reproducibility of the transfer curve is lost. **FIG. 8** shows the example. When hysteresis is generated in the magnetized state of the free layer near the externally applied magnetic field at zero, deviation due to the hysteresis is generated also on the transfer curve. Assuming the deviation as a and the change of the magnetic resistance as ΔR, the ratio Vhc=a/R is used as a characteristic value indicative of a degree of the deviation on the transfer curve. It has been well-known that in a case where the residual magnetization of the magnetic domain control film is small and thereby the bias magnetic field is insufficient, the manufacturing conditions for the free layer are not appropriate, or the magnetic properties of the magnetic domain control film are worsened, the deviation of the transfer curve increases. It is estimated that deviation is generated for the transfer curve, since the magnetic domain of the free layer takes a complicated magnetic domain state at the zero magnetic field because the magnetic domain control bias magnetic field is not appropriate (**FIG. 8**(*a*)). On the contrary, the transfer curve is closed when the magnetization state of the zero magnetic field of the free layer is univalent and has reproducibility.

[**0095**] On the other hand, Vhc and ΔR of the transfer curve substantially correspond to the output characteristic of the reading head when write/read operation is conducted on a magnetic recording medium as an actual magnetic head (head sensitivity, waveform fluctuation, etc.) and noise preparation. Those of small Vhc and less deviation of the transfer curve are excellent in noise properties. Accordingly, for the same stack of magnetoresistive layers, it can be evaluated whether the bias magnetic field is appropriate or not by the evaluation for Vhc.

[**0096**] Then, the oxidation process on the surface of the NiTa amorphous was investigated. In Embodiment 1, while the surface oxidation of the NiTa amorphous layer was conducted by a method of atmospheric exposure, an oxygen gas is introduced in a vacuum and the surface of NiTa amorphous is oxidized in an oxygen atmosphere in order to make the accuracy of the oxidation process higher in this case. In this method, the state of surface oxidation can be controlled easily by controlling the gas pressure of the oxygen atmosphere in a vacuum and exposure time of the NiTa amorphous film to the oxygen atmosphere.

[**0097**] **FIG. 9** shows the change of the magnetic properties when the exposing time to the oxygen atmosphere was changed. Thin films were formed under the same conditions as those for other thin film forming conditions in Embodiment 1, while changing the thickness of the NiTa amorphous film to 5 nm, the thickness of the Cr film to 5 nm and the thickness of the CoCrPt alloy thin film to 10 nm. As the oxygen atmosphere, a gas formed by mixing 10% O_2 in an Ar gas was introduced in a vacuum after forming the NiTa amorphous film. The gas pressure was set to 10 mTorr. Then, a CoCrPt/Cr film is formed. The magnetic properties are measured by a convenient type magnet meter and the squareness of the magnetization curve develops in SFD (Switching Field Distribution). When the squareness is higher, the SOD shows a lower value. The values for the coercivity Hc and the residual magnetization Brt are correlated with the measurement for VSM in which values calibrated for VSM measurement are used. Further, substrates were comparatively evaluated for 7059 glass substrates manufactured by Corning, and substrates formed by applying ion beam etching after forming a stack of magnetoresistive layers-thin film to expose an MnPt film as an anti-ferromagnetic film **4**, on which were deposited an NiTa thin film as a magnetic domain control amorphous film **9** and a CoCrPt/Cr thin film after the oxidizing treatment.

[**0098**] The coercivity increases once as the oxidation time for the NiTa amorphous film increases and then the coercivity lowers as oxidation proceeds. At the oxidation time of 30 sec, the coercivity value is the highest as 1500 (Oe) and the SFD value shows the lowest value. There was no difference in the magnetic properties between those on the 7059 substrate and on MnPt. Under the oxidation condition in atmospheric exposure shown in Embodiment 1, the coercivity value shows a high value and the SFD value is also high.

[**0099**] Then, to confirm the effect of the present invention when the track is narrow, a head with decreased residual magnetization of the magnetic domain control film was prepared to evaluate the head properties. An investigation was conducted while setting the track width to 100 nm and the residual magnetization of the magnetic domain control film CoCrPt to 100 Gμm. The sample was prepared by using the preparing method described above. Conditions that were changed are collectively shown in Table 2. Ion beam etching was stopped at the instance the MnPt layer was over-etched by 2.5 nm. For comparison, those of the existent structure (sample #7), with no NiTa amorphous film and Cr underlayer (sample #6), and with no NiTa amorphous layer (sample #1) were prepared and evaluated for comparison. Further, as the surface oxidation conditions for the NiTa amorphous film, those conditions with no oxidation, oxidation for 30 sec, oxidation for 120 sec and atmospheric exposure were selected (samples #2, 3, 4 and 5). The magnetic properties under the conditions correspond to those of **FIG. 9** in which the sample under the oxidation condition of 30 sec has the best magnetic properties.

[**0100**] Reading heads were prepared under the conditions described above and the transfer curve was measured for evaluating the magnetic domain control bias magnetic field. The result is shown in **FIG. 10**. The resistance value R was substantially equal with that of the existent structure (sample #8). It can be seen that the Vhc value showing the intensity of the magnetic domain control bias magnetic field is lowest in the sample having the best magnetic properties under the oxidation condition for 30 sec to provide a good transfer curve. It can be seen that Vhc is high and the deviation is generated for the transfer curve in those of the existent structure (sample #7), with no underlayer (sample #6) and with no NiTa film (sample #1). Further, Vhc increases, regarding the surface oxidation condition for the NiTa film, in order of oxidation for 30 sec, with no oxidation, oxidation for 150 sec and atmospheric air oxidation.

[**0101**] In a case where the residual magnetization of the magnetic domain control film CoCrPt is reduced to 100 Gμm, Vhc in the head of the existent structure (sample #7) is high. This is due possibly to the fact that the bias magnetic field is not appropriately applied to the free layer since the vertical positions of the magnetic domain control film and the free layer are greatly deviated from each other. Vhc is high of those with no NiTa magnetic domain control amorphous film and Cr underlayer (sample #6) and with no NiTa film (sample #1). This is due possibly to the fact that no sufficient magnetic properties of the magnetic domain con-