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(54) **HEAT ASSISTED MAGNETIC RECORDING MEDIUM AND METHOD FOR FABRICATING THE SAME**

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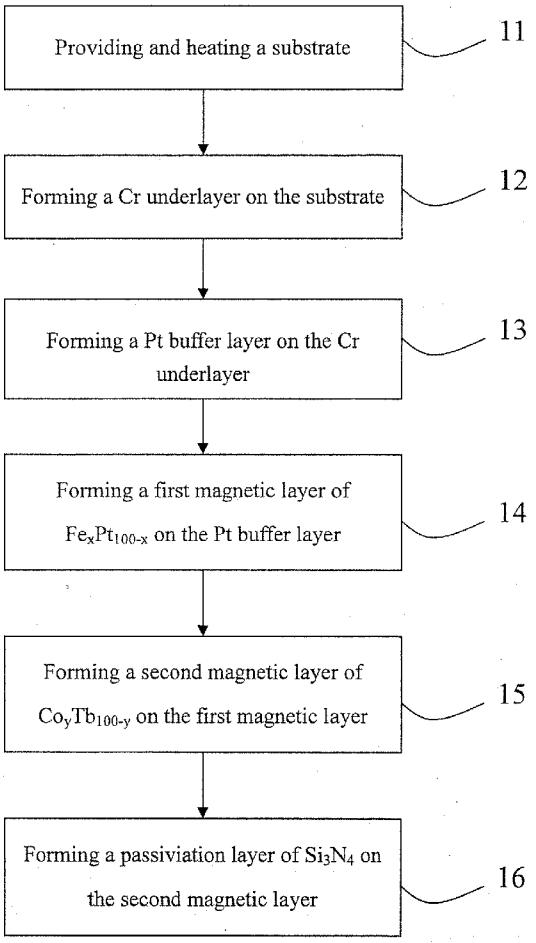
(57) **ABSTRACT**

A novel heat assisted magnetic recording (HAMR) medium and the fabrication method therefor are provided. The exchange coupling effect occurring at the interface of FePt/CoTb double layers is adopted, and thus the resulting magnetic flux would be sufficient enough to be detected and readout under the room temperature. The provided HAMR medium exhibits a relatively high saturation magnetization and perpendicular coercivity, and thus possesses a great potential for the ultra-high density recording application.



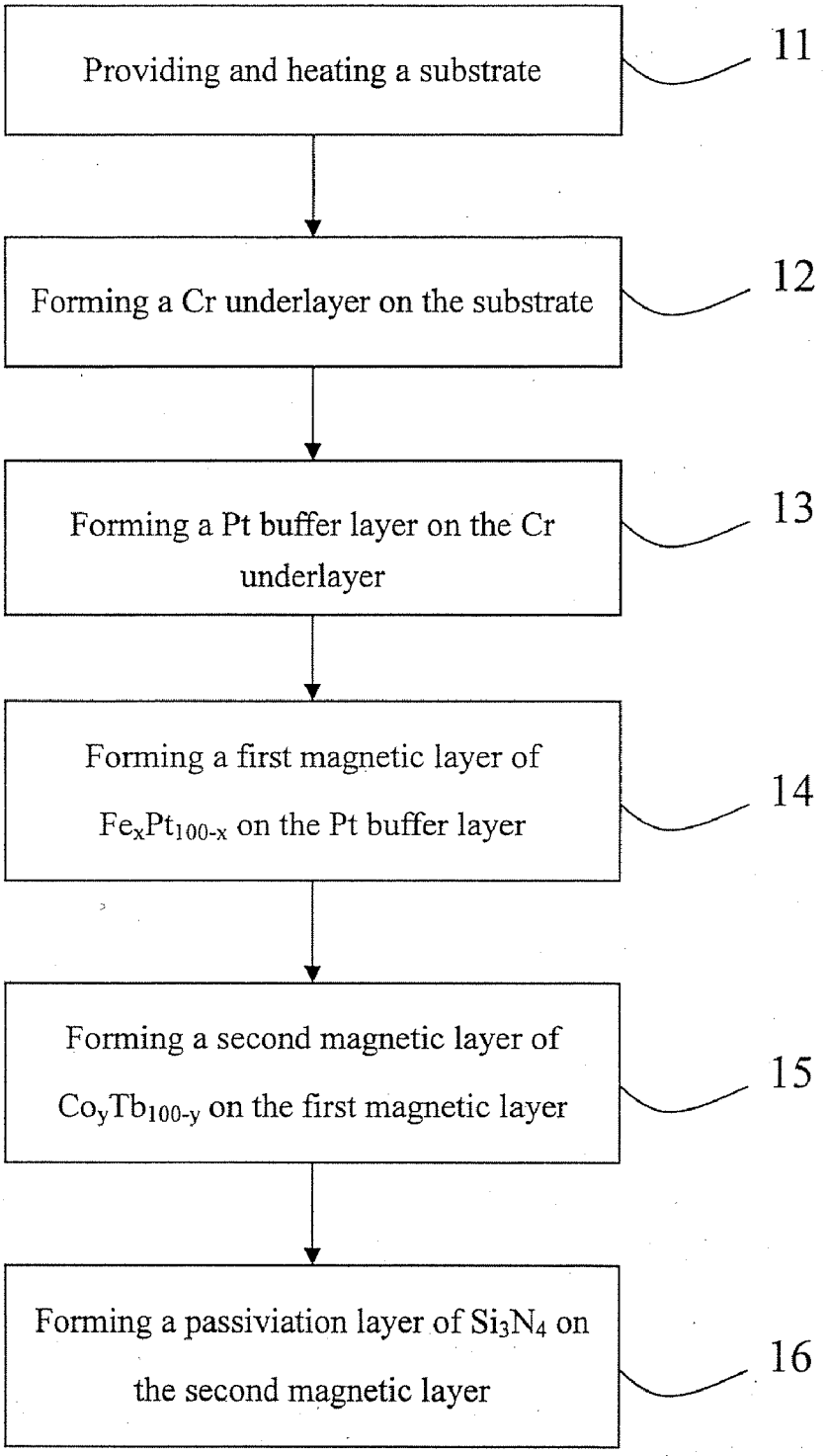

Providing and heating a substrate
11
Forming a Cr underlayer on the substrate
12
Forming a Pt buffer layer on the Cr underlayer
13
Forming a first magnetic layer of Fe_xPt_{100-x} on the Pt buffer layer
14
Forming a second magnetic layer of Co_yTb_{100-y} on the first magnetic layer
15
Forming a passiviation layer of Si_3N_4 on the second magnetic layer
16

Fig. 1

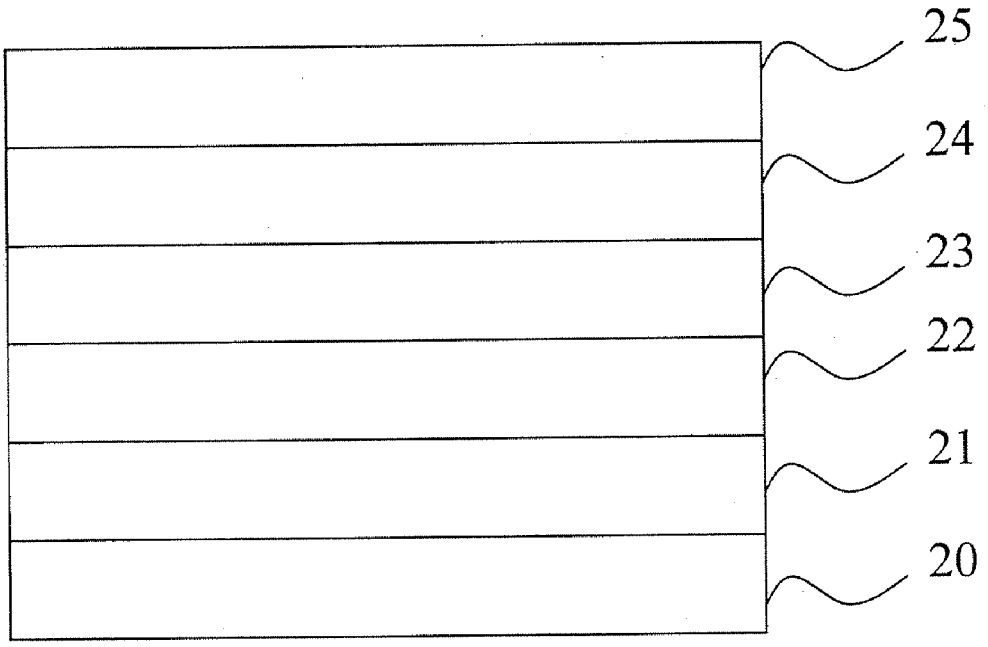


Fig. 2

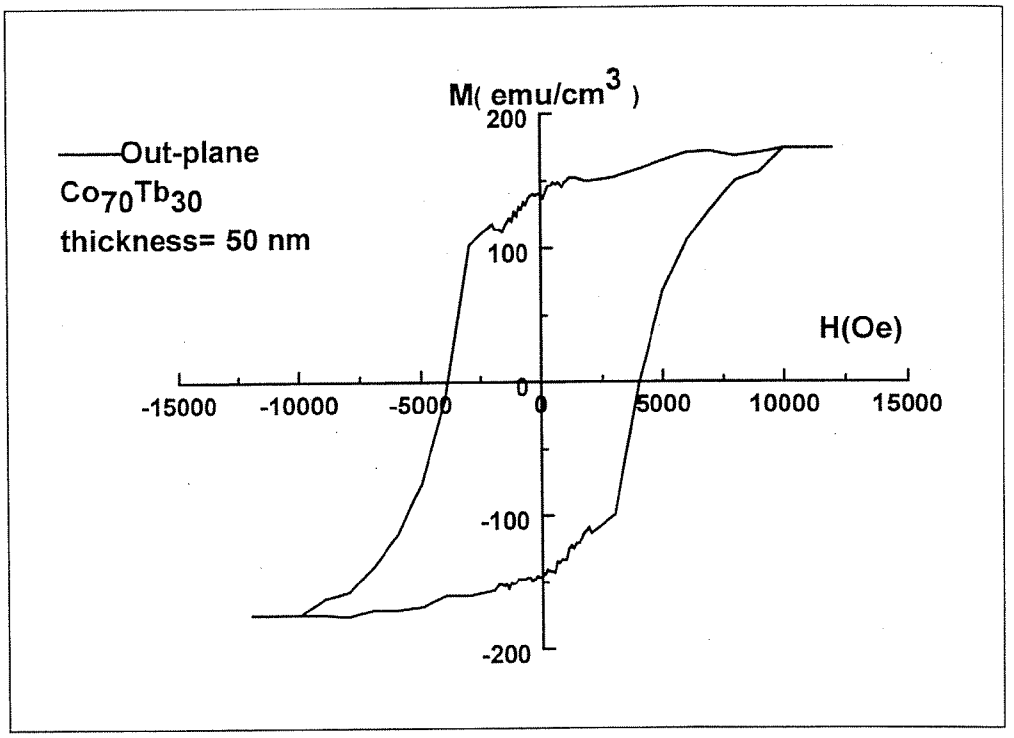

M(emu/cm3)
200
100
-100
-200
H(Oe)
-15000
-10000
-5000
0
5000
10000
15000
——Out-plane
Co70Tb30
thickness= 50 nm

Fig. 3

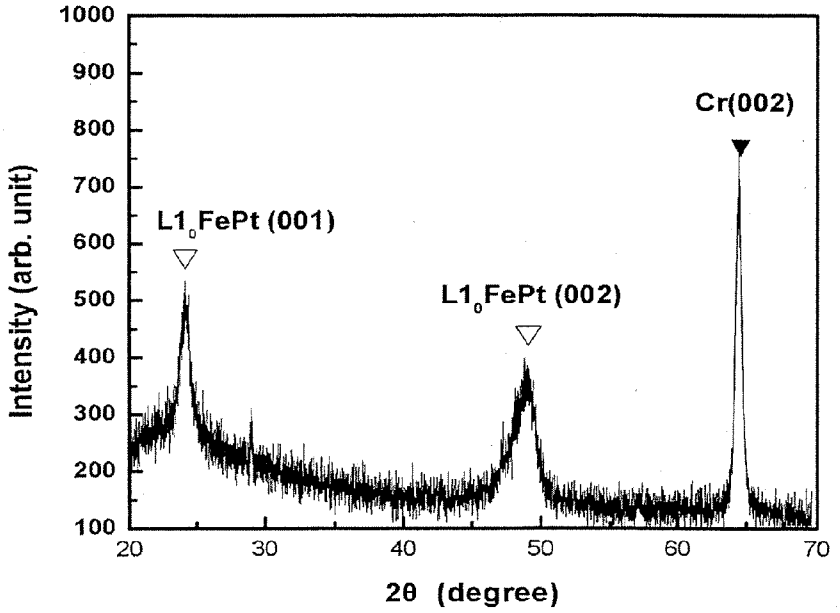

Intensity (arb. unit)
2θ (degree)
L1$_0$FePt (001)
L1$_0$FePt (002)
Cr(002)

Fig. 4(A)

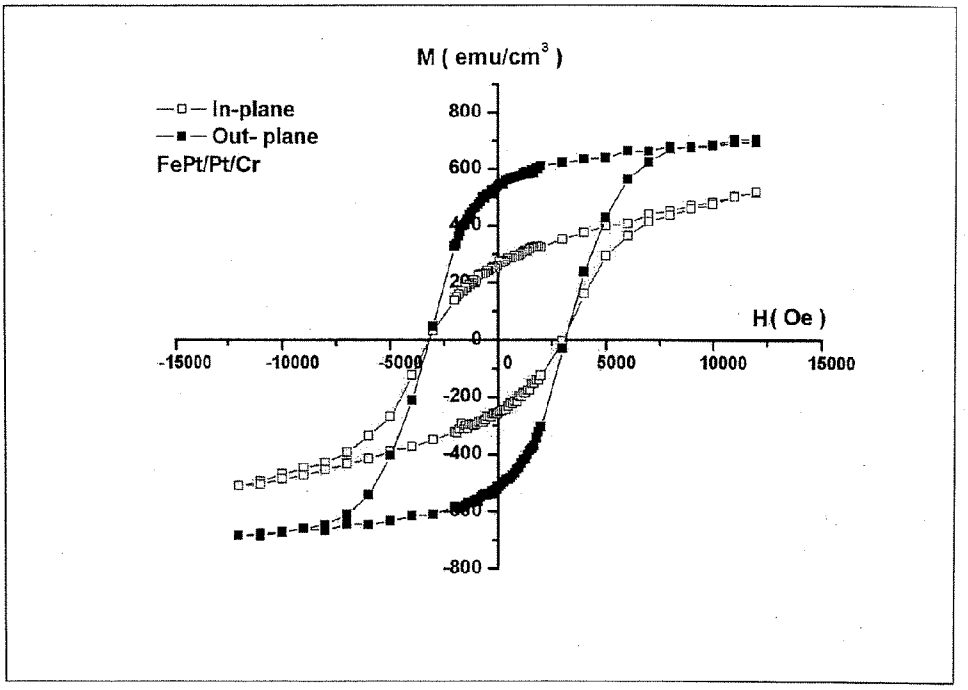

M (emu/cm^3)
In-plane
Out- plane
FePt/Pt/Cr
H(Oe)

Fig. 4(B)

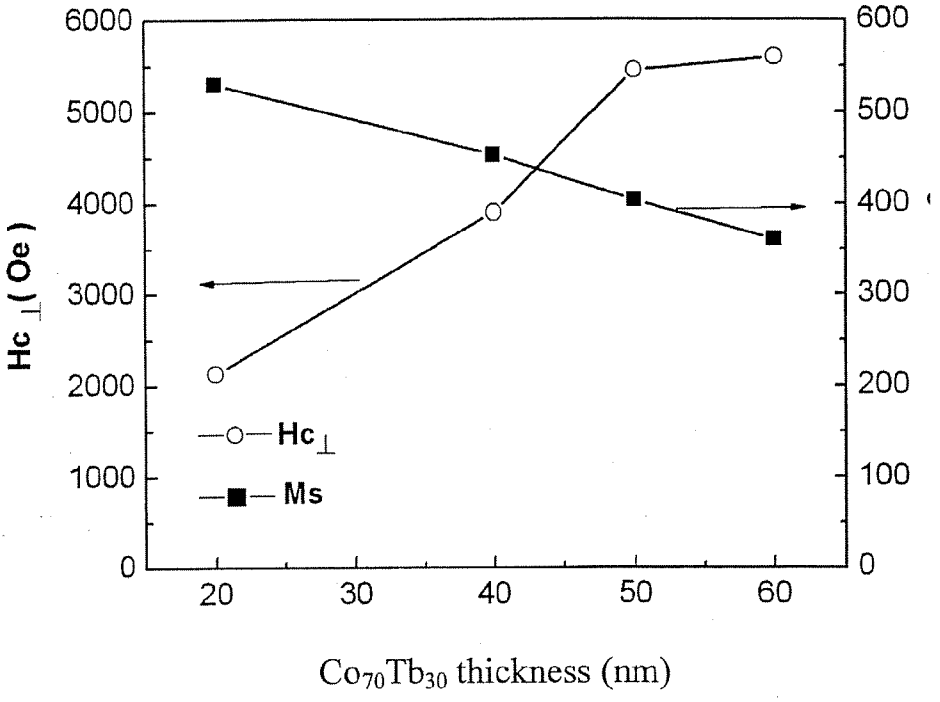

6000
5000
4000
3000
2000
1000
0
600
500
400
300
200
100
0
20
30
40
50
60
Hc ⊥ (Oe)
Hc⊥
Ms
Co70Tb30 thickness (nm)

Fig. 5

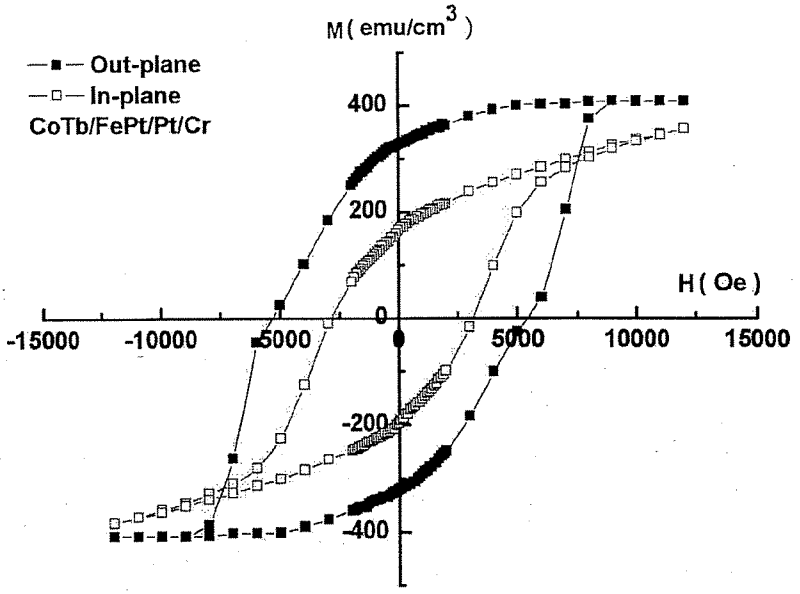

M(emu/cm3)
Out-plane
In-plane
CoTb/FePt/Pt/Cr
400
200
0
-200
-400
H(Oe)
-15000
-10000
-5000
5000
10000
15000

Fig. 6

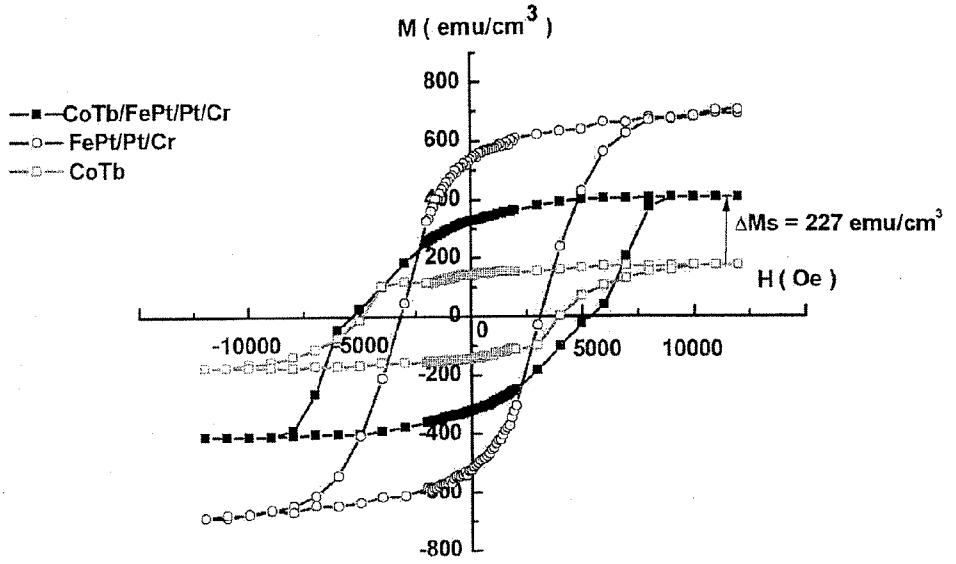

M (emu/cm3)
CoTb/FePt/Pt/Cr
FePt/Pt/Cr
CoTb
800
600
400
200
0
-200
-400
-600
-800
-10000
-5000
0
5000
10000
ΔMs = 227 emu/cm3
H (Oe)

Fig. 7

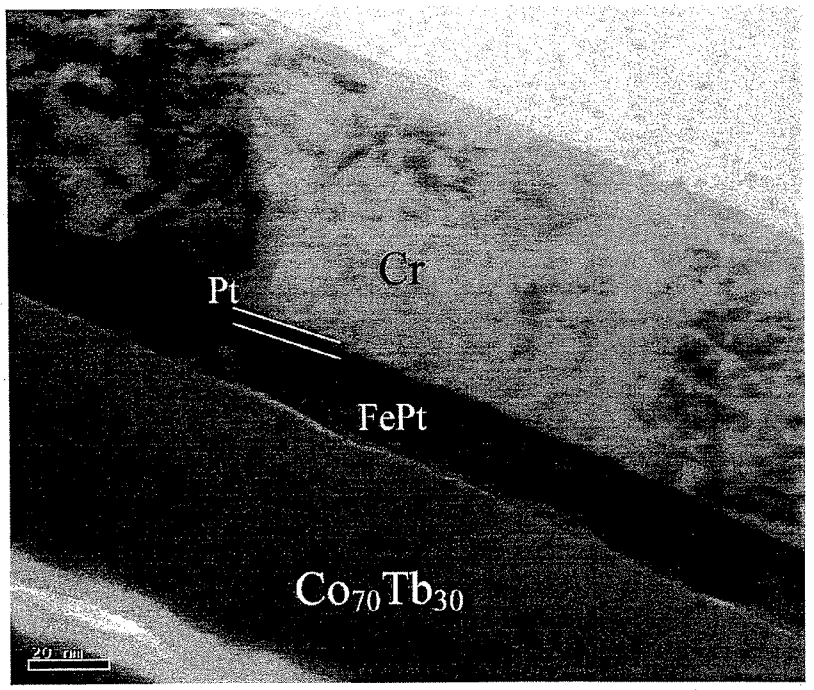

Pt
Cr
FePt
Co70Tb30
20 nm

Fig. 8

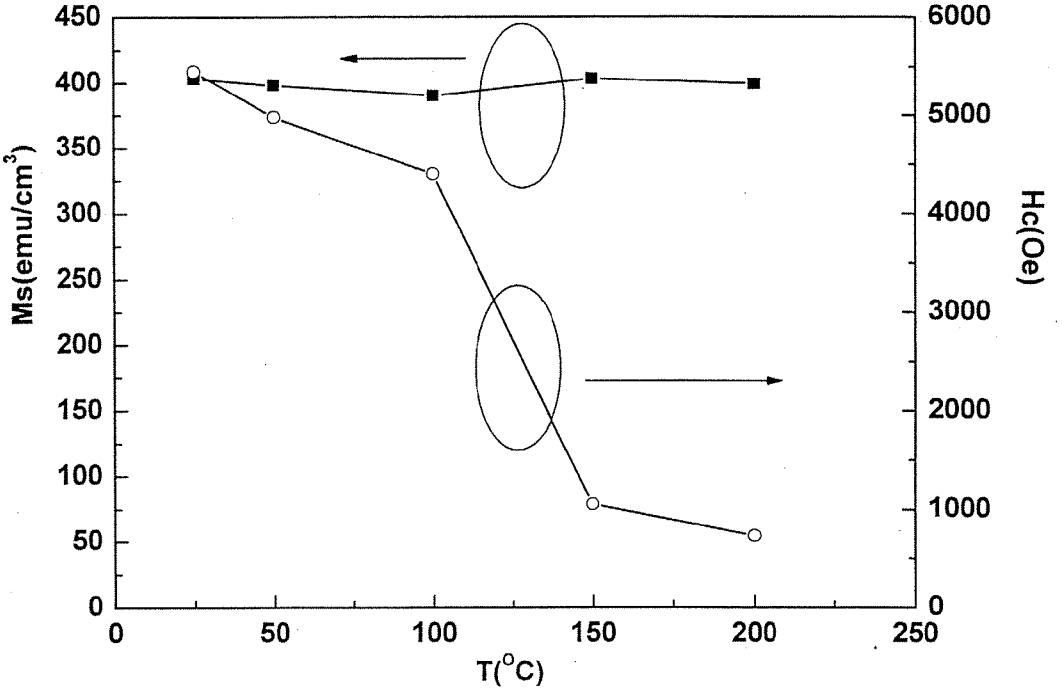

Ms(emu/cm^3)
Hc(Oe)
T(^{o}C)
0
50
100
150
200
250
0
50
100
150
200
250
300
350
400
450
0
1000
2000
3000
4000
5000
6000

Fig. 9

HEAT ASSISTED MAGNETIC RECORDING MEDIUM AND METHOD FOR FABRICATING THE SAME

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is a division of U.S. patent application Ser. No. 11/462,400, filed Aug. 4, 2006, which is incorporated by reference as if fully set forth.

FIELD OF THE INVENTION

[0002] The present invention relates to a recording medium and the fabrication method therefor, and more particularly to a heat assisted magnetic recording (HAMR) medium and the fabrication method therefor.

BACKGROUND OF THE INVENTION

[0003] Currently, the heat assisted magnetic recording (HAMR) method with writing and magnetic flux reading is well proposed for increasing the perpendicular recording density of the magnetic disk, where the amorphous rare earth-transition metal (RE-TM) thin films are usually applied as the recording medium therefor.

[0004] The RE-TM thin film is advantageous in having the perpendicular magnetic anisotropy above 10^6 erg/cm^3 and exhibiting the perpendicular magnetization, and thus it is always considered as a candidate for HAMR. Generally, the recording medium for HAMR needs to be provided with the following properties including a satisfactory magneto-optical writing performance, a large saturation magnetization, Ms, that generates a sufficient magnetic flux for the giant magnetoresistance (GMR) head or the tunneling magnetoresistance (TMR) head readout, and a large perpendicular coercivity, Hc.perp., so as to resist the self-demagnetization. Apparently, the traditional magneto-optical (MO) recording medium is not suitable for being applied for HAMR because such medium fails to generate sufficient magnetic flux for GMR or TMR head readout owing to the relatively lower saturation magnetization (Ms) value thereof.

[0005] For overcoming the drawbacks of the conventional recording medium with a relatively lower Ms value, the prevent invention provides an improved HAMR medium of a FePt/CoTb bi-layer structure, in which the Ms value and $Hc^{\perp}$ value thereof are significantly enhanced owing to a relatively high Ms value of the FePt (001) thin film and a relatively high exchange energy at the interface between the FePt/CoTb bi-layer structure.

SUMMARY OF THE INVENTION

[0006] It is a first aspect of the present invention to provide a heat assisted magnetic recording (HAMR) medium with a relatively high saturation magnetization (Ms) and perpendicular coercivity ($Hc^{\perp}$), so as to produce sufficient magnetic flux under the room temperature for signal readout.

[0007] It is a second aspect of the present invention to provide a method for fabricating a novel HAMR medium which exhibits a relatively high saturation magnetization (Ms) and perpendicular coercivity (Hc), so that the provided HAMR medium is suitable for being readout by the giant magneto-resistive (GMR) head or the tunneling magneto-resistive (TMR) head under the room temperature.

[0008] In accordance with the first aspect of the present invention, a magnetic recording medium is provided. The provided medium includes a substrate, an underlayer located on the substrate, a buffer layer located on the underlayer, a magnetic layer located on the buffer layer and a recording and reading layer located on the magnetic layer.

[0009] Preferably, the substrate is one of a glass substrate and an oxidized Si substrate.

[0010] Preferably, the underlayer is a Cr layer.

[0011] Preferably, the Cr layer has a thickness ranged from 10 to 100 nm.

[0012] Preferably, the thickness of the Cr layer is 70 nm.

[0013] Preferably, the buffer layer is a Pt layer.

[0014] Preferably, the Pt layer has a thickness ranged from 1 to 10 mm.

[0015] Preferably, the thickness of the Pt layer is 2 nm.

[0016] Preferably, the magnetic layer is a Fe_xPt_{100-x} layer and the recording and reading layer is a Co_yTb_{100-y} layer.

[0017] Preferably, x is ranged from 45 to 55 and y is ranged from 65.8 to 71.9.

[0018] Preferably, x is 50 and y is 70.44.

[0019] Preferably, the Fe_xPt_{100-y} layer has a thickness ranged from 5 to 60 nm, and the Co_yTb_{100-y} layer has a thickness ranged from 20 nm to 60 nm.

[0020] Preferably, the thickness of the Fe_xPt_{100-x} layer is 20 nm, and the thickness of the Co_yTb_{100-y} layer is 50 nm.

[0021] In accordance with the mentioned aspect, the provided heat assisted magnetic recording medium further includes a passiviation layer located on the recording and reading layer. Preferably, the passiviation layer is a layer of silicon nitride.

[0022] In accordance with the second aspect of the present invention, a method for fabricating a magnetic recording medium is provided. The provided method includes steps of: (a) providing a substrate; (b) performing a thermal process to the substrate; (c) forming an underlayer of Cr on the substrate; (d) forming a buffer layer of Pt on the underlayer; (e) forming a layer of Fe_xPt_{100-x} on the buffer layer; and (f) forming a layer of Co_yTb_{100-y} on the layer of Fe_xPt_{100-x}.

[0023] Preferably, the step (b) further includes a step of heating the substrate to a first temperature.

[0024] Preferably, the first temperature is less than 800° C.

[0025] Preferably, the first temperature is 350° C.

[0026] Preferably, in the step (b), the thermal process is performed for 5 to 90 minutes.

[0027] Preferably, in the step (b), the first temperature is 350° C., and the thermal process is performed for 30 minutes.

[0028] Preferably, in the step (b), the thermal process is performed under a pressure ranged from 1×10^{-9} to 1×10^{-6} Torr.

[0029] Preferably, in the step (c), the buffer layer of Cr is formed on the substrate under a temperature of 350° C.

[0030] Preferably, in the step (d), the buffer layer of Pt is formed on the underlayer under a second temperature below 800° C.

[0031] Preferably, the second temperature is 350° C.

[0032] Preferably, in the step (e), the layer of Fe_xPt_{100-x} is formed on the buffer layer under a third temperature below 800° C.

[0033] Preferably, the third temperature is 420° C.

[0034] Preferably, in the step (f), the layer of Co_yTb_{100-y} is formed on the layer of Fe_xPt_{100-x} under a fourth temperature below 50° C.

[0035] Preferably, the fourth temperature is an ambient temperature.

[0036] Preferably, the underlayer of Cr, the buffer layer of Pt, the layer of Fe_xPt_{100-x} and the layer of Co_yTb_{100-y} are formed by DC magnetron sputtering in an ultrahigh vacuum sputtering chamber.

[0037] Preferably, the underlayer of Cr, the buffer layer of Pt, the layer of Fe_xPt_{100-x} and the layer of Co_yTb_{100-y} are deposited under an argon pressure ranged from 2 to 12 mTorr.

[0038] Preferably, the argon pressure is 5 mTorr.

[0039] Preferably, the layer of Fe_xPt_{100-x} is deposited by DC magnetron sputtering with a first DC power ranged from 0.2 to 0.5 W/cm^2.

[0040] Preferably, the first DC power is 0.22 W/cm^2.

[0041] Preferably, the layer of Co_yTb_{100-y} is deposited by DC magnetron sputtering with a second DC power ranged from 1 to 4 W/cm^2.

[0042] Preferably, the second DC power is 2.96 W/cm^2.

[0043] In accordance with the mentioned aspect, the present method further includes a step of (g) forming a passiviation layer on the layer of Co_yTb_{100-y}.

[0044] Preferably, the passiviation layer is formed by magnetron sputtering with an RF power ranged from 2 to 7 W/cm^2.

[0045] Preferably, the RF power is 2.47 W/cm^2.

[0046] The foregoing and other features and advantages of the present invention will be more clearly understood through the following descriptions with reference to the drawings, wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

[0047] FIG. **1** is a flow chart illustrating the method for fabricating the heat assisted magnetic recording (HAMR) medium according to a preferred embodiment of the present invention;

[0048] FIG. **2** is a cross-sectional view schematically illustrating the fabricated HAMR medium according to the preferred embodiment of the present invention;

[0049] FIG. **3** is a diagram illustrating the M-H loop of a pre-deposited $Co_{70}Tb_{30}$ layer under the ambient temperature;

[0050] FIG. **4**(A) and FIG. **4**(B) are diagrams respectively illustrating the XRD pattern and the M-H loop of the pre-deposited FePt(001)/Pt(001)/Cr(002) layer sequence according to the present invention;

[0051] FIG. **5** is a diagram illustrating the Ms value variation and the Hc.perp. value variation of the HAMR medium depending on the thickness of the $Co_{70}Tb_{30}$ layer thereof in accordance with the present invention;

[0052] FIG. **6** is a diagram illustrating the M-H loop of the provided $Co_{70}Tb_{30}$/FePt(001)/Pt(001)/Cr(002) layer sequence of the HAMR medium according to the present invention;

[0053] FIG. **7** is a diagram illustrating the comparison for M-H loop of the conventional $Co_{70}Tb_{30}$ recording layer, the provided FePt(001)/Pt(001)/Cr(002) layer sequence and the provided $Co_{70}Tb_{30}$/FePt(001)/Pt(001)/Cr(002) layer sequence of the HAMR medium according to the present invention;

[0054] FIG. **8** is a TEM photo showing the cross-sectional view of the provided $Co_{70}Tb_{30}$/FePt(001)/Pt(001)/Cr(002) layer sequence of the HAMR medium according to the present invention; and

[0055] FIG. **9** is a diagram illustrating the Ms value variation and the Hc.perp. value variation of the $Co_{70}Tb_{30}$/FePt (001) layer sequence of the HAMR medium depending on the temperature in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0056] The present invention will now be described more specifically with reference to the following embodiments. It is to be noted that the following descriptions of preferred embodiments of this invention are presented herein for purpose of illustration and description only; it is not intended to be exhaustive or to be limited to the precise form disclosed.

[0057] In accordance with the preferred embodiment of the present invention, the improved heat assisted magnetic recording (HAMR) medium is achieved by a novel recording layer sequence of a first magnetic layer and a second magnetic layer.

[0058] The fabrication method for the heat assisted magnetic recording (HAMR) medium according to the present invention is illustrated with reference to FIG. **1**.

[0059] Please refer to FIG. **1**, which is a flow chart illustrating the method for fabricating the HAMR medium according to a preferred embodiment of the present invention. According to the preferred embodiment, a substrate is first provided and heated to about 350° C., as shown in the step **11**. An underlayer of Cr is formed on the substrate, as shown in the step **12**. Subsequently, a buffer layer of Pt is formed on the underlayer, as shown in the step **13**. Afterward, a magnetic layer of Fe_xPt_{100-x} is formed on the buffer layer and then a recording and reading layer of Co_yTb_{100-y} is formed thereon, as shown in the steps **14** and **15**, respectively. A passiviation layer of Si_3N_4 is formed on the resulting layer sequence, and then the HAMR medium according to the present invention is hence fabricated, as shown in the step **16**.

[0060] In the present invention, the underlayer, the buffer layer, the first magnetic layer and the second magnetic layer are formed by DC magnetron sputtering in an ultrahigh vacuum sputtering chamber, where the targets of CoTb alloy and FePt alloy as well as the respective metallic targets of Co, Tb, Fe and Pt are adoptable therefor. The sputtering process is performed under an argon pressure ranged from 2 to 12 mTorr, and preferably, an argon pressure of 5 mTorr, wherein the first magnetic layer is deposited by DC magnetron sputtering with a first DC power ranged from 0.2 to 0.5 W/cm^2 (preferably 0.22 W/cm^2), and the second magnetic layer is deposited with a second DC power ranged from 1 to 4 W/cm^2 (preferably 2.96 W/cm^2).

[0061] The passiviation layer of Si_3N_4 is formed by magnetron sputtering with an RF power ranged from 2 to 7 W/cm^2 (preferably 2.47 W/cm^2).

[0062] In accordance with the present invention, the substrate temperature is controlled below 800° C., and preferably at 350° C. while depositing the underlayer of Cr, the buffer layer of Pt and the first magnetic layer of Fe_xPt_{100-x}. Moreover, when the second magnetic layer of Co_yTb_{100-y} is deposited, the substrate temperature is controlled below 50° C., and preferably at the ambient temperature. Furthermore, the annealing process is performed at an annealing temperature ranged from 300 to 800° C. with a time period ranged from 5 to 90 minutes. In a preferred embodiment, the annealing temperature is 350° C. and the time period is 30 minutes, and the layer sequence is annealed under a working pressure below 1×10^{-6} Torr, and preferably, under a working pressure of 1×10^{-9} Torr.

[0063] In a further preferred embodiment according to the present invention, the $Fe_{50}Pt_{50}(001)/Pt(001)/Cr(200)$ layer sequence is fabricated on the 7059 coming glass substrate by DC magnetron sputtering in an ultrahigh vacuum sputtering chamber. Alternatively, a cleaned quartz substrate or a naturally oxidized silicon substrate is also adoptable in the present invention. The base pressure is controlled better than 5×10^{-9} torr before sputtering. The substrate is heated to 350° C. and the Cr(200) underlayer as well as the Pt(001) buffer layer are deposited thereon. The deposition temperature for the $Fe_{50}Pt_{50}$ (20 nm) magnetic layer is set to 420° C., so as to overcome the order-disorder transformation energy barrier to yield the $L1_0$ FePt phase therefor. The thickness of the Cr underlayer and the Pt buffer layer is 70 nm and 2 nm, respectively. In the present invention, the Co_yTb_{100-y} layers with various thicknesses (20 nm~60 nm) are deposited on the $Fe_{50}Pt_{50}(001)/Pt(001)/Cr(200)$ layer sequence by DC magnetron sputtering at the ambient temperature, and finally, the passiviation layer of Si_3N_4 (20 nm) is deposited thereon for protecting the resulting layer sequence from oxidation.

[0064] The sputtering parameters for the preparation of Cr, Pt, Fe_xPt_{100-x} and Co_yTb_{100-y} layers are listed as Table 1. The base pressure of the sputter chamber is controlled at approximately 5×10^{-9} Torr, and the mentioned layers are deposited under an argon pressure P_{Ar} ranged between 2 and 12 mTorr, so as to obtain a relatively improved magnetic property thereof. In more specifics, the argon pressure P_{Ar} of 5 mTorr is preferred.

TABLE 1

Deposition Temperature for $Co_{70}Tb_{30}$	Ambient Temperature
Deposition Temperature for FePt (001)	420° C.
RF Power Density	2~7 W/cm^2 for Si_3N_4 Target
DC Power Density	1~4 W/cm^2 for CoTb Target
DC Power Density	0.2~0.5 W/cm^2 for FePt Target
Base Vacuum	5×10^{-9} Torr
Distance between Substrate and Target	9 cm
Argon Pressure	0.3~20 mTorr
Argon Flow Rate	20 mL/min

[0065] Please refer to FIG. **2**, which is a cross-sectional view schematically illustrating the fabricated HAMR medium according to the preferred embodiment of the present invention. The HAMR medium includes a substrate **20** which is a quartz substrate or a naturally oxidized silicon substrate, and thereon includes a layer sequence of an underlayer **21**, a buffer layer **22**, a magnetic layer **23**, a recording and reading layer **24**, and a passiviation layer **25**. In a preferred embodiment, the underlayer **21** is made of Cr, the buffer layer **22** is made of Pt, the magnetic layer **23** and the recording and reading layer **24** are respectively made of Fe_xPt_{100-x} and Co_yTb_{100-y}, and the passiviation layer **25** is a Si_3N_4 layer.

[0066] According to the present invention, the thickness of the Cr layer is ranged from 10 to 100 nm (preferably 70 nm), and the thickness of the Pt layer is ranged from 1 to 10 nm (preferably 2 nm). The thickness of the Fe_xPt_{100-x} layer is ranged from 5 to 60 nm, and the thickness of the Co_yTb_{100-y} layer is ranged from 20 nm to 60 nm. More preferably, the thickness of the Fe_xPt_{100-x} layer is 20 nm, and the thickness of the Co_yTb_{100-y} layer is 50 nm. Furthermore, the x value for the Fe_xPt_{100-x} layer is ranged from 45 to 55 and the y value for the Co_yTb_{100-y} layer is ranged from 65.8 to 71.9, and more preferably, x is 50 and y is 70.44.

[0067] In the present invention, the structure of the fabricated layer sequence is examined by an X-ray diffractometer (XRD) with Cu—Kα. radiation and by Philips Tecnai F30 field emission gun transmission electron microscopy (TEM). The composition as well as the homogeneity of the CoTb magnetic layer is determined by means of energy disperse spectrum (EDS). The thickness of the fabricated layer sequence is measured by an atomic force microscope (AFM), and the magnetic properties thereof are measured by a vibrating sample magnetometer (VSM) with a maximum applied field of 12 kOe.

[0068] Please refer to FIG. **3**, which is a diagram showing the M-H loop of the $Co_{70}Tb_{30}$ magnetic layer at the ambient temperature. It is shown that the coericivity ($Hc^{\perp}$) and the saturation magnetization (Ms) of the $Co_{70}Tb_{30}$ magnetic layer are approximately 3600 Oe and 176 emu/cm^3, respectively, where the saturation magnetization is too small to be detected by a high resolution giant magneto-resistive (GMR) head or a tunneling magneto-resistive (TMR) head. Therefore, the FePt(001) layer is introduced under the $Co_{70}Tb_{30}$ layer in accordance with the preferred embodiment of the present invention, so as to increase the Ms value therefor.

[0069] When the Pt(001)/Cr(200) layer sequence is introduced, the preferred orientation of the $L1_0$ FePt layer would switch from $L1_0$ FePt(111) to $L1_0$ FePt(001), and thus the FePt layer may exhibit a perpendicular magnetic anisotropy. In the absence of an Pt intermediate layer, however, the Cr atoms would diffuse directly into the FePt magnetic layer and thus suppress the formation of $L1_0$ FePt(001) preferred orientation. With reference to FIG. **4**(A), which is an XRD pattern of FePt/Pt/Cr layer sequence, it is found that there exist the respective peaks of the Cr(002) reflection plane, (001) and (002) superlattice planes of the $L1_0$ FePt(001) phase. With reference to FIG. **4**(B), which is a diagram showing the M-H loop of the pre-deposited FePt(001)/Pt(001)/Cr (002) layer sequence according to the present invention. It is apparent that the FePt(001)/Pt(001)/Cr(002) layer sequence exhibits a perpendicular magnetic anisotropy with an out-plane squareness (SL) of about 0.8, and the Ms and $Hc^{\perp}$ values are about 691 emu/cm^3 and 3100 Oe, respectively.

[0070] Please refer to FIG. **5**, which is a diagram illustrating the Ms value variation and the $Hc^{\perp}$ value variation of the HAMR medium depending on the thickness of the $Co_{70}Tb_{30}$ layer thereof in accordance with the present invention. As the $Co_{70}Tb_{30}$ film thickness increases from 20 to 60 nm, the $Hc^{\perp}$ value of the $Co_{70}Tb_{30}$/FePt(001)/Pt/Cr layer sequence may increase from about 2100 to 5700 Oe, and the Ms value thereof may decrease from 530 to 365 emu/cm^3. For the HAMR medium, a relatively large $Hc^{\perp}$ and Ms value at room temperature is always required, and hence the $Co_{70}Tb_{30}$ layer with a thickness of 50 nm is preferred in this case, which is deposited on the FePt(001) magnetic layer in the preferred embodiment.

[0071] Please refer to FIG. **6**, which is a diagram showing the M-H loop of the fabricated $Co_{70}Tb_{30}$/FePt(001)/Pt/Cr layer sequence after the $L1_0$ FePt(001) preferred orientation layer is introduced into the $Co_{70}Tb_{30}$ layer whose thickness is 50 nm thereof. It shows that the $Hc^{\perp}$, Ms, $S^{\perp}$ and in-plane squareness ($S_{\parallel}$) of the fabricated layer sequence are 54500e, 403 emu/cm^3, 0.82 and 0.38, respectively. Moreover, with reference to FIG. **7** showing the respective M-H loops of a $Co_{70}Tb_{30}$ single layer, a FePt(001) layer and the fabricated $Co_{70}Tb_{30}$/FePt(001)/Pt/Cr layer sequence, it reveals that the Ms value of fabricated $Co_{70}Tb_{30}$/FePt(001)/Pt/Cr (Ms=403 emu/cm^3) is ranged between those of the $Co_{70}Tb_{30}$ single layer (Ms=176 emu/cm^3) and the FePt layer (Ms=691 emu/cm^3). Since the $Co_{70}Tb_{30}$ layer exhibit a ferrimagnetic property, and the FePt layer exhibits a ferromagnetic one, as well as the Ms value is defined as the moments in the domain of a material per unit volume, the Ms value of the fabricated

$CO_{70}Tb_{30}$/FePt(001)/Pt/Cr layer sequence is thus ranged between those of the $Co_{70}Tb_{30}$ layer and the FePt(001)/Pt/Cr layer. On the other hand, the $Hc^{\perp}$ value of the $CO_{70}Tb_{30}$/FePt (001)/Pt/Cr layer sequence is larger than those of the $Co_{70}Tb_{30}$ layer and the FePt(001) layer. This is because there exists a large exchange coupling energy (about 2.75 erg/cm^2) at the interface between the $Co_{70}Tb_{30}$ and the FePt(001) layers. The exchange coupling of $Co_{70}Tb_{30}$/FePt(001) layer sequence is derived from the following equation:

$$\Delta\sigma = H_b \times M_s \times t, \quad (1)$$

[0072] where the H_b is the biasing field, Ms is the saturation magnetization of $Co_{70}Tb_{30}$ layer and t is the thickness of FePt(001) layer. Therefore, owing to a relatively large $\Delta\sigma$, it becomes more difficult to reorient the moment of the $CO_{70}Tb_{30}$/FePt(001)/Pt/Cr layer sequence than that of the $Co_{70}Tb_{30}$ or FePt(001) single layer.

[0073] With reference to FIG. **8** which is a TEM photo showing the cross-sectional view of the fabricated $CO_{70}Tb_{30}$/FePt(001)/Pt/Cr layer sequence, it reveals that the interface between the $Co_{70}Tb_{30}$ and FePt(001) layers is rough. Such roughness would create some areas of different domain orientations, and thus the uncompensated surfaces are increased. The more the uncompensated areas exist, the larger exchange interaction could be obtained.

[0074] Please refer to FIG. **9**, which is a diagram illustrating the Ms value variation and the $Hc^{\perp}$ value variation of the $Co_{70}Tb_{30}$/FePt(001) layer sequence of the HAMR medium depending on the temperature in accordance with the present invention. It shows that the Ms value of the fabricated $Co_{70}Tb_{30}$/FePt(001) layer sequence almost keeps at a constant of about 400 emu/cm^3, even the temperature increases from the ambient temperature to 200° C., while the $Hc^{\perp}$ value thereof decreases from 5450 to 7300e. Such rapid decrement of $Hc^{\perp}$ value exactly satisfies the requirement for writing for the HAMR medium.

[0075] Through the present invention, a novel heat assisted magnetic recording (HAMR) medium and the fabrication method therefor are provided. The exchange coupling effect occurring at the interface of FePt/CoTb double layers is adopted, so that domains of the recording layer would be reproduced to the readout layer, and thus the resulting magnetic flux would be sufficient enough to be detected and readout under the room temperature. The provided HAMR medium exhibits a relatively high saturation magnetization and perpendicular coercivity, and thus possesses a great potential for the ultra-high density recording application.

[0076] Therefore, the present invention not only has the novelty and the progressiveness, but also has an industry utility.

[0077] While the invention has been described in terms of what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention needs not be limited to the disclosed embodiments. On the contrary, it is intended to cover various modifications and similar arrangements included within the spirit and scope of the appended claims which are to be accorded with the broadest interpretation so as to encompass all such modifications and similar structures.

What is claimed is:

1. A method for fabricating a heat assisted magnetic recording medium, comprising steps of: (a) providing a substrate; (b) performing a thermal process to said substrate; (c) forming an underlayer of Cr on said substrate; (d) forming a buffer layer of Pt on said underlayer; (e) forming a layer of Fe_xPt_{100-x} on said buffer layer; and(f) forming a layer of Co_yTb_{100-y} on said layer of Fe_xPt_{100-x}.

2. The method according to claim **1**, wherein said step (b) further comprising a step of: heating said substrate to a first temperature.

3. The method according to claim **2**, wherein said first temperature is less than 800° C.

4. The method according to claim **3**, wherein said first temperature is 350° C.

5. The method according to claim **2**, wherein in said step (b), said thermal process is performed for 5 to 90 minutes.

6. The method according to claim **6**, wherein in said step (b), said first temperature is 350° C., and said thermal process is performed for 30 minutes.

7. The method according to claim **1**, wherein in said step (b), said thermal process is performed under a pressure ranged from 1×10^{-9} to 1×10^{-6} Torr.

8. The method according to claim **1**, wherein in said step (c), said buffer layer of Cr is formed on said substrate under a temperature of 350° C.

9. The method according to claim **1**, wherein in said step (d), said buffer layer of Pt is formed on said underlayer under a second temperature below 800° C.

10. The method according to claim **9**, wherein said second temperature is 350° C.

11. The method according to claim **1**, wherein in said step (e), said layer of Fe_xPt_{100-x} is formed on said buffer layer under a third temperature below 800° C.

12. The method according to claim **11**, wherein said third temperature is 420° C.

13. The method according to claim **1**, wherein in said step (f), said layer of Co_yTb_{100-y} is formed on said layer of Fe_xPt_{100-x} under a fourth temperature below 50° C.

14. The method according to claim **13**, wherein said fourth temperature is an ambient temperature.

15. The method according to claim **1**, wherein said underlayer of Cr, said buffer layer of Pt, said layer of Fe_xPt_{100-x} and said layer of Co_yTb_{100-y} are formed by DC magnetron sputtering in an ultrahigh vacuum sputtering chamber.

16. The method according to claim **15**, wherein said underlayer of Cr, said buffer layer of Pt, said layer of Fe_xPt_{100-x} and said layer of Co_yTb_{100-y} are deposited under an argon pressure ranged from 2 to 12 mTorr.

17. The method according to claim **16**, wherein said argon pressure is 5 mTorr.

18. The method according to claim **16**, wherein said layer of Fe_xPt_{100-x} is deposited by DC magnetron sputtering with a first DC power ranged from 0.2 to 0.5 W/cm^2.

19. The method according to claim **18**, wherein said first DC power is 0.22 W/cm^2.

20. The method according to claim **15**, wherein said layer of Co_yTb_{100-y} is deposited by DC magnetron sputtering with a second DC power ranged from 1 to 4 W/cm^2.

21. The method according to claim **20**, wherein said second DC power is 2.96 W/cm^2.

22. The method according to claim **1**, further comprising a step of: (g) forming a passiviation layer on said layer of Co_yTb_{100}-y.

23. The method according to claim **22**, wherein said passiviation layer is formed by magnetron sputtering with an RF power ranged from 2 to 7 W/cm^2.

24. The method according to claim **23**, wherein said RF power is 2.47 W/cm^2.

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