

[54] **METHOD OF PRODUCING GRID ELECTRODES FOR ELECTRONIC DISCHARGE VESSELS**
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ABSTRACT

A grid electrode for an electronic discharge vessel wherein the wire which forms the grid is first covered with a layer of an intermetallic compound comprising a high-melting metal such as zirconium or titanium and a metal of Group VIII of the Periodic System, for example platinum. The intermetallic compound is applied to the grid wire in powdered form and then sintered after which an outer layer of a noble metal, for example platinum is then applied electrolytically.

10 Claims, No Drawings

METHOD OF PRODUCING GRID ELECTRODES FOR ELECTRONIC DISCHARGE VESSELS

The present invention relates to a method of producing grid electrodes for electronic discharge vessels whereby an intermediate coating consisting of a high-melting intermetallic compound is applied to the wires forming the grid and the intermediate coating is then covered with a layer of a noble metal, and further to a grid electrode produced by the method.

The method is known whereby grid electrodes are coated with a noble metal of the VIII group of the periodic system, preferably platinum, in order to reduce thermal emission. To reduce diffusion of the platinum into the grid wire (basic metal) and increase the radiative capacity, it has been proposed that an intermediate coating should be provided between the basic metal and the outer coating. Carbides, borides or silicides of high-melting metals have been proposed as suitable materials for the intermediate coating.

These known methods have the disadvantage that the coating reacts more or less quickly with the basic metal or, in the case of several coating components, within itself, and the reaction products can be activated by the evaporation products of the Th-W cathode. All methods employing carbides as the intermediate coating have the added disadvantage that in time carbides form with the basic metal, and these carbides cause the grid to become brittle.

The principal object of the present invention is to create a grid electrode such that the thermal emission does not increase even at greatly increased loading, and which at the same time possesses a slight and reproducible secondary emission together with increased high-voltage strength.

This object is achieved in that the intermetallic compound for the intermediate coating comprises a high-melting metal, such as zirconium or titanium, and a metal of group VIII of the periodic system.

The electrode produced by the method is characterized by the fact that the intermetallic compound comprises a high-melting metal and a noble metal of group VIII of the periodic system. The intermetallic compound is preferably applied to the electrode core as a powder and then sintered. By suitably choosing the grain size of the powder it is possible to determine exactly the surface roughness and hence to influence the secondary emission of the electrode as required.

EXAMPLE OF THE METHOD

Stoichiometric quantities of zirconium and platinum are melted together in vacuo, yielding the intermetallic compound ZrPt₃. The solidified specimens of this intermetallic compound are crushed in a mortar and then ground in a mill lined with a hard material such as tungsten carbide until the desired grain size preferably 3 μ , is attained.

The shaped grid of a conventional transmitting tube, consisting of wires of molybdenum or tungsten, is annealed in hydrogen at 1,000° to 1,100° C to remove the oxides, etc. The grid is then covered by cataphoresis with ZrPt₃, the production of which in powder form has already been described, preferably to a coating thickness of 5 — 10 μ . The grid, together with the applied intermediate coating, is then annealed in vacuo or a protective gas for 20 minutes at 1,500° — 1,600° C, whereupon the intermediate coating sinters, retaining

its roughness. After this the grid, with its sintered intermediate coating, is covered electrolytically with a layer of platinum 3 μ thick and then degassed by annealing once more in vacuo at a temperature of 1,500° — 1,600° C. Having been degassed, the grid is ready to be fitted.

Grids produced in this way exhibit great adhesion between the intermediate coating and the basic metal on the one hand, and the platinum coat on the other, resulting in increased high-voltage strength. This high adhesion also improves the mechanical properties of the grid, so that very fine grids, meshed grids, for example, can be produced.

By suitably selecting the grain size of the ZrPt₃ powder applied to the grid it is possible to vary the roughness of the grid surface, and consequently the secondary emission, in a reproducible manner.

In addition, these grids yield higher measured radiation values and a higher thermal load capacity, thus allowing higher electrical loadings.

Specific radiation values from 20 W/cm² to 29 W/cm² can be achieved at 1,525°K, depending on the chosen roughness of the grid surface. This corresponds to between 65 and 95 percent of the radiation of a black body.

At the same temperature the specific primary emission is approx. 1 μ A/cm². This corresponds roughly to the operating conditions in electronic discharge vessels. This primary emission does not increase even after prolonged thermal overloading at 1,800° K.

We claim:

1. A method of producing grid electrodes for electronic discharge vessels which comprises the steps of applying to the wires forming the grid an intermediate coating consisting of a high-melting intermetallic compound constituted by a high-melting metal and platinum, and then covering said intermediate coating with an outer layer of platinum.

2. A method as defined in claim 1 for producing grid electrodes for electronic discharge vessels wherein said high-melting metal is zirconium.

3. A method as defined in claim 2 for producing grid electrodes for electronic discharge vessels wherein said intermetallic compound is ZrPt₃.

4. A method as defined in claim 1 for producing grid electrodes for electronic discharge vessels wherein said intermetallic compound is applied to the wires forming said grid in powder form and is then sintered.

5. A method as defined in claim 1 for producing grid electrodes for electronic discharge vessels wherein said intermetallic compound in powder form is applied to the wires forming said grid by electrophoresis until the thickness thereof is at least 5 μ , preferably 5 to 10 μ , and is then heated in an inert atmosphere or in vacuo to at least 1,500°C, preferably 1,500° to 1,600°C, to thereby sinter the same.

6. A method as defined in claim 5 for producing grid electrodes for electronic discharge vessels wherein the sintering time is approximately 20 minutes.

7. A method as defined in claim 1 for producing grid electrodes for electronic discharge vessels wherein said outer platinum layer is applied electrolytically to the intermediate coating and said grid is then annealed in vacuo at a temperature of at least 1,000°C, preferably from 1,500° to 1,600°C.

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8. A method as defined in claim 7 for producing grid electrodes for electronic discharge vessels wherein the thickness of the applied platinum is at least 3 μ .

9. A method as defined in claim 1 for producing grid electrodes for electronic discharge vessels wherein said high-melting metal is titanium.

10. A grid electrode for electronic discharge vessels

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comprising a base metal forming the grid wire, an intermediate layer of an intermetallic compound comprising a high-melting metal and platinum applied to said wire, and an outer layer of platinum applied to said intermediate layer.

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