netoresistive effect in practice. The central portion of the multilayer film having an excellent reproduction gain is called a sensitive region, and the remaining portions, formed on both sides of the sensitive region, and having a poor reproduction gain, are called insensitive regions. The sensitive region and the insensitive regions are measured using a micro track profile method. Referring to **FIG. 31**, the micro track profile method is discussed.

[0067] As shown in **FIG. 31**, the conventional magnetoresistive-effect device (see **FIG. 33**), including the multilayer film exhibiting the magnetoresistive effect, the hard bias layers on both sides of the multilayer film, and the electrode layers formed on the hard bias layers, is formed on the substrate. The electrode layers are formed on only both sides of the multilayer film.

[0068] The width dimension A of the top surface of the multilayer film not covered with the electrode layers is measured through an optical microscope. The width dimension A is defined as a track width Tw measured through an optical method (hereinafter referred to as an optical track width dimension O-Tw).

[0069] A signal is recorded onto a micro track on the recording medium. A magnetoresistive-effect device is set to scan the micro track in the direction of a track width, and the relationship between the width dimension A and the reproduction output is measured. Alternatively, the recording medium having the micro track may be set to scan the magnetoresistive-effect device in the direction of the track width to measure the relationship between the width dimension A of the multilayer film and the reproduction output. The measurement results are shown in the lower portion of **FIG. 31**.

[0070] From the measurement results, the reproduction output rises high at the center of the multilayer film, and gets lower toward edges thereof. The central portion of the multilayer film exhibits an excellent magnetoresistive effect, and contributes to the reproduction capability, while edge portions of the multilayer film suffers from a poor magnetoresistive effect, resulting a low reproduction output with an insufficient reproduction capability.

[0071] The portion, having a width dimension B on the multilayer film and generating an output equal to or greater than 50% of a maximum reproduction output, is defined as the sensitive region, and the portion, having a width dimension C on the multilayer film and generating an output smaller than 50% of the maximum reproduction output, is defined as the insensitive region.

[0072] Since the insensitive region offers no effective reproduction capability, and merely raises a direct current resistance (DCR), the electrode layer is set to extend over the insensitive region in the present invention. In this arrangement, the junction areas of the multilayer film with the hard bias layers and the electrode layers, formed on both sides of the multilayer film, are increased. A sense current from the electrode easily flows into the multilayer film without passing through the hard bias layer, the direct current resistance is reduced, and the reproduction characteristics are thus improved.

[0073] As described above, when electrode layers **210** and **210** are overlapped onto a multilayer film **209** as shown in **FIG. 34**, the electrode layers **210** and **210** are connected to the multilayer film **209**, permitting a sense current to effectively flow into the multilayer **209** from the electrode layer **210**.

[0074] In order to cause a sense current to effectively flow into the multilayer film **209** from the electrode layer **210**, the thickness of the electrode layer **210** must be larger than before, the thickness hi of the electrode **210** on and in direct contact with the multilayer film **209** must be larger, and the direct current resistance of the electrode layer **210** must be reduced.

[0075] If the thickness h1 of the electrode layer **210** is small relative to that of the multilayer film **209**, the direct current resistance of the electrode layer **210** rises, more likely causing the sense current from the electrode layer **210** to shunt to a hard bias layer **205**. As a result, the reproduction output can drop.

[0076] With the electrode layer **210** overlapped onto the multilayer film **209** and the thickness h1 of the electrode layer **210** increased relative to the thickness of the multilayer film **209**, the shunt of the sense current to the hard bias layer **205** is controlled, and the sense current effectively flows from the electrode layer **210** to the multilayer film **209**.

[0077] If the electrode layer **210** having a thickness h1 is deposited on the top surface of the multilayer film **209**, a large step develops between the top surface of the electrode layer **210** and the top surface of the multilayer film **209**. When an upper gap layer **211**, made of an insulator material, covers throughout the electrode layer **210** and the multilayer film **209**, the upper gap layer **211** suffers a poor step coverage, and a film discontinuity occurs at the step. As a result, the upper gap layer **211** fails to provide sufficient insulation.

[0078] It is yet another object of the present invention to provide a magnetoresistive-effect device which increases reproduction output by reducing a current loss caused by a sense current flowing into a hard bias layer, while making dominant a sense current flowing into a sensitive region occupying the central portion of a multilayer film, and which permits an upper gap layer to be deposited with proper insulation assured.

[0079] According to a sixth aspect of the present invention, a magnetoresistive-effect device includes a multilayer film including an antiferromagnetic layer, a pinned magnetic layer, which is deposited on and in contact with the antiferromagnetic layer, and the magnetization direction of which is pinned through an exchange anisotropic magnetic field with the antiferromagnetic layer, and a free magnetic layer, separated from the pinned magnetic layer by a nonmagnetic electrically conductive layer, a pair of hard bias layers, deposited on both sides of the multilayer film, for orienting the magnetization direction of the free magnetic layer perpendicular to the magnetization direction of the pinned magnetic layer, and a pair of electrode layers respectively deposited on the hard bias layers, wherein an intermediate layer, made of at least one of a high-resistivity material having a resistance higher than that of the electrode layer and an insulating material, is interposed between each of the hard bias layers and each of the electrode layers, and the electrode layers extend over the multilayer film.

[0080] The multilayer film is preferably fabricated by successively laminating the antiferromagnetic layer, the