

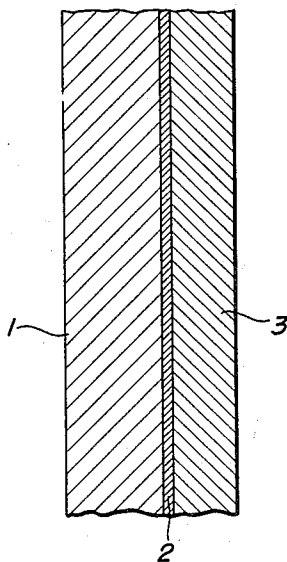
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OXIDE COATED CATHODES FOR ELECTRON TUBES

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OXIDE COATED CATHODES FOR ELECTRON TUBES

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1 Claim. (Cl. 29—183.5)

This invention relates to improvements in oxide coated cathodes for electron tubes.

A conventional oxide coated cathode comprises a core or base of metal containing a minor quantity of C, Mg, Al, Si, Cr, W, Ti, U, Th, Zr, Be or other element that can reduce oxides, and an oxide coating. The reducing elements as enumerated above serve to reduce the alkali-earth oxides covering the core metal to form an alkali-earth layer having good thermal emissivity.

It has been found, however, that most of the reducing elements contained in the base metals form boundary layers of insulating compounds between the base metals and the oxide coatings. These boundary layers tend to produce contact potentials or increase interface resistance, thus impairing the performance of electron emissive cathodes. It has also been found that the very time when such a boundary layer is formed during the manufacture of an electron tube is in the stages of decomposition of alkali-earth carbonates, the raw materials for forming the desired oxides, and subsequent aging of the electron tube, when the cathode is heat treated in a gas atmosphere within the tube.

It is, a primary object of the present invention to provide oxide coated cathodes for electron tubes having minimum interface resistance and thus to improve the thermal emissivity of the cathodes.

Another object of the present invention is to provide electron tubes of improve performance and extended life.

Other objects and advantages of the present invention, which become apparent from the following description with reference to the accompanying drawings, in which the single figure is an enlarged fragmental sectional view of a cathode embodying the present invention showing its laminar construction at a particular stage during its manufacture.

Referring to the sole figure, a core metal 1 according to the present invention is applied during one step of its manufacture with a very thin layer of anti-oxidizing metal 2 plated thereon, and an emitter coating 3 of emitter materials of suitable oxides or the raw material of conventional carbonates is formed on the anti-oxidizing layer 2 by painting or the like. According to the present invention, the core metal 1 is formed of nickel containing a minor quantity of a reducing element or elements selected from the group consisting of C, Mg, Al, Si, Cr, W, Ti, U, Th, Zr, Be and the like that are effective to reduce the oxides of the coating 3. The preferred metal suitable for forming the thin anti-oxidizing layer 2 is platinum or pure nickel.

When the cathode as above-specified is heated during the course of its manufacture, the metal of thin anti-oxidizing layer 2 is incorporated unitarily with the core metal 1. In other words, it should be noted that the thin anti-oxidizing layer 2 is temporarily present and substantially disappears by virtue of the heat treatment during its manufacture to form a substantially uniform structure with the core metal 1.

By appropriately selecting the material of the anti-oxidizing layer 2 as well as its thickness, the anti-oxidizing

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layer 2 can be so formed that it effectively protects the surface portion of core metal 1 against oxidization during the exhausting operation of electron tube and its aging. It then disappears when a high vacuum has been established in the tube. When platinum is used as the anti-oxidizing layer 2, it disappears by formation of a solid solution with core metal 1. When pure nickel is employed, the core metal 1 and the reducing elements contained therein diffuse outwardly into the pure nickel anti-oxidizing layer 2, thus forming a uniform and indiscriminate core or base on which usual oxide coating is formed.

Consequently, according to the present invention, the surface portion of core metal 1 will not be oxidized during the heat treatment of the cathode, and any substantial boundary layer of insulating or other undesirable character is not formed between the core metal and oxide coating. Thus, the interface resistance between the core metal and the oxide coating is extremely low. In addition, after the anti-oxidizing layer 2 has disappeared as hereinbefore explained, the reducing elements contained in the base metal can react directly with the oxide coating without obstruction by any intermediary layer. There results an effective reduction of the oxide layer, so that the lowering of mutual conductance as well as electron emissivity of the vacuum tube is kept small throughout the whole life of the tube and eventually extends the useful life of the tube. In addition, peeling off of the oxide coating is effectively prevented, and a superior oxide coated cathode with stable performance is obtained.

As practical examples of the present cathodes, core metals 1 of nickel containing 0.04% of Mg and 4.0% of W were plated with pure nickel layers 2 of 1 to 5 micron thickness, and painted thereon with conventional emitter materials such as alkali-earth carbonates forming the emitter coating 3. Such cathodes were assembled into 6J6 type vacuum tubes. These tubes were tested in comparison with standard 6J6 type vacuum tubes of the same ratings under the same operating conditions for the same period of working time. The average rate of lowering of mutual conductance of the new tubes was lower than a half of that of standard tubes. When operated under more severe conditions, a more decreased rate of lowering of mutual conductance has been obtained.

What is claimed is:

An oxide coated cathode having a minimized interface resistance for an electron tube, said cathode comprising a core metal of about 0.04% magnesium, 4% tungsten and the remainder nickel, a layer of pure nickel having a thickness between 1 to 5 microns plated on said core metal, and a layer of emitter materials applied over said layer of pure nickel whereby when said cathode is heated said layer of pure nickel is incorporated with said core metal so that no interface layer exists between said emitter material and said core metal.

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