type thin-film device or a dual spin-valve type thin-film device, the antiferromagnetic layer **330** in the multilayer film **371** is preferably made of a PtMn alloy, or may be made of an X—Mn alloy where X is a material selected from the group consisting of Pd, Ir, Rh, Ru, and alloys thereof, or a Pt—Mn—X' alloy where X' is a material selected from the group consisting of Pd, Ir, Rh, Ru, Au, Ag, and alloys thereof. When the antiferromagnetic layer is made of one of the above-cited materials, the antiferromagnetic layer needs to be subjected to a heat treatment to generate an exchange coupling magnetic field in the interface with the pinned magnetic layer.

FIG. **33** shows a conventional magnetoresistive-effect device having its hard bias layers and electrode layers on only both sides of the multilayer film. The width dimension A of the top surface of the multilayer film of the conventional magnetoresistive-effect device is measured using the optical microscope as shown in FIG. **31**. The magnetoresistive-effect device is then scanned across a micro track having a signal recorded thereon, on a recording medium in the direction of the track width, and a reproduction output is detected. A top width dimension of B giving an output equal to or greater than 50% of a maximum reproduction output is defined as the sensitive region E and a top width dimension of C giving an output smaller than 50% of the maximum reproduction output is defined as the insensitive region D.

Based on these measurement results, a lift-off resist layer **372** is formed on the multilayer film **371**, paying attention to the width dimension C of the insensitive regions D and D measured through the micro track profile method. Referring to FIG. **40**, undercuts **372***a* and **372***a* are formed on the underside of the resist layer **372**. The undercuts **372***a* and **372***a* are formed above the insensitive regions D and D, and the sensitive region E of the multilayer film **371** is fully covered with the resist layer **372**.

In a manufacturing step shown in FIG. **41**, both sides of the multilayer film **371** are cut away by etching, and in a manufacturing step shown in FIG. **42**, hard bias layers **373** and **373** are formed on both sides of the multilayer film **371**. In this invention, the sputtering technique, used to form the hard bias layers **373** and **373**, intermediate layers **376** and **376**, and electrode layers **375** and **375**, is preferably at least one sputtering technique selected from an ion-beam sputtering method, a long-throw sputtering method, and a collimation sputtering method.

In accordance with the present invention, as shown in FIG. **42**, a substrate **370** having the multilayer film **371** formed thereon is placed normal to a target **374** having the same composition as that of the hard bias layers **373** and **373**. In this setup, the hard bias layers **373** and **373** are grown in a direction normal to the multilayer film **371** using the ion-beam sputtering method, for instance. The hard bias layers **373** and **373** are not grown into the undercuts **372***a* and **372***a* of the resist layer **372** arranged on the multilayer film **371**. Referring to FIG. **42**, a layer **373***a* having the same composition as that of the hard bias layers **373** and **373** is formed on top of the resist layer **372**.

Intermediate layers **376** and **376** are grown on the hard bias layers **373** and **373** through ion-beam sputtering method. In this case, the target **374** is replaced with a target **377** having the composition of a high-resistivity material selected from the group consisting of $TaSiO_2$, TaSi, $CrSiO_2$, CrSi, WSi, $WSiO_2$, TiN, and TaN, or an insulating material selected from the group consisting of Al_2O_3, SiO_2, Ti_2O_3, TiO, WO, AlN, Si_3N_4, B_4C, SiC, and SiAlON. The intermediate layers **376** and **376** are not deposited into the undercuts **372***a* and **372***a* of the resist layer **372** arranged on the multilayer film **371**. As shown in FIG. **42**, a layer **376***a* having the same composition as that of the intermediate layers **376** and **376** is formed on the resist layer **372**.

In a manufacturing step shown in FIG. **43**, the electrode layers **375** and **375** are obliquely grown on the hard bias layers intermediate layers **376** and **376** at an angle to the multilayer film **371**. In this case, the electrode layers **375** and **375** are grown into the undercuts **372***a* and **372***a* formed on the underside of the resist layer **372** arranged on top of the multilayer film **371**.

Referring to FIG. **43**, the electrode layers **375** and **375** are deposited on the hard bias layers **373** and **373** through the ion beam splutter method, while the substrate **370**, having the multilayer film **371** thereon, is rotated in a plane at an angle with respect to a target **378** having the same composition as that of the electrode layer **375**. The electrode layer **375** sputtered at an oblique angle is grown not only on the intermediate layer **376** but also into the undercut **372***a* of the resist layer **372** formed on the multilayer film **371**. Specifically, the electrode layer **375** grown into the undercut **372***a* covers the insensitive region D of the multilayer film **371**.

In a manufacturing step shown in FIG. **44**, the resist layer **372** shown in FIG. **43** is removed using a resist stripper, and this completes a magnetoresistive-effect device having the electrode layers **375** and **375** formed on top of the insensitive regions D and D of the multilayer film **371**.

In accordance with the present invention, the intermediate layer, made of a high-resistivity material having a resistance higher than that of the electrode layer or an insulating materia, is formed between the hard bias layer and the electrode layer. With the electrode layer formed to extend over the multilayer film, the sense current shunting to the hard bias layer is controlled, and the sense current directly flows from the electrode layer to the multilayer film. The magnetoresistive-effect device of this invention thus presents a high reproduction gain and a high reproduction output, compared with the conventional art.

The use of the intermediate layer permits the thickness of the electrode in the contact area thereof with the multilayer film to be thinned. This arrangement reduces the size of a step between the top surface of the electrode layer and the top surface of the multilayer film, and forms an upper gap layer over the border area between the electrode layer and the multilayer film, with an improved step coverage and with no film discontinuity involved, and provides sufficient insulation.

The electrode layers overlapping the multilayer film are formed to extend over the insensitive regions that occupy both end portions of the multilayer film. In this arrangement, the sense current predominantly flows into the sensitive region that is centrally positioned in the multilayer film and substantially exhibits the magnetoresistive effect. The reproduction output is even further increased.

What is claimed is:

1. A magnetoresistive-effect device comprising: a multilayer film comprising an antiferromagnetic layer, a pinned magnetic layer, which is deposited on and in contact with said antiferromagnetic layer, and the magnetization direction of which is pinned through an exchange anisotropic magnetic field with said antiferromagnetic layer, and a free magnetic layer, separated from said pinned magnetic layer by a nonmagnetic electrically conductive layer; a protective layer which is deposited on and in contact with said free