regarded as pass grades.

[0067] A: The number of pit defects is 50 or less.

B: The number of pit defects is more than 50 and equal to or less than 500.

C: The number of pit defects is more than 500 and equal to or less than 1000.

D: The number of pit defects exceeds 1000.

[0068] [Comparative Example 2]

Before the plated layer is formed in Comparative Example 1, the ground aluminum alloy substrate was scrubbed twice with polyvinyl alcohol (PVA) sponge at ambient temperature while a detergent (nonionic surfactant) was ejected, then spin rinsing was performed with a spin rinse device while pure water is ejected, and spin drying was performed.

[0069] A water contact angle of the cleaned aluminum alloy substrate was measured by the above-described method.

A plated layer was formed on the cleaned aluminum alloy substrate by the same method as that in Comparative Example 1.

[0070] [Example 1]

In Comparative Example 2, cleaning was performed by replacing the detergent with a non-polar solvent of HFE.

A water contact angle of the cleaned aluminum alloy substrate was measured by the above-described method.

A plated layer was formed on the cleaned aluminum alloy substrate by the same method as that in Comparative Example 1.

[0071] [Example 2]

Before the plated layer was formed in Comparative Example 1, the ground aluminum alloy substrate was heated at 300°C for 30 minutes. The heating was performed using a conveyor-type continuous air furnace device as an electric furnace.

A water contact angle of the heated aluminum alloy substrate was measured by the above-described method.

A plated layer was formed on the heated aluminum alloy substrate by the same method as that in Comparative Example 1.

[0072] [Example 3]

The heating in Example 2 was performed by changing the temperature to 200°C.

A water contact angle of the heated aluminum alloy substrate was measured by the above-described method.

A plated layer was formed on the heated aluminum alloy substrate by the same

method as that in Comparative Example 1.

[0073] [Example 4]

Before the plated layer was formed in Comparative Example 1, an ultraviolet irradiation treatment was performed at 1200 mW/m² for two seconds. For the ultraviolet irradiation treatment, Ballast for High power UV Lamp as a product name manufactured by SUN ENERGY corporation was used.

A water contact angle of the aluminum alloy substrate after the ultraviolet irradiation treatment was measured by the above-described method.

A plated layer was formed on the aluminum alloy substrate after the ultraviolet irradiation treatment by the same method as that in Comparative Example 1.

[0074] [Table 1]

	Water Contact Angle (°)	Evaluation of Pit Defect of Plating Layer
Comparative Example 1	90	D
Comparative Example 2	80	C
Example 1	15	A
Example 2	15	A
Example 3	35	B
Example 4	35	B

[0075] It is found that, in Example 1 in which the cleaning with the organic solvent was performed, in Examples 2 and 3 in which the annealing was performed, and in Example 4 in which the ultraviolet irradiation treatment was performed before the plated layer was formed, plating pit defects were significantly reduced as compared with Comparative Example 1 in which these treatments were not performed.

It is found that, in Comparative Example 2, the cleaning was performed with water before the plated layer was formed, but the number of plating pit defects was not so much reduced.

[0076] The disclosure of Japanese Patent Application No. 2023-216244 is hereby incorporated by reference in its entirety.

All the documents, patent applications and technical standards that are described in the present specification are hereby incorporated by reference to the same extent as if each individual document, patent application or technical standard is concretely and individually

described to be incorporated by reference.

CLAIMS

Claim 1. A method for manufacturing a disk-shaped substrate, the method comprising: performing, on the disk-shaped substrate ground with a grinding fluid, at least one treatment selected from the group consisting of (1) heating, (2) cleaning with an organic solvent, and (3) ultraviolet irradiation treatment, to remove at least some polymer components of the grinding fluid on a surface of the disk-shaped substrate.

Claim 2. The method for manufacturing a disk-shaped substrate according to claim 1, wherein the grinding fluid contains at least one selected from the group consisting of an oily agent, an extreme-pressure additive, a surfactant, a preservative, and an antifoaming agent.

Claim 3. The method for manufacturing a disk-shaped substrate according to claim 1 or 2, wherein the disk-shaped substrate is an aluminum substrate, an aluminum alloy substrate, or a glass substrate.

Claim 4. The method for manufacturing a disk-shaped substrate according to claim 1 or 2, wherein a water contact angle of the surface of the disk-shaped substrate after the treatment is performed is 45° or less.

Claim 5. A magnetic recording medium comprising:
the disk-shaped substrate obtained by the method for manufacturing a disk-shaped substrate according to claim 1 or 2; and
a magnetic layer provided on the disk-shaped substrate.

Claim 6. A disk-shaped substrate comprising a main face that is a ground surface, wherein a water contact angle of a surface of the main face is 45° or less.

Claim 7. A magnetic recording medium comprising:
the disk-shaped substrate according to claim 6; and
a magnetic layer provided on the disk-shaped substrate.