Description

Background of the Invention

This invention relates to magnetic heads adapted for mounting on the side of a slider.

In a typical thin film head located on the back of the slider, the pole piece is oriented perpendicularly to the direction of media travel (see Fig. 1). As shown in the figure, well defined magnetic domains 10 form in the pole tip 12. These "good" domains are capable of conducting flux by rotation of the polarization of the domains without changing the location of their wall boundaries. As shown in Fig. 2, as the width, W, of the pole tip 12 is decreased to accommodate narrower track widths, the domains 14 that form are "bad" in that they can conduct flux only by wall motion. That is, for the domains to change polarization, the boundary walls 16 move as shown in Fig. 3.

The problem with conduction of flux by wall motion is that the motion of the boundaries can be impeded by imperfections in the material. As the boundaries deform, they become temporarily stuck and only after the deformation is great enough does the boundary "snap" free of the imperfection. This sudden change in boundary location is the mechanism which generates Barkhausen noise.

To avoid decreasing the width of the pole sufficiently to result in flux conduction by wall motion, it has been suggested to mount the head on the edge of the slider rather than on the rear of the slider as is conventionally the case. By moving the pole to the side of the slider, the width of the track is determined by the thickness of the pole (T), not the width of the pole (W). Since pole width is not restricted, it can be made large enough for the formation of the "good" domains which do not require wall motion for conduction. Fig. 4 shows a pole 20 mounted on the side of a slider 22. Although side mounting of the transducer has been mentioned in the literature, the techniques used to create such a pole restricted the pole gap to three microns or greater. See, "A Yoke Type MR Head For High Track Density Recording", T. Maruyama et al., IEEE Conference on Magnetics, Tokyo, April, 1987 and K. Kanai et al., IEEE Trans. on Magn., MAG-11, No. 5, p. 1212, 1975. The reason that the pole gap was restricted to three microns or greater is that the gap was created by ion milling a slot and then depositing aluminum oxide within the slot. It is unlikely that this technique would be useful for creating gaps of the order of 0.5 microns as are currently used. Furthermore, the technique previously reported is incapable of making a three-pole head.

IEEE Transactions on Magnetics, vol. Mag-11, no. 5, September 1975, pages 1212-1214: K. Kanai et al "Super-narrow track MR head" shows a head obtaining narrow track width by using the thickness of a magnetic thin film as the track width (ie. "horizontally-spaced" poles), the head having an air gap and being formed by etching a ferromagnetic thin film evaporated onto a substrate.

Journal of Applied Physics, vol 61, no. 8, 15 April 1987, pages 4157-4162: M. Hanawono et al "Design and fabrication of thin-film heads based on a dry process" shows a head fabricated using a sputter deposition process to form an upper pole of NiFe over both planar and sloped surfaces of a PIQ resin. The head formed has vertically-spaced poles rather than the horizontally-spaced poles of the present invention.

US-A-4639289 shows a head fabricated by deposition of a magnetic film on either side of and over the top of a vertical wall of non-magnetic material produced against the edge of sacrificial resin layer.

Summary of the Invention

The present invention is concerned with methods of fabricating side of the slider mounted poles with narrow pole gaps including a three-pole transducer. According to one aspect of the invention, a base layer of a non-magnetic material such as Al_2O_3 is deposited onto a slider substrate. A seed layer of a magnetic material such as NiFe is then deposited on top of the base layer. Next, a sheet of magnetic material such as NiFe is plated on top of the seed layer to a predetermined thickness. A photoresist layer is applied and patterned to define a first magnetic pole. Ion beam milling is then used to etch away the remaining, unprotected NiFe film and a predetermined amount of the base layer leaving the side walls as vertical as possible. The remaining photoresist layer is removed revealing the first pole. A non-magnetic gap layer (Al_2O_3) is next applied using ion beam deposition with a high degree of incidence (approximately 70° from the perpendicular). Because the base layer has been etched to a predetermined amount (depending on the desired gap layer thickness), the gap layer deposition will now fill in the previously etched region thereby nearly planarizing the first pole with the base layer. One variation of the above-described process is to create the first pole by through mask plating. Thereafter, a gap layer is deposited. After insulation and coil layers are deposited on the first pole by conventional techniques, a second pole is deposited using through mask plating. Any excess material remaining on the second pole is etched away using ion beam etching with a high degree of incidence, approximately 70° from perpendicular.

In another aspect of the invention a nonmagnetic seed layer such as TaAu serves as a substrate. A photoresist mask is applied to the substrate and steep angle deposition is used to deposit an inner gap material against the vertical side walls of the temporary block of photoresist. The horizontal surfaces are then ion milled with normal incidence to remove unwanted ma-

terial that was deposited during the previous deposition step. The photoresist block is then stripped chemically and a new photoresist pattern is generated to define the desired geometry of the poles. The ceramic component of the gap forms a wall that is part of the plating mask at this point. The poles are then plated through this combined mask.

Yet another aspect of this invention results in a three-pole head by a process similar to the one described directly above. A photoresist mask is applied to a nonmagnetic seed layer substrate such as TaAu. Steep angle deposition is used to deposit inner gap material against the vertical side wall of the temporary block of photoresist. A magnetic material such as NiFe (middle pole) is deposited by steep angle deposition and steep angle deposition is again used to deposit a second layer of inner gap material against the vertical side walls of the NiFe. The horizontal surfaces are ion milled with normal incidence to remove unwanted material (ceramic and magnetic) that was deposited on them during the previous deposition steps. Aluminum oxide is again deposited at the same steep angle and the structure is ion milled once again. This latest step electrically isolates the thin NiFe pole from the seed layer. The photoresist block is chemically stripped away and a new photoresist pattern is generated to define the desired geometry of the poles. The ceramic and magnetic components of the gap form a wall that is part of the plating mask. The magnetic material such as NiFe is again plated in the proper geometry resulting in the three-pole head. A variation of the above three-pole process would laminate the central pole by depositing a very thin layer of ceramic by steep angle deposition after half of the middle pole is deposited. The second half of the pole follows and the process proceeds as before. The invention according to these three aspects is defined in Claims 1,6 and 11.

Brief Description of the Drawing

Fig. 1 is a schematic illustration of a magnetic recording pole;
Fig. 2 is a schematic illustration of a pole narrower than the pole of Fig. 1;
Fig. 3 is a schematic illustration of a pole showing flux conduction by wall motion;
Fig. 4 is a perspective view of a pole mounted on the side of a slider;
Figs. 5, 6, and 7 are cross-sectional views of one of the processes disclosed herein;
Fig. 8 is a cross-sectional view of another of the processes disclosed herein;
Figs. 9 and 10 are cross-sectional views of yet another process disclosed herein;
Fig. 11 is a cross-sectional view of a two-pole head;
Fig. 12 is a front view of a two-pole head having sculptured pole tips;
Figs. 13, 14, and 15 are cross-sectional views of another process disclosed herein; and
Figs. 16, 17, 18, and 19 are cross-sectional views illustrating the process for making a three-pole head.

Description of the Preferred Embodiments

With reference now to Fig. 5, a magnetic recording pole according to one aspect of the invention begins with a base layer 30 of sputtered Al_2O_3 deposited onto a slider substrate 32. A seed layer 34 of NiFe is deposited on top of the base layer 30. Next, a sheet of magnetic material 36 such as NiFe is plated on top of the seed layer 34 to a predetermined thickness. A photoresist layer 38 is then applied to the layer 36 and patterned to define a first magnetic pole to be created from the layer 36. Ion beam milling is now used to etch away the remaining, unprotected NiFe film 36 and a predetermined amount of Al_2O_3 from the base layer 30 leaving the sidewalls as nearly vertical as possible. The photoresist 38 is then removed leaving a first pole, P1 (Fig. 6). With reference to Fig. 7, an Al_2O_3 gap layer 40 is now applied using ion beam deposition with a high degree incidence (approximately 70° from perpendicular) as shown by an arrow 42. Because the base layer 30 is etched to a predetermined amount (depending upon the desired gap layer thickness), the gap layer 40 deposition will now fill in the previously etched step nearly planarizing P1 with the base layer 30. The remaining offset is equal to a radial distance "R" of the Al_2O_3 deposited at the junction of the base layer 30 and the pole P1.

Another technique for making the first pole P1 is illustrated by Fig. 8. In this procedure, the NiFe layer 36 which forms the pole P1 is deposited by through mask plating on the seed layer 34. Thereafter the gap layer 40 is deposited over P1. In this case the planar offset equal to the gap layer 40 thickness and fillet radius is tolerated.

If this planar offset is undesirable, then a thicker layer 36 can be deposited using through mask plating as shown in Fig. 9. The photoresist portions 38 provide the masking. The structure in Fig. 9 is then ion beam etched after photoresist removal to yield the correct base layer 30 and pole P1 thickness as shown in Fig. 10.

After the pole P1 is made by any of the foregoing procedures, insulation and coil layers (not shown) are deposited using conventionally known techniques. With reference to Fig. 11, a second pole P2 is then deposited using through mask plating. The pole tip of pole P2 is carefully aligned to the edge of the pole tip of pole P1 so that both pole tips appear on the same horizontal plane. Since the pole tip of pole P2 has to be in intimate contact with the gap layer 40, P2 must be either perfectly aligned to the edge of P1 or slightly

overlapping as shown in Fig. 11. After pole P2 is plated, photoresist is removed and any excess material from P2 can now be etched away using ion beam etching with a high degree of incidence, approximately 70° from perpendicular as shown by an arrow 44 in Fig. 11.

Because both P1 and P2 pole tips now appear on the same horizontal plane, it is possible to perform additional processing that allows the pole tips to be sculptured by means of ion beam etching to enhance magnetic performance. Such sculpturing is shown in Fig. 12.

In addition to the previously mentioned advantages in magnetic performance, the above-described processes have several additional advantages. In a conventional recording head, track width is bound by the limits of the microlithography used in the processing. In the side mounting transducer head of the present invention, track width is now determined by deposition thickness and the ability to align pole P1 with pole P2, both of which can be tightly controlled. Also, the previously indicated problems of pole gap thickness are eliminated, because the gap layer thickness is controlled by deposition thickness and not microlithography. By repeating the steps for defining pole P2, it is possible to incorporate an additional pole tip for use in a three-pole head.

An alternate process will now be described in conjunction with Figs. 13-15. In this process, a non-magnetic seed layer such as TaAu serves as a substrate 50. A photoresist mask 52 having substantially vertical walls is applied to the substrate 50. Steep angle deposition is used to deposit an inner gap material such as Al_2O_3 against the vertical side wall of the photoresist 52 forming a layer 54. The Al_2O_3 is deposited from the side along a direction shown by an arrow 56. The horizontal surfaces are then ion milled with normal incidence to remove unwanted material. A preferred ion milling material is CF_4 which will preferentially remove Al_2O_3. Next, the photoresist block 52 is stripped away chemically which leaves the Al_2O_3 portion 54 shown in Fig. 14. A new photoresist pattern is generated to define the geometry of the poles and the ceramic and magnetic components of the gap form a wall that is part of the plating mask at this step in the process. Poles 58 and 60 (Fig. 15a) are then plated through this combined mask. A side view of the completed pole is shown in Fig. 15b.

A process for making a three-pole head will now be described in conjunction with Figs. 16-19. A non-magnetic seed layer 70 such as TaAu serves as a substrate. A photoresist mask 72 is applied to the substrate 70. Steep angle deposition is used to deposit inner gap material such as Al_2O_3 against the vertical side wall of the block of photoresist 72 to form a layer 74. The Al_2O_3 is deposited in the direction of an arrow 76. A magnetic material such as NiFe is deposited to form a layer 78. It is important to note that the NiFe layer 78 could actually be a laminated structure by including the process steps required for the production of a laminate. Steep angle deposition is used once again to deposit inner gap material against the vertical side walls of the NiFe layer 78 to form a layer 80. The horizontal surfaces are then ion milled with normal incidence to remove unwanted material (ceramic and magnetic) that was deposited during previous deposition steps. The pole after the ion milling step is shown in Fig. 17. Alumina is again deposited and the structure is ion milled again, resulting in the structure shown in Fig. 18. The photoresist block 72 is stripped chemically and a new photoresist pattern is generated to define the geometry of the poles to be created. The ceramic and magnetic components of the gap form a wall that is part of the plating mask at this point in the process. NiFe is again plated in the proper geometry to create the layers 82, 84 and 86. A side view of the completed pole is shown in Fig. 19b. Layer 86 is included to beef up the central pole for higher head efficiency.

This design most naturally uses a solenoidal coil. In this case, half of the coil must be deposited before the sequence described above and the other half afterwards.

A benefit of the techniques disclosed herein is that the thickness of the pole can be controlled very precisely because it is plated, whereas the width of the pole in previous implementations was determined by the masking operation and was therefore less controllable.

The structures made according to the present invention avoid the poor domain structure that develops when pole width is reduced in response to decreased track width. The techniques disclosed herein also reduce the amount of error in the definition of the pole edges which is caused by uncertainties in the process of removing material from the pole edge.

It is recognized that modifications and variations of the invention will occur to those skilled in the art which fall within the scope of the appended claims.

Claims

1. A method for fabricating a magnetic head comprising the sequential steps of:

   (a) creating a first magnetic pole (P1) from magnetic material (36) by forming said first pole over a substrate (30) such that the pole has at least approximately vertical side walls;

   (b) depositing a non-magnetic material layer (40) obliquely (42) from one side onto the substrate and a vertical side wall of the first pole formed in step (a) and defining a non-magnetic gap region thereby on the first pole vertical side wall;

   (c) applying a preselected mask pattern of

overlapping as shown in Fig. 11. After pole P2 is plated, photoresist is removed and any excess material from P2 can now be etched away using ion beam etching with a high degree of incidence, approximately 70° from perpendicular as shown by an arrow 44 in Fig. 11.

Because both P1 and P2 pole tips now appear on the same horizontal plane, it is possible to perform additional processing that allows the pole tips to be sculptured by means of ion beam etching to enhance magnetic performance. Such sculpturing is shown in Fig. 12.

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It is recognized that modifications and variations of the invention will occur to those skilled in the art which fall within the scope of the appended claims.

Claims

1. A method for fabricating a magnetic head comprising the sequential steps of:
   (a) creating a first magnetic pole (P1) from magnetic material (36) by forming said first pole over a substrate (30) such that the pole has at least approximately vertical side walls;
   (b) depositing a non-magnetic material layer (40) obliquely (42) from one side onto the substrate and a vertical side wall of the first pole formed in step (a) and defining a non-magnetic gap region thereby on the first pole vertical side wall;
   (c) applying a preselected mask pattern of

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photoresist on the non-magnetic layer after the deposition of a seed layer;
(d) plating a magnetic material to form a second pole (P2) over the non-magnetic layer (40) through the photoresist mask, the second pole being displaced horizontally with respect to the first pole, thus defining the non-magnetic gap region as a gap layer between the first and second poles (P1,P2);
(e) removing the photoresist; and
(f) removing excess magnetic material by ion milling from the opposite side (44) from the non-magnetic material (40) deposition.

2. The method of claim 1 wherein the magnetic material (36) is NiFe.

3. The method of claim 1 wherein the substrate (30) and the non-magnetic material (40) are Al_2O_3, the substrate being formed on a slider substrate.

4. The method of claim 1 wherein the first magnetic pole (P1) is created by the steps of:
(a) sputtering an Al_2O_3 base layer (30) on a slider substrate (32);
(b) depositing a seed layer (34) of a magnetic material on top of the base layer;
(c) plating a sheet of magnetic material (36) on top of the seed layer to a predetermined thickness;
(d) applying a photoresist layer (38) to the sheet of magnetic material and patterning the photoresist to define a first magnetic pole;
(e) etching the unprotected magnetic material (36) and a predetermined amount of Al_2O_3 in the base later (30) by ion beam milling; and
(f) removing the photoresist.

5. The method of claim 1 wherein the first magnetic pole (P1) is created by the steps of:
sputtering a base layer (30) of Al_2O_3 onto a slider substrate (32);
depositing a seed layer (34) of a magnetic material on top of the base layer (30); and
through mask plating a magnetic material (36) on the seed layer.

6. A method for fabricating a magnetic head comprising the sequential steps of:
(a) applying a photoresist mask (52) having substantially vertical side walls to a non-magnetic seed layer substrate (50) on a carrier substrate;
(b) steep angle (56) depositing a non-magnetic material (54) against the vertical side walls of the photoresist mask;
(c) ion milling the horizontal surfaces with vertical incidence, and leaving a portion of the material (54) deposited in step (b) to act as a gap layer between the poles (58,60) plated in step (e), this portion of material forming a wall;
(d) chemically stripping the photoresist mask and applying a new photoresist pattern to define the geometry of the poles (58,60) plated in step (e), this new pattern and the gap material wall forming a pole mask;
(e) plating magnetic material through the pole mask to form the poles (58,60) of the head, the vertical thickness of the poles defining a track width.

7. The method of claim 6 wherein the magnetic material (58,60) is NiFe.

8. The method of claim 6 wherein the non-magnetic material (54) is Al_2O_3.

9. The method of claim 6 wherein the carrier substrate is TaAu.

10. The method of claim 6 wherein step (c) includes the use of CF_4 as ion milling material.

11. A method for fabricating a three-pole magnetic head comprising the sequential steps of:
(a) applying a photoresist mask (72) to a non-magnetic seed layer substrate (70);
(b) depositing, by steep angle (76) deposition, an inner gap of non-magnetic material (74) against a vertical side wall of the photoresist (72);
(c) depositing a magnetic material (78) by steep angle deposition upon the inner gap non-magnetic material (74) to form a central pole;
(d) steep angle (76) depositing a non-magnetic material (80) to form a non-magnetic structure against a vertical side of the magnetic material (78);
(e) ion milling horizontal surfaces of the workpiece after step (d) with normal incidence;
(f) depositing a non-magnetic layer onto the non-magnetic structure formed in step (d) at a steep angle followed by ion milling at normal incidence;
(g) chemically stripping the photoresist mask and applying a new photoresist pattern to define the geometry of two outer poles (82,84);
(h) depositing a magnetic material having a desired geometry by through mask plating, at least to form the two outer poles (82,84), the vertical thickness of the two outer poles defining a track width.

12. The method of claim 11 wherein the magnetic material (78) is NiFe.

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13. The method of claim 11 wherein the non-magnetic material (74,80) is Al_2O_3.

14. The method of claim 11 wherein the substrate (70) is TaAu.

15. The method of claim 11 wherein step (e) includes the use of CF_4 as ion milling material.

16. The method of claim 11 wherein step (c) includes laminating the central pole.

Patentansprüche

1. Verfahren zum Herstellen eines Magnetkopfes mit den folgenden Schritten:
   (a) Schaffen eines ersten Magnetpoles (P1) aus einem magnetischen Material (36) durch Bilden des ersten Poles über einem Substrat (30), derart, daß der Pol wenigstens angenähert vertikale Seitenwände hat,
   (b) Ablagern einer nichtmagnetischen Materialschicht (40) schräg (42) von einer Seite auf dem Substrat und einer vertikalen Seitenwand des ersten Poles, gebildet in Schritt (a) und dadurch Definieren eines nichtmagnetischen Spaltbereiches auf der vertikalen Seitenwand des ersten Poles,
   (c) Auftragen einer vorgewählten Maskenschicht eines Photoresists auf der nichtmagnetischen Schicht nach der Abscheidung einer Keimschicht,
   (d) Plattieren eines magnetischen Materials zum Bilden eines zweiten Poles (P2) über der nichtmagnetischen Schicht (40) durch die Photoresistmaske, wobei der zweite Pol horizontal bezüglich des ersten Poles versetzt ist, um so den nichtmagnetischen Spaltbereich als eine Spaltschicht zwischen den ersten und zweiten Polen (P1, P2) zu definieren,
   (e) Entfernen des Photoresists, und
   (f) Entfernen von überschüssigem magnetischem Material durch Ionenschleifen von der entgegengesetzten Seite (44) von der Abscheidung des nichtmagnetischen Materials (40).

2. Verfahren nach Anspruch 1, bei dem das magnetische Material (36) NiFe ist.

3. Verfahren nach Anspruch 1, bei dem das Substrat (30) und das nichtmagnetische Material (40) Al_2O_3 sind, wobei das Substrat auf einem Gleitstücksubstrat gebildet ist.

4. Verfahren nach Anspruch 1, bei dem der erste magnetische Pol (P1) durch die folgenden Schritte geschaffen ist:
   (a) Sputtern einer Al_2O_3-Basisschicht (30) auf ein Gleitstücksubstrat (32),
   (b) Abscheiden einer Keimschicht (34) eines magnetischen Materials auf die Oberseite der Basisschicht,
   (c) Plattieren einer Schicht eines magnetischen Materials (36) auf die Oberseite der Keimschicht bis zu einer vorbestimmten Dicke,
   (d) Auftragen einer Photoresistschicht (38) auf die Schicht des magnetischen Materials und Mustern des Photoresists, um einen ersten Magnetpol zu definieren,
   (e) Ätzen des ungeschützten magnetischen Materials (36) und einer vorbestimmten Menge an Al_2O_3 in der Basisschicht (30) durch Ionenstrahlschleifen, und
   (f) Entfernen des Photoresists.

5. Verfahren nach Anspruch 1, bei dem der erste Magnetpol (P1) durch die folgenden Schritte geschaffen ist:
   Sputtern einer Basisschicht (30) von Al_2O_3 auf ein Gleitstücksubstrat (32),
   Abscheiden einer Keimschicht (34) eines magnetischen Materials auf die Oberseite der Basisschicht (30), und
   durch eine Maske Plattieren eines magnetischen Materials (36) auf der Keimschicht.

6. Verfahren zum Herstellen eines Magnetkopfes mit den folgenden Schritten:
   (a) Auftragen einer Photoresistmaske (52) mit im wesentlichen vertikalen Seitenwänden auf ein nichtmagnetisches Keimschichtsubstrat (50) auf einem Trägersubstrat,
   (b) unter einem steilen Winkel (56) Abscheiden eines nichtmagnetischen Materials (54) gegen die vertikalen Seitenwände der Photoresistmaske,
   (c) Ionenschleifen der horizontalen Oberflächen mit vertikalem Einfall und Zurücklassen eines Teiles des in Schritt (b) abgeschiedenen Materials (54), um als eine Spaltschicht zwischen den Polen (58, 60), die in Schritt (e) plattiert sind, zu wirken, wobei dieser Teil des Materials eine Wand bildet,
   (d) chemisches Abstreifen der Photoresistmaske und Auftragen eines neuen Photoresistmusters, um die Geometrie der in Schritt (e) plattierten Pole (58, 60) zu definieren, wobei dieses neue Muster und die Spaltmaterialwand eine Polmaske bilden,
   (e) Plattieren eines magnetischen Materials durch die Polmaske, um die Pole (58, 60) des Kopfes zu bilden, wobei die vertikale Dicke der Pole eine Spurbreite definiert.

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7. Verfahren nach Anspruch 6, bei dem das magnetische Material (58, 60) NiFe ist.

8. Verfahren nach Anspruch 6, bei dem das nichtmagnetische Material (54) Al_2O_3 ist.

9. Verfahren nach Anspruch 6, bei das Trägersubstrat TaAu ist.

10. Verfahren nach Anspruch 6, bei dem der Schritt (c) die Verwendung von CF_4 als ein Ionenschleifmaterial umfaßt.

11. Verfahren zum Herstellen eines Dreipolmagnetkopfes mit den folgenden Schritten:
(a) Auftragen einer Photoresistmaske (52) auf ein nichtmagnetisches Keimschichtsubstrat (70),
(b) Auftragen durch Abscheidung unter steilem Winkel (76) eines inneren Spaltes eines nichtmagnetischen Materials (74) gegen eine vertikale Seitenwand des Photoresists (72),
(c) Auftragen eines magnetischen Materials (78) durch Steilwinkelabscheidung auf den inneren Spalt des nichtmagnetischen Materials (74), um einen zentralen Pol zu bilden,
(d) Abscheiden unter steilem Winkel (76) eines nichtmagnetischen Materials (80), um eine nichtmagnetische Struktur gegen eine vertikale Seite des magnetischen Materials (78) zu bilden,
(e) Ionenschleifen von horizontalen Oberflächen des Werkstückes nach Schritt (d) mit normalem Einfall,
(f) Abscheiden einer nichtmagnetischen Schicht auf die nichtmagnetische Struktur, die in Schritt (d) gebildet ist, bei einem steilen Winkel, gefolgt durch Ionenschleifen bei normalem Einfall,
(g) chemisches Abstreifen der Photoresistmaske und Auftragen eines neuen Photoresistmusters, um die Geometrie von zwei äußeren Polen (82, 84) zu definieren,
(h) Abscheiden eines magnetischen Materials mit einer gewünschten Geometrie mittels Durchmaskenplattieren, um wenigstens die beiden äußeren Pole (82, 84) zu bilden, wobei die vertikale Dicke der beiden äußeren Pole eine Spurbreite definiert.

12. Verfahren nach Anspruch 11, bei dem das magnetische Material (78) NiFe ist.

13. Verfahren nach Anspruch 11, bei dem das nichtmagnetische Material (74, 80) Al_2O_3 ist.

14. Verfahren nach Anspruch 11, bei dem das Substrat (70) TaAu ist.

15. Verfahren nach Anspruch 11, bei dem der Schritt (e) die Verwendung von CF_4 als ein Ionenschleifmaterial umfaßt.

16. Verfahren nach Anspruch 11, bei dem der Schritt (c) ein Laminieren des zentralen Poles umfaßt.

Revendications

1. Procédé de fabrication d'une tête magnétique comprenant les étapes séquentielles suivantes :
(a) création d'un premier pôle magnétique (P1) à partir d'une matière magnétique (36) en formant ledit premier pôle sur un substrat (30) de sorte que le pôle ait au moins des parois latérales approximativement verticales ;
(b) dépôt d'une couche de matière non magnétique (40), en biais (42), à partir d'un côté sur le substrat et une paroi latérale verticale du premier pôle formé à l'étape (a) et définissant, de ce fait, une zone d'entrefer non magnétique sur la paroi latérale verticale du premier pôle ;
(c) application d'un motif de masque présélectionné de résine photosensible sur la couche non magnétique après le dépôt d'une couche de germe ;
(d) placage d'une matière magnétique pour former un second pôle (P2) sur la couche non magnétique (40) à travers le masque de résine photosensible, le second pôle étant déplacé horizontalement par rapport au premier pôle, définissant ainsi la zone d'entrefer non magnétique comme une couche d'entrefer entre les premier et second pôles (P1, P2) ;
(e) enlèvement de la résine photosensible ; et
(f) enlèvement de la matière magnétique en excès par usinage par faisceau d'ions depuis le côté opposé (44) à partir du dépôt de la matière non magnétique (40).

2. Procédé selon la revendication 1, dans lequel la matière magnétique (36) est du NiFe.

3. Procédé selon la revendication 1, dans lequel le substrat (30) et la matière non magnétique (40) sont en Al_2O_3, le substrat étant formé sur un substrat de patin.

4. Procédé selon la revendication 1, dans lequel le premier pôle magnétique (P1) est créé par les étapes suivantes :
(a) pulvérisation d'une couche de base de Al_2O_3 (30) sur un substrat de patin (32) ;
(b) dépôt d'une couche de germe (34) de matière magnétique sur le sommet de la couche de base ;

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(c) placage d'une feuille de matière magnétique (36) sur le sommet de la couche de germe à une épaisseur prédéterminée ;
(d) application d'une couche de résine photosensible (38) à la feuille de matière magnétique et formation de motif sur la résine photosensible pour définir un premier pôle magnétique ;
(e) gravure de la matière magnétique non protégée (36) et d'une quantité prédéterminée de Al_2O_3 dans la couche de base (30) par usinage par faisceau d'ions ; et
(f) enlèvement de la résine photosensible.

5. Procédé selon la revendication 1, dans lequel le premier pôle magnétique (P1) est créé par les étapes suivantes :
pulvérisation d'une couche de base (30) de Al_2O_3 sur un substrat de patin (32) ;
dépôt d'une couche de germe (34) de matière magnétique sur le sommet de la couche de base (30) ; et
placage à travers le masque d'une matière magnétique (36) sur la couche de germe.

6. Procédé de fabrication d'une tête magnétique comprenant les étapes séquentielles suivantes :
(a) application d'un masque de résine photosensible (52) ayant des parois latérales sensiblement verticales à un substrat de couche de germe non magnétique (50) sur un substrat porteur ;
(b) dépôt à angle aigu (56) d'une matière non magnétique (54) contre les parois latérales verticales du masque de résine photosensible ;
(c) usinage par faisceau d'ions des surfaces horizontales avec une incidence verticale, en laissant une partie de la matière (54) déposée à l'étape (b) pour agir en tant que couche formant entrefer entre les pôles (58, 60) plaqués à l'étape (e), cette partie de la matière formant une paroi ;
(d) élimination chimique du masque de résine photosensible et application d'un nouveau motif de résine photosensible pour définir la géométrie des pôles (58, 60) plaqués à l'étape (e), ce nouveau motif et la paroi de matière d'entrefer formant un masque de pôle ;
(e) placage de matière magnétique à travers le masque de pôle pour former les pôles (58, 60) de la tête, l'épaisseur verticale des pôles définissant une largeur de piste.

7. Procédé selon la revendication 6, dans lequel la matière magnétique (58, 60) est du NiFe.

8. Procédé selon la revendication 6, dans lequel la matière non magnétique (54) est du Al_2O_3.

9. Procédé selon la revendication 6, dans lequel le substrat porteur est du TaAu.

10. Procédé selon la revendication 6, dans lequel l'étape (c) comprend l'utilisation de CF_4 en tant que matière d'usinage par faisceau d'ions.

11. Procédé de fabrication d'une tête magnétique à trois pôles comprenant les étapes séquentielles suivantes :
(a) application d'un masque de résine photosensible (72) à un substrat de couche de germe non magnétique (70) ;
(b) dépôt, par dépôt à angle aigu (76), d'un entrefer intérieur de matière non magnétique (74) contre une paroi latérale verticale de la résine photosensible (72) ;
(c) dépôt d'une matière magnétique (78), par dépôt à angle aigu, sur la matière non magnétique d'entrefer intérieur (74) pour former un pôle central ;
(d) dépôt à angle aigu (76) d'une matière non magnétique (80) pour former une structure non magnétique contre un côté vertical de la matière magnétique (78) ;
(e) usinage par faisceau d'ions des surfaces horizontales de la pièce de travail après l'étape (d) avec une incidence normale ;
(f) dépôt d'une couche non magnétique sur la structure non magnétique formée à l'étape (d) à un angle aigu suivi par un usinage par faisceau d'ions à une incidence normale ;
(g) élimination chimique du masque de résine photosensible et application d'un nouveau motif de résine photosensible pour définir la géométrie des deux pôles extérieurs (82, 84) ;
(h) dépôt d'une matière magnétique ayant une géométrie souhaitée par placage à travers le masque, au moins pour former les deux pôles extérieurs (82, 84), l'épaisseur verticale des deux pôles extérieurs définissant une largeur de piste.

12. Procédé selon la revendication 11, dans lequel la matière magnétique (78) est du NiFe.

13. Procédé selon la revendication 11, dans lequel la matière non magnétique (74, 80) est du Al_2O_3.

14. Procédé selon la revendication 11, dans lequel le substrat (70) est du TaAu.

15. Procédé selon la revendication 11, dans lequel l'étape (e) comprend l'utilisation de CF_4 en tant que matière d'usinage par faisceau d'ions.

16. Procédé selon la revendication 11, dans lequel l'étape (c) comprend le laminage du pôle central.

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