United States Patent Office 2,813,995
Patented Nov. 19, 1957

2,813,995

CATHODE AND METHOD OF MANUFACTURE

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No Drawing. Application October 14, 1953, Serial No. 386,133

Claims priority, application Great Britain October 22, 1952

6 Claims. (Cl. 313—346)

This invention relates to electric discharge devices and more particularly to thermionic cathodes such as are used in vacuum and gaseous discharge devices especially gaseous discharge lamps of the tubular type.

An object of this invention is to provide a cathode with a greatly increased life.

A further object is to provide a cathode which gives off a minimum of both gaseous and evaporated decomposition or activation products which blacken the envelope during the normal operating life of the cathode.

It is well known that a type of cathode widely used in discharge lamps consists essentially of a base of tungsten or tungsten alloy which is coated with oxides of either barium, strontium or calcium or with a mixture or solid solution of any two or three of these compounds, or with a mixture or solid solution in which these compounds form the major constituent. When heated to temperatures at which these cathodes are normally operated it has been shown that chemical reactions occur between the base metal and the coating material. The products of these reactions are usually tungstates or basic tungstates of the alkaline earth elements. The formation of these reaction products has an undesirable effect on the efficient operation and the life of these cathodes.

According to the present invention the formation of these undesirable compounds is prevented or considerably reduced by the formation on the base metal of a protective layer before the application of the coating. The operation of such a protective layer may be twofold. The layer prevents the direct reaction of the base metal and the coating mixture, it may also itself form reaction products with the base metal or the coating mixture or both, these products being less harmful to the efficient operation of the cathode than those formed by direct reaction between the base metal and the coating.

In a preferred arrangement according to the invention, the cathodes of an electric discharge lamp comprises spirals of coiled tungsten wire which are coated with a protective layer of tungsten silicide or disilicide by heating the spirals together with powdered silicon in a stream of hydrogen and hydrochloric acid gas. Henceforth, throughout this application, the term "silicide" will be used to denote generically the reaction product of tungsten and silicon, irrespectively of whether such product is the monosilicide or disilicide or intermediates.

These treated spirals are then coated in known manner with a coating of at least one of the alkaline earth oxides. The presence of this silicide film on the base metal prevents or reduces the formation of the harmful alkaline earth tungstates. In some cases there may be a formation of much less harmful silicate compounds.

The invention may also include the addition of any metal powder to the coating mixture, the grains of which have been subjected to such a protective treatment.

Cathodes, the tungsten base of which has been provided with a silicide film in the manner described above, have been used in the making of fluorescent discharge lamps. In this application not only have they given much longer life than untreated cathodes but also have the

advantage that the blackening at the ends of the lamp formed by reactions between the excited mercury atoms and ions and the decomposition or evaporation products of the cathode has been reduced to negligible proportions. Such fluorescent lamps, as is well known, usually comprise an elongated tubular glass envelope having a cathode at each end thereof, a layer of fluorescent powder on the inner surface of the envelope, and a filling of inert starting gas such as argon, krypton, etc. at a pressure of a few millimeters, together with a small quantity of mercury, and are operated at a loading such that the mercury vapor pressure is of the order of ten microns.

If tungsten or tungsten alloy wire is first formed into coils having any of the configurations well known in the art, the coils may be buried in powdered silicon contained in a number of porcelain boats or other suitably constructed vessels and placed in a furnace.

The temperature at which the process is carried out is not critical and may lie in the range 700–1400 degrees centigrade within which the preferred temperature of 950 degrees centigrade occurs.

The proportion of hydrogen to hydrochloric acid gas is likewise not critical but a mixture of equal parts has been found satisfactory and is passed through the furnace while the heating is carried out.

The length of time for which the process is allowed to proceed depends on the thickness of the protective layer required and 1 hour is more than sufficient to deposit the minimum 2 to 3 mils required, when the temperature is 950 degrees centigrade.

The invention is not however to be limited to the particular example described since various modifications will readily occur to those skilled in the art without departing from the scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A cathode for an electric discharge device comprising a tungsten base member having thereon a surface layer of a silicide of tungsten formed in situ as the reaction product of the tungsten base member with silicon and a coating thereon of alkaline earth oxide.

2. The method of manufacturing cathodes for electric discharge devices which comprises forming on the surface of a tungsten base member a protective layer of a silicide of tungsten by reaction of silicon with the surface layer of said base member and then coating said surface with alkaline earth oxide.

3. A cathode for an electric discharge device comprising a tungsten base member having thereon a surface layer at least two mils in thickness of a silicide of tungsten formed in situ as the reaction product of the tungsten base member with silicon and a coating thereon of alkaline-earth oxide.

4. The method of manufacturing cathodes for electric discharge devices which comprises forming on the surface of a tungsten base member a protective layer of a silicide of tungsten by heating the tungsten base member together with silicon in an atmosphere of hydrogen and hydrochloric acid gas, and then coating said surface with alkaline-earth oxide.

5. The method of claim 4 wherein the heating is to a temperature in the range from 700° to 1400° C.

6. The method of claim 4 wherein the heating is to a temperature of approximately 950° C.

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