invention showing the position relation between the magnetic domain control layer having high electric resistivity and the magnetoresistive sensor layer;

[0024] **FIG. 6** is a cross-sectional view of the media-opposed surface side of Example 1 (4) of the present invention showing the position relation between the magnetic domain control layer having high electric resistivity and the magnetoresistive sensor layer;

[0025] **FIG. 7** is a cross-sectional view of the media-opposed surface side of Example 4 of the present invention showing the position relation between the magnetic domain control layer having high electric resistivity and the magnetoresistive sensor layer;

[0026] **FIG. 8** is a diagram showing the sectional structure of the media-opposed surface side of the magnetoresistive sensor of Example 5 of the present invention and the position of the magnetic domain control layer;

[0027] **FIG. 9** is a cross-sectional view of the depth direction of the magnetoresistive sensor of Example 5 of the present invention;

[0028] **FIG. 10** is a three-dimensional block diagram showing the structure of the exposed type magnetoresistive sensor of Examples 1 and 5 of the present invention;

[0029] **FIG. 11** is a block diagram schematically showing one example of the yoke structure shown in Example 5 of the present invention and the position of the magnetic domain control layers of the present invention to magnetic domain-control this;

[0030] **FIG. 12** is one example of the position of the magnetic domain control layers of the yoke structure shown in Example 5 of the present invention;

[0031] **FIG. 13** is one example of the position of the magnetic domain control layers of the yoke structure shown in Example 5 of the present invention;

[0032] **FIG. 14** is a block diagram schematically showing one example of the flux guide type yoke structure shown in Example 5 of the present invention and one example of the position of the magnetic domain control layers of the present invention to magnetic domain-control this;

[0033] **FIG. 15** is a diagram showing one example of the shape of the flux guide type yoke of Example 5 of the present invention, and one example of the position relation between the same and the magnetoresistive sensor;

[0034] **FIG. 16** is a diagram showing one example of the shape of the flux guide type yoke of Example 5 of the present invention, and one example of the position relation between the same and the magnetoresistive sensor layer;

[0035] **FIG. 17** is one example of the position of the magnetic domain control layers of the yoke structure shown in Example 5 of the present invention;

[0036] **FIG. 18** is one example of the position of the magnetic domain control layers of the yoke structure shown in Example 5 of the present invention;

[0037] **FIG. 19** is a schematic diagram of the structure and operation of a magnetic disk apparatus of Example 6 of the present invention;

[0038] **FIG. 20** is a side view of one example of the structure of MRAM using the magnetoresistive sensor layer provided with the magnetic domain control layers having high electric resistivity of the present invention;

[0039] **FIG. 21** is a diagram of **FIG. 20** viewed perpendicular to the substrate surface (representing state "1"); and

[0040] **FIG. 22** is a diagram in which the direction of an electric current flowing through the conductive line is shifted 90 degrees from that of **FIG. 21** (representing state "0").

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0041] Embodiments of the present invention will be described based on the examples with reference to the drawings.

Example 1

[0042] **FIGS. 1 and 2** are diagrams showing the structure of a magnetoresistive sensor as one embodiment according to the present invention viewed from the media-opposed surface and section of the plane perpendicular to the depth direction, respectively. Arrow **110** in the drawing denotes the depth direction.

[0043] On a substrate **101** is formed a base insulating layer **102**, made of, for example, alumina. After subjected to precision polishing by means of chemimechanical polishing (CMP), a lower magnetic shield layer **103** is formed thereon. This is made of Ni81Fe19 having a thickness of 2 μm manufactured by, for example, the sputtering method, the ion beam sputtering method, or the plating method. A resist mask is patterned in a predetermined size in this layer, and other portions thereof are subjected to ion milling to strip off the resist. Al2O3 is grown thereon to fill in portions **104** removed by ion milling. After this is subjected to CMP, an electrode layer made of Cu or Ru (not shown) is grown by 20 nm, so as to form a drawing electrode layer **111** in a portion away from the sensor portion. This is, for example, a layer made of Ta, Au and Ta.

[0044] A lift-off pattern is formed in a region on the previous electrode layer consisting of a magnetoresistive sensor layer, so as to form thereon a layer having a thickness of 150 nm made of a mixture of Al2O3 and SiO2. This may be a single phase layer made of Al2O3 or SiO2. After lifting this off, a magnetoresistive sensor layer **105** is formed. In the magnetoresistive sensor layer, there are studied as the examples two types of using GMR and of using TMR. An electric current for sensing a signal (sensing current) is flowed perpendicular to the plane of these magnetoresistive sensor layers (Current Perpendicular to the Plane: CPP)

[0045] A GMR layer comprises, for example, from the lower side, a Co48Mn52 anti-ferromagnetic layer of 12 nm, a pinned layer consisting of Co of 1 nm, Ru of 0.8 nm and Co of 2 nm, a free layer consisting of Cu of 2 nm, Co of 0.5 nm and Ni81Fe19 of 2.5 nm, and Ta of 3 nm. With respect to the anti-ferromagnetic layer, in the case of using a regular anti-ferromagnetic layer of a PtMn system, anneal is required in order to exhibit the exchange bonding between the pinned layer and the anti-ferromagnetic layer. The magnetic field of the pinned layer is directed in the in-plane direction orthogonal to the depth.