[0162] Further, another reason why such large GMR was attained was found to be contributed by the fact that, as mentioned above, resistivity of $Co_2Fe_{0.5}Cr_{0.5}Al$ thin film used as a pin layer and a free layer was equal to that of an antiferromagnetic layer **53** using IrMn.

[0163] It should be understood that the invention is by no way limited to the specific examples thereof set forth above, but to include all possible modifications that can be made within the scope with respect to the features specifically set forth in the appended claims and to encompass all the equivalents thereof.

INDUSTRIAL APPLICABILITY

[0164] A spin injection device of the present invention is capable of exhibiting the magnetization reversal with a low current density. Also, a spin injection magnetic apparatus of the present invention is capable of realizing the magnetization reversal of a free layer of MTJ by spin injection with even lower current density. Therefore, it is applicable to such various magnetic apparatuses and magnetic memory devices as super gigabit large capacity, high speed, non-volatile MRAM and the like.

[0165] Also, in accordance with the present invention, the magnetic thin film using $Co_2Fe_xCr_{1-x}Al$ ($0 \leqq x \leqq 1$) of either one of $L2_1$, B2, or A2 structures can be fabricated at room temperature without heating. Further, it shows the ferromagnetic property and the high spin polarizability.

[0166] Also, with a giant magnetoresistance effect device using $Co_2Fe_xCr_{1-xAl}$ ($0 \leqq x \leqq 1$) of either one of $L2_1$, B2, or A2 structures, extremely large GMR can be attained at room temperature in low external magnetic field. Also with a tunnel magnetoresistance effect device, quite large TMR can be similarly attained.

[0167] Further by applying various magnetoresistance effect devices of the present invention using $Co_2Fe_xCr_{1-x}Al$ ($0 \leqq x \leqq 1$) of either one of $L2_1$, B2, or A2 structures to such various magnetic apparatuses as the magnetic heads of super gigabit large capacity and high speed, or non-volatile and high speed MRAM and the like, novel magnetic apparatuses can be realized. In this case, since the saturation magnetization is small, the magnetic switching field by spin injection becomes small, and magnetization reversal can be realized with low power consumption, as well as it is applicable as the key material to open widely the field of spin electronics, as efficient spin injection to semiconductors becomes possible, and development of spin FET is also possible.

1. A spin injection device characterized in that it comprises a spin injection part having a spin polarizing part and an injection junction part,

and SyAF having a first magnetic layer and a second magnetic layer having different magnitudes of magnetization, and magnetically coupled together antiparallel to each other via a nonmagnetic layer, wherein:

said SyAF and said injection junction part are bonded, and

a spin polarization electron is injected from said spin injection part, and magnetization of said first and second magnetic layers is reversed while maintained in antiparallel state.

2. The spin injection device as set forth in claim 1, characterized in that the injection junction part of said spin injection part is either a nonmagnetic conductive layer or a nonmagnetic insulating layer.

3. The spin injection device as set forth in claim 1 or claim 2, characterized in that said spin polarization electron is capable of spin conservation conduction or tunnel junction at the injection junction part of said spin injection part.

4. The spin injection device as set forth in claim 1 or claim 2, characterized in that the spin polarization part of said spin injection part is a ferromagnetic layer.

5. The spin injection device as set forth in claim 1 or claim 2, characterized in that the spin polarization part of said spin injection part is provided in contact with an antiferromagnetic layer that fixes the spin of a ferromagnetic layer.

6. The spin injection device as set forth in claim 1 or claim 2, characterized in that the aspect ratio of the first and the second magnetic layers of SyAF in contact with the injection junction part of said spin injection parts is less than 2.

7. A spin injection magnetic apparatus characterized in that it comprises a free layer having the first and the second magnetic layers coupled together magnetically antiparallel to each other via a nonmagnetic layer, and in which magnitudes of magnetization are different, and the magnetization of said first and the second magnetic layers is capable of magnetization reversal while maintaining the antiparallel state, and

a ferromagnetic fixed layer tunnel-junctioned with said free layer via an insulating layer, wherein:

said ferromagnetic fixed layer and said free layer are made to be a ferromagnetic spin tunnel junction.

8. The spin injection magnetic apparatus as set forth in claim 7, characterized in that it is provided with, in addition to the above-mentioned aspects, a spin injection part having an injection junction part connected to said free layer and a spin polarization part.

9. The spin injection magnetic apparatus as set forth in claim 8, characterized in that the injection junction part of said spin injection part is either a nonmagnetic conductive layer or a nonmagnetic insulating layer.

10. The spin injection magnetic apparatus as set forth in claim 8 or claim 9, characterized in that said spin polarization electron is capable of spin conservation conduction or tunnel junction at the injection junction part of said spin injection part.

11. The spin injection magnetic apparatus as set forth in claim 8 or claim 9, characterized in that the spin polarization part of said spin injection part is a ferromagnetic layer.

12. The spin injection magnetic apparatus as set forth in claim 8 or claim 9, characterized in that the spin polarization part of said spin injection part is provided in contact with an antiferromagnetic layer that fixes the spin of a ferromagnetic layer.

13. The spin injection magnetic apparatus as set forth in any one of claims **7**, **8** or **9**, characterized in that the aspect ratio of the first and the second magnetic layers of the free layer in contact with the injection junction part of said spin injection part is less than 2.

14. The spin injection magnetic apparatus as set forth in claim 8 or claim 9, characterized in that said spin injection part is word line.