case where the magnetic domain control amorphous layer was present, whereas Vhc was 0.035 in a case of no magnetic domain control amorphous layer. Accordingly, it has been formed that the magnetic properties of the Co alloy magnetic domain control film **11** present in the portion of the slope gives an effect on the stability of the magnetic domain control bias magnetic field. In the existent system, the properties of the Co alloy magnetic domain control film cannot be improved in the inclined portion, and the characteristic instability of the magnetic domain control field in the inclined portion cannot be eliminated.

[0129] A head with the residual magnetic flux density being reduced to 100 Gμm was prototyped by applying the magnetic domain control film **11** of a structure of this embodiment to a top spin valve film to confirm the effect of improving the output and the effect of suppressing noise. The Co alloy magnetic domain control film **11** in this case has crystallographic orientation of State B in **FIG. 6**. It is probable, from the result of the experiment showing that the magnetic properties of the Co alloy magnetic film formed at the inclined portion of the stack of magnetoresistive layers and the crystallographic orientation of the Co alloy magnetic domain control film give effects on the stability of the magnetic domain control bias magnetic field, that the shape and the crystal orientation of the magnetic domain control film **11** have a strong correlation to determine the bias magnetic field. In the current technique, the shape of the Co alloy magnetic film formed to the inclined portion of the stack of magnetoresistive layers is in the shape of covering the free layer end and a shape of the Co alloy magnetic film completely disposed at the end of the free layer cannot be formed. In the case of the shape covering the end of the free layer at present, it is considered that the isometric orientation is preferred for the crystallographic orientation of the Co alloy magnetic domain control film.

[0130] If the shape of the magnetic domain control film can be optimized in the feature, it may be the possibility that the orientation of the C axis of the Co alloy film is preferably in the film plane for the crystallographic orientation of the Co alloy magnetic domain control film. Anyway, it is possible to control the crystallographic orientation of the Co alloy magnetic domain control film by the manufacturing method disclosed in the present invention and it is possible to optimize the magnetic domain control film structure.

[0131] As described above, by the use of the reading head having the magnetic domain control structure described above, it is possible to easily provide a magnetic head having high sensitivity and good noise properties and it is possible to easily supply a magnetic recording apparatus of high recording density.

[0132] Embodiments 6 and 7 describe the effectiveness in a case of applying the structure and the manufacturing method of the magnetic domain control film disclosed in the present invention in a case where the types of the stack of magnetoresistive layers are different from each other. On the other hand, development of the utilizing the TMR effect or development of the stack of magnetoresistive layers of new structure has been progressed rapidly in recent years. The main purpose of the present invention concerns a structure of applying an optimal magnetic domain control bias magnetic field to the free layer of the stack of magnetoresistive layers having at least the pinned layer and the free layer, and the present invention is applicable to various magnetic domain control systems of the stacks of magnetoresistive layers. Accordingly, it should be recognized that the present invention is a useful technique that can be applied easily to the stack of magnetoresistive layers of the TMR system or to the stack of magnetoresistive layers having a pinned layer with no anti-ferromagnetic material.

[0133] By the use of the magnetic domain control system for the free layer of the magnetoresistive head as in the present invention, it is possible to attain a magnetoresistive head having good noise properties and high stability while possessing high sensitivity also to a narrow stack as compared with the device of the existent magnetic domain control method.

What is claimed is:

1. A magnetoresistive sensor comprising:

a stack of magnetoresistive layers including an anti-ferromagnetic layer, a pinned layer, a non-magnetic layer, and a free layer;

an underlayer of said stack of magnetoresistive layers;

a magnetic domain control film; and

a pair of electrode films for supplying current to said stack of magnetoresistive layers;

wherein a center position of an upper surface and a lower surface of said magnetic domain control film is positioned within a range of an upper surface and a lower surface of said free layer; and

further comprising:

an underlayer formed below said magnetic domain control film; and

an amorphous metal film layer formed below said underlayer for controlling crystallization of said underlayer.

2. A magnetoresistive sensor according to claim 1, wherein

said stack of magnetoresistive layers comprises said underlayer, said anti-ferromagnetic layer, said pinned layer, said non-magnetic layer, said free layer and a protection layer formed in this order from the lower layer to the upper layer.

3. A magnetoresistive sensor according to claim 1, wherein

said stack of magnetoresistive layers comprises said underlayer, said anti-ferromagnetic layer, said pinned layer, said non-magnetic layer, said free layer, said upper non-magnetic layer, said upper pinned layer, said upper anti-ferromagnetic layer and a protection layer formed in this order from the lower layer to the upper layer.

4. A magnetoresistive sensor according to claim 1, wherein

said stack of magnetoresistive layers comprises said underlayer, said free layer, said upper non-magnetic layer, said upper pinned layer, said upper anti-ferromagnetic layer and a protection layer formed in this order from the lower layer to the upper layer.

5. A magnetoresistive sensor according to claim 1, wherein