[0121] A magnetic head corresponding to **FIG. 15** was manufactured and magnetic recording operation was conducted to a magnetic recording medium to evaluate characteristics of read signals. As a result, it was confirmed that the read output intensity was increased and the signal noise were suppressed sufficiently.

EMBODIMENT 6

[0122] There are known three types of a stack of magnetoresistive layers depending on the system of arranging the pinned layer and the free layer. That is, the stack of magnetoresistive layers is classified into three types: a bottom spin-valve film (BSV film) in which a pinned layer is disposed as a lower portion and a free layer is disposed as an upper layer by way of an non-magnetic layer; a top spin valve film (TSV film) in which a free layer is disposed as a lower portion and a pinned layer is disposed as an upper layer by way of a non-magnetic layer; and a dual spin valve film (DSV film) in which fixed layers are disposed as a lower portion and an upper portion respectively and a free layer is disposed as a central portion by way of a lower non-magnetic layer and an upper non-magnetic layer. They have their respective features.

[0123] Embodiments 1, 2, 3, 4 and 5 are examples in a case where the structure of the stack of magnetoresistive layers is a bottom spin valve film. **FIG. 16** shows a structure in a case where the stack of magnetoresistive layers is a dual spin valve film. In the dual spin valve film, since the layer developing the magnetoresistive effect is at a boundary between an upper portion and a lower portion of the free layer, it has a structure capable of increasing the magnetic resistance change coefficient and capable of easily obtaining symmetry of signal waveforms, so that the stack of magnetoresistive layers can be used for a magnetic disk drive requiring high signal quality.

[0124] The stack of magnetoresistive layers of a dual spin valve film shown in **FIG. 16** has a structure in which an underlayer **3**, a lower anti-ferromagnetic layer **4**, a lower pinned layer **5**, a lower non-magnetic layer **6**, a free layer **7**, an upper non-magnetic layer **6U**, an upper pinned layer **5U**, an upper anti-ferromagnetic layer **4U** and a protection film layer **8** are formed in this order from the lower layer to the upper layer. In the same manufacturing method as the manufacturing method shown in **FIG. 5**, after applying a photoresist on the stack of magnetoresistive layers, etching is conducted as far as the lower anti-ferromagnetic layer by the ion beam etching method. Subsequently, a magnetic domain control film amorphous layer **9**, a magnetic domain control underlayer **10**, a magnetic domain control film layer **11**, and an electrode film layer **12** are formed successively. The vertical positions of the free layer in the stack of magnetoresistive layers and the magnetic domain control film can be aligned with each other by adjusting the position of etching depth for etching during the beam etching and the film thickness of each of the magnetic domain control film amorphous layer **9**, the magnetic domain control underlayer **10** and the magnetic domain control film layer **11**. Further, the magnetic properties and the crystallographic orientation of the magnetic domain control film can be controlled by the method shown in Embodiments 2, 3 and 4, so that the magnetic domain control bias magnetic field can be optimized.

[0125] A head with the residual flux density being reduced to 100 Gμm was prototyped by applying the magnetic domain control film of the structure described above to the dual spin valve film, and the effect for the improvement of the output and the effect of suppressing noise could be confirmed.

EMBODIMENT 7

[0126] **FIG. 17** shows a structure in which the stack of magnetoresistive layers is a top spin valve film. The stack of magnetoresistive layers of the top spin valve film in **FIG. 17** has a structure in which an underlayer **3**, a free layer **7**, an upper non-magnetic layer **6U**, an upper pinned layer **5U**, an upper anti-ferromagnetic layer **4U** and a protection film **8** are formed in this order from the lower layer to the upper layer. The magnetic domain control bias magnetic field can be optimized by the same manufacturing method and the structure of the stack of magnetic domain control layers as those in the bottom spin valve film or the dual spin valve film. That is, by the same manufacturing method as shown in **FIG. 5**, after applying a photoresist on the stack of magnetoresistive layers, etching is conducted as far as the lower gap layer **2** by an ion beam etching method. In this case, the etching depth may reach the underlayer **3** for the purpose of aligning the vertical positions of the free layer and the magnetic domain control film with each other. Then, a magnetic domain control film amorphous layer **9**, a magnetic domain control film underlayer **10** and a magnetic domain control film layer **11** and an electrode film **12** are successively formed. The vertical positions of the free layer **7** of the stack of magnetoresistive layers and the magnetic domain control film **11** can easily be aligned with each other by adjusting the position for etching depth for etching during ion beam etching and the film thickness for each of the layers of the magnetic domain control film amorphous layer **9** and the magnetic domain control film underlayer **10** and the magnetic domain control film layer **11**.

[0127] In a case of the top spin valve film structure, the free layer **7** is disposed at a lower portion near the lower gap film. Further, Al_2O_3 or Al_2O_3=SiO_2 amorphous insulative film is often used for the lower gap film. Further, magnetic properties of the CoCrPt alloy film and the Cr alloy underlayer used as the magnetic domain control film are obtained easily on the amorphous insulative film Al_2O_3 or Al_2O_3=SiO_2, and the crystallographic orientation is also in the state of State A1 in **FIG. 6**. Accordingly, this is a structure in which the Co alloy magnetic domain control film **11** of good magnetic properties can be easily disposed at a position in the vicinity of the free layer **7** even when the magnetic domain control amorphous film is not disposed and in which the alignment of the vertical positions is easy. However, it is estimated that the magnetic properties of the Co alloy magnetic domain control film present on the inclined surface at the end of the stack of magnetoresistive layers are lowered and it is easily estimated that the characteristic instability of the magnetic domain control film due to the inclined portion is not removed.

[0128] Then, reading heads with and without magnetic domain control amorphous layer in the top spin valve film were prepared and magnetic resistance transfer curve was measured to evaluate the magnetic domain control bias magnetic field. In this case, the residual magnetic flux density is 100 Gμm and the vertical positions of the free layer **7** and the magnetic domain control film **11** are aligned with each other. As a result, the Vhc value was 0.015 in a