it is extremely difficult to control the amount of overhang describe above or control the direction of the Co polycrystal in the direction within the film plane. Accordingly, it is probable that the crystal orientation of the Co film at present provides a structure capable of obtaining better magnetic domain control bias magnetic field in a case of the isometric orientation shown by State B in **FIG. 6**, or Co(10.0), Co(00.2), Co(11.0) mixed crystal orientation of State of A1 in **FIG. 6**.

[**0105**] Then, reading head properties of the trial head of sample #3 in Table 2 was evaluated. As a result, a thin film head having output sensitivity properties of about twice that of the existent structure, and with less output fluctuation and less Barkhausen noise and read noise could be obtained. As a result of TEM (Transmission Electron Microscopy) observation for the cross sectional shape of the sample, the angle of inclination at the end of the free layer was from 45° to 55°. Also in the existent structure head, it has been known that the angle of inclination at the end of the free layer gives a significant effect on the bias magnetic intensity because of no application of a bias magnetic field to the free layer and it has been considered that at least 45° or more of the angle is necessary. While the angle at the end of the free layer of the head prepared by the identical process is about 65° to 75°, the angle at the end of the free layer of the head having the structure of the present invention is as small as about 45° to 55°, but it has been found that the structure can be applied with a sufficient bias magnetic field. However, the angle of inclination at the end of the free layer should be more abrupt.

[**0106**] In the existent structure, the residual magnetization of the magnetic domain control film could be decreased only to about 200 Gμm, but it can be lowered to 80 Gμm in the present invention and this can contribute by so much for the improvement of the sensitivity. Further, as a result of evaluation for the degree of the dead area, it has been found that this was 70 μm in the existent structure whereas it is decreased to one-half as about 40 nm in the present invention and it has been found that this is a technique essential for the narrow track reading head.

EMBODIMENT 3

[**0107**] **FIG. 4** is a view schematically showing a positional relation between a pinned layer ferromagnetic body, a free layer and a magnetic domain control film at the end of a stack of magnetoresistive layers and bias magnetic field magnetic fluxes. (a) is a view in a case of a structure corresponding to **FIG. 2** which shows that the central height **19** of the free layer and the central height of the magnetic domain control film coincide with each other. (b) is a view in a case corresponding to **FIG. 1**, showing that the central height of the free layer and the central height **20** of the magnetic domain control film coincide with each other. (c) is a view in a case corresponding to an existent structure in **FIG. 3** and showing that the central height of the free layer and the central height of the magnetic domain control film do not coincide with each other. Symbols "+" and "−" schematically show magnetic charges generated due to the tapered shape of the magnetic domain control film in the inclined portion at the end of the free layer. A blank arrow H represents a magnetization direction of the magnetic domain control film and a gray arrow Hd shows a demagnetizing field formed due to the tapered shape of the magnetic domain control film in the inclined portion at the end of the free layer. Symbol α represents an angle of inclination at the end of the free layer and it should be noted that the angle at the lower phase of the tapered shape in the magnetic domain control field of the inclined portion at the end of the free layer is an angle approximate to α. S represents a gap distance between the end of the free layer and the side of the magnetic domain control film. The angle at the tapered lower surface of the magnetic domain control film of the inclined portion at the end of the free layer and the gap distance S between the end of the free layer and the lateral side of the magnetic domain control film depend on the process for forming the magnetic domain control amorphous film and the magnetic domain control underlayer.

[**0108**] Next, the effect of the forming conditions of the NiTa amorphous film and the Cr underlayer on the magnetic properties of the magnetic domain control film and the head properties was examined.

[**0109**] **FIG. 12** shows the dependence of the magnetic properties on the Cr film thickness when the CoCrPt/Cr thin film is formed on the NiTa amorphous film. The thickness of the NiTa amorphous film is 5 nm, and, the oxidation time condition for 30 sec determined in Embodiment 2 is selected for the oxidation condition thereof. The thickness of the CoCrPt alloy film was 10 nm. A substrate was used which was prepared by forming a stack of magnetoresistive layers-thin film on a 7059 glass substrate and then etching as far as the MnPt film by ion beam etching. It has been found that the magnetic properties are deteriorated at the Cr underlayer thickness of 2.5 nm or less.

[**0110**] **FIG. 13** shows the dependence of the magnetic properties on the Nita amorphous film thickness when the CoCrPt/Cr thin film is formed on the NiTa amorphous film. The thickness of the Cr underlayer is 5 nm, and the oxidation time condition for 30 sec determined in Embodiment 2 is selected for the oxidation condition thereof. The thickness of the CoCrPt alloy film was 10 nm. A substrate was used which was prepared by forming a stack of magnetoresistive layers-thin film on a 7059 glass substrate and then etching as far as the MnPt film (an anti-ferromagnetic layer **4** constituting the pinned layer) by ion beam etching. It has been found that the magnetic properties are deteriorated at the thickness of the NiTa amorphous film **9** of less than 1.5 nm.

[**0111**] In a case where the NiTa amorphous film or the Cr underlayer is thin, when the orientation of Co crystals is examined, it shows intense orientation of Co(00.2) orientation and the C axis is directed to the direction vertical to the film plane and the coercivity, etc. are lowered. When the NiTa amorphous film or the Cr underlayer is thin, the crystallinity thereof is lowered and crystal orientation of the Co alloy magnetic film can no longer be controlled.

[**0112**] Since good magnetic properties can be obtained also when the thicknesses of the Ni amorphous film and the Cr underlayer are 1.5 nm and 2.5 nm, respectively, a head was prototyped under the condition for the underlayer thickness and the head properties were evaluated. While the average value of Vhc was 0.04 in the head under the condition of sample #3 in Embodiment 2, the sample reduced with the film thickness showed a value of 0.02 and a head of good reproducibility with the hysteresis deviation of the transfer curve was further decreased was obtained. This is because the gap distance between the free layer **7** and the magnetic domain control film **11** shown in FIGS. **4**(*a*)