deformation in which the length of the c axis of the crystal lattice of the $L1_0$ type ordered structure, and the high magnetic anisotropy constant Ku and a high coercive force Hc are obtained by this deformation of the crystal lattice. The ordered alloy does not contain Sc in a higher oxidation state such as oxides of Sc, since it is difficult to be considered that the wording effect of this embodiment can be achieved by compounds of Sc in the higher oxidation state. This is because substitution of other atoms with the compounds of Sc in the higher oxidation state, or a process to deform the crystal lattice such as intrusion of the compounds of Sc in the higher oxidation state into the lattice hardly occurs in principle.

[0026] In this embodiment, all of the atoms in the ordered alloy do not necessarily possess the ordered structure. Instead, it is necessary that the degree of order S, which represents a level of the ordered structure, is not less than a predetermined value. The degree of order S is determined by measuring the magnetic thin film by an X-ray diffraction method (XRD), and calculating a ratio of the measured value to a theoretical value in a completely ordered state. For the $L1_0$ type ordered alloy, the degree of order S is calculated with integrated intensities of (001) and (002) peaks due to the ordered alloy. The degree of order S is determined by dividing a ratio of the measured integrated intensity of the (002) peak to that of the (001) peak, by a theoretically calculated ratio of the integrated intensity of the (002) peak to that of the (001) peak in the case where the ordered alloy is completely

ordered. If such obtained degree of order S is not less than 0.5, the ordered alloy will have a magnetic anisotropy constant Ku practical for the magnetic thin film.

[0027] The magnetic thin film of this embodiment may have a granular structure which consists of magnetic crystal grains consisting of the above-described ordered alloy and a non-magnetic crystal grain boundary. Here, the non-magnetic crystal grain boundary may comprise carbon (C), boron (B), an oxide and a nitride. The oxide useful in the non-magnetic crystal grain boundary includes SiO_2, TiO_2, and ZnO. The nitride useful in the non-magnetic crystal grain boundary includes SiN and TiN. In the granular structure, the magnetic crystal grains are magnetically separated from each other by the non-magnetic crystal grain boundary. When the magnetic thin film is used as the magnetic recording layer of a magnetic recording medium, this magnetic separation contributes improvement in SNR of the magnetic recording medium.

[0028] The magnetic thin film of this embodiment is preferably formed by a sputtering method involving heating of a substrate. Any method well known in the art, such as a DC magnetron sputtering method and an RF sputtering method can be used as the sputtering method. This is also the case for the description of "sputtering method" in the following explanation, unless otherwise described. The substrate temperature when forming the magnetic thin film is preferably within a range from 400°C to 500°C. By adopting the substrate temperature within this range, it becomes possible to improve the degree of order

deformation in which the length of the c axis of the crystal lattice of the $L1_0$ type ordered structure, and the high magnetic anisotropy constant Ku and a high coercive force Hc are obtained by this deformation of the crystal lattice. The ordered alloy does not contain Sc in a higher oxidation state such as oxides of Sc, since it is difficult to be considered that the wording effect of this embodiment can be achieved by compounds of Sc in the higher oxidation state. This is because substitution of other atoms with the compounds of Sc in the higher oxidation state, or a process to deform the crystal lattice such as intrusion of the compounds of Sc in the higher oxidation state into the lattice hardly occurs in principle.

[0026] In this embodiment, all of the atoms in the ordered alloy do not necessarily possess the ordered structure. Instead, it is necessary that the degree of order S, which represents a level of the ordered structure, is not less than a predetermined value. The degree of order S is determined by measuring the magnetic thin film by an X-ray diffraction method (XRD), and calculating a ratio of the measured value to a theoretical value in a completely ordered state. For the $L1_0$ type ordered alloy, the degree of order S is calculated with integrated intensities of (001) and (002) peaks due to the ordered alloy. The degree of order S is determined as a square root of a quotient of a ratio of the measured integrated intensity of the (001) peak to that of the (002) peak, by a theoretically calculated ratio of the integrated intensity of the (001) peak to that of the (002) peak in the case where the

ordered alloy is completely ordered. If such obtained degree of order S is not less than 0.5, the ordered alloy will have a magnetic anisotropy constant Ku practical for the magnetic thin film.

[0027] The magnetic thin film of this embodiment may have a granular structure which consists of magnetic crystal grains consisting of the above-described ordered alloy and a non-magnetic crystal grain boundary. Here, the non-magnetic crystal grain boundary may comprise carbon (C), boron (B), an oxide and a nitride. The oxide useful in the non-magnetic crystal grain boundary includes SiO_2, TiO_2, and ZnO. The nitride useful in the non-magnetic crystal grain boundary includes SiN and TiN. In the granular structure, the magnetic crystal grains are magnetically separated from each other by the non-magnetic crystal grain boundary. When the magnetic thin film is used as the magnetic recording layer of a magnetic recording medium, this magnetic separation contributes improvement in SNR of the magnetic recording medium.

[0028] The magnetic thin film of this embodiment is preferably formed by a sputtering method involving heating of a substrate. Any method well known in the art, such as a DC magnetron sputtering method and an RF sputtering method can be used as the sputtering method. This is also the case for the description of "sputtering method" in the following explanation, unless otherwise described. The substrate temperature when forming the magnetic thin film is preferably within a range from 400°C to 500°C. By adopting the substrate temperature within this range, it becomes possible to improve the degree of order