COMPOSITE ELECTRODES FOR DIRECTIONAL CRYSTAL DEVICES

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Fig. 1

Fig. 2

INVENTORS
Paul Günther and Franz Kerkhoff

By atty.
This invention is concerned with composite electrodes for directional devices comprising semi-conductors, for example, transistors and the like.

Composite electrodes for the purpose and of the type noted above are generally known. It is likewise known to form on such electrodes preferably point-shaped or knife-edge contacts of a hard core which is provided with a coating of another generally softer material, the latter being more suitable than the core material to form electrical contact engagement with a semi-conductor crystal. Such a known electrode may, for example comprise a tungsten wire plated with platinum. The drawback of such structure is that it is impossible to provide upon tungsten a sufficiently uniform platinum coating and that it is consequently impossible to produce such electrodes with the required uniformity in the course of customary mass production processes.

It has been found by research lying in back of the invention that the above mentioned drawbacks can be avoided by using other particular materials. In accordance with the invention, electrodes of the previously indicated type which comprise at least two different materials, for example, a core or carrier and a coating, are made of metals from the first, fourth, fifth and/or eight groups of the periodic table of elements. More specifically, a hard material as for example niobium, tantalum, iron or alloys of such materials, for example, hard bronze of the type phosphor-beryllium-bronze or the like may be used primarily for the core of the electrode; and for the coating may be used primarily materials of high output capacity, for example, rhodium, palladium, iridium, also platinum or, under some circumstances alloys of these materials. In the case of using in a transistor a plurality of electrodes, for example, two or three electrodes, the selection of the material for the surface coating will depend upon whether the electrode is to be employed as a collector or an emitter.

The invention will now be described with reference to the accompanying drawings showing in diagrammatic representation examples thereof. In these drawings,

Fig. 1 shows a germanium crystal coatings with a single point contact electrode; and

Fig. 2 illustrates a transistor comprising a germanium crystal coating with two point contact electrodes.

In Fig. 1, numeral 1 indicates the germanium crystal.

In contact engagement with the surface of the crystal is a point electrode comprising a wire of phosphor-beryllium-bronze provided with a platinum coating 3.

The electrode is produced by providing upon the bronze wire, for example, in an alkaline ammonia phosphorous platinum bath of platinum coating in galvanic manner.

Fig. 2 shows a transistor comprising a germanium crystal 4 coating with two point contact electrodes 5 and 6. Between the electrodes, a p-n layer is provided in a known manner. The electrode 5 is made like the electrode of Fig. 1, comprising a bronze core with a platinum coating 3. The other electrode 6 comprises a steel core 7 covered by a copper coating 8.

The coatings may be applied or provided in different manner than galvanic, for example, by vaporization, by cathode vaporization, or in mechanical manner, for example, by spraying or rolling. Burning such as is usually applied in the production of mirrors, ceramics, etc., is recommended for mass production.

What is believed to be new and desired to have protected is defined in the appended claims.

We claim:

1. A transistor comprising a crystal, in electrode in point contact with said crystal, said electrode comprising a core and a coating surrounding said core, said core of one or more metals of the group consisting of niobium, tantalum, iron, copper, tin, zinc, phosphorous, beryllium and alloys of the aforesaid metals, said coating of one or more metals of the group consisting of rhodium, palladium, iridium, platinum and alloys of the aforesaid metals, and said coating of said electrode in point contact with said crystal.

2. A transistor according to claim 1, wherein said core of the electrode comprises a hard bronze of the type phosphor-beryllium-bronze.

3. A transistor according to claim 1, wherein said core of the electrode is formed of a hard bronze of the type phosphor-beryllium-bronze, and said coating is formed of platinum.

4. A transistor comprising a crystal, at least two electrodes in point contact with said crystal, a p-n layer provided in said crystal between the electrodes, one of said electrodes comprising a phosphor-beryllium-bronze core and a platinum coating, the other of said electrodes comprising a steel core and a copper coating, and said coatings of said electrodes in point contact with said crystal.

5. A composite electrode for a directional crystal device, said electrode provided with a point at one end for point contact with a crystal and comprising a core and a coating surrounding said core, wherein said core is formed from one or more materials of the group consisting of tantalum, phosphor-beryllium-bronze or steel, said coating formed of one or more materials of the group consisting of the elements of group eight of the periodic table of elements and consisting of rhodium, palladium, iridium and platinum.

6. A composite electrode according to claim 5, wherein said composite electrode may be used in a diode.

7. A composite electrode according to claim 5, wherein said composite electrode may be used as an emitter in a transistor.

8. A composite electrode for a directional crystal device said electrode formed with a point at one end for point contact with a crystal and comprising a steel core and a copper coating surrounding said core.

9. A composite electrode as a collector, said electrode comprising a core and a coating surrounding said core, wherein said core is formed from one or more materials of the group consisting of tantalum, phosphor-beryllium-bronze and steel, and said coating comprising one or more materials of the group consisting of copper and tin.

10. A semi-conductor device of the transistor type including a directional crystal, a composite electrode for point contact with said directional crystal, said composite electrode comprising a phosphor-beryllium-bronze.
core and a platinum coating surrounding said core, and said coating complementally formed to said core and formed for point contact with said directional crystal.

11. A semiconductor device according to claim 10, comprising a second composite electrode for point contact with said directional crystal, said second composite electrode comprising a steel core and a copper coating surrounding said core, and said coating of said second composite electrode complementally formed to said core and formed for point contact with said directional crystal.

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