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PROCESS FOR ELECTROPHORETICALLY COATING A METAL WITH PARTICULATE CARBON MATERIAL

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This invention relates to a process for coating electrodes of electrical devices and to a coating suspension adapted to be used in the process.

Certain electrodes employed in devices such as electron discharge tubes operate at a temperature sufficiently high to cause electrons to be emitted therefrom which will accelerate toward other electrodes operating at higher voltages. This type of emission is undesirable since it affects the operating characteristics of the tube. One method of lowering the emission from an electrode when heated is to provide it with a coating of a material such as graphite which is black in appearance and substantially non-emissive. Due to the characteristics of this coating material, the electrode operates at a lower temperature and the emission therefrom is reduced accordingly.

Some of the problems encountered in the fabrication of graphite coated electrodes resides in the selection of materials and the choice of coating application techniques. Generally, the graphite is dispersed in a suspension and applied in spray or electrophoretic operations. Suspension mediums which have been proposed include aqueous colloidal suspensions containing ammonia or a wetting agent. Although these coatings reduce electron emission, it has been found that they have a tendency to adversely affect the cathode material and reduce cathode emission. Also, the thickness and uniformity of these coatings are difficult to control when applied by the processes described above.

Accordingly, an object of the invention is to reduce the aforementioned disadvantages and to uniformly coat electrodes with a temperature reducing material.

A further object is to decrease the adverse effects of an electrode coating on the cathode material employed in an electron tube.

Another object is to produce uniformly coated electrodes by the application of a carbon suspension in an electrophoretic process.

The foregoing objects are achieved in one aspect of the invention by the provision of an electrophoretic process for coating electrodes employing a suspension comprising a particulate carbon material suspended in a liquid including a binder which contains a nitrate of a metal. The binder furnishes the charging ions to electrophoretically deposit and bind the carbon material to the electrodes.

The carbon material used to lower the operating temperature of the electrodes is employed in micronized or particulate form and may comprise graphite, lampblack or boneblack. The binder materials may include an aqueous or alcohol solution of a nitrate such as nitrates of aluminum, beryllium, titanium, magnesium, and zirconium. This material may be formed by dissolving a quantity of, for instance, partially hydrolized aluminum nitrate in a powdered form in water or a suitable alcohol. This binder, when dissolved in water, generally forms a viscous tacky material having a pH range between 3 and 6.

In accordance with one aspect of the invention, the coating suspension comprises particulate carbon material dispersed in a liquid containing the binder and an alcohol and water dispersion medium and binder solvent. It has been found that alcohols or organic solvents such as ethyl

alcohol, ethanol, methanol and isopropanol may be used satisfactorily in the suspension.

The particulate carbon material employed may be varied in accordance with the heat characteristics of the metallic electrode which is to be coated. For instance, from 10 to 100 grams of micronized graphite may be satisfactorily used in approximately 800 milliliters of the binder and solvent solution. The solvent may comprise a 4:1 ratio by volume of alcohol to water. However, this ratio is not critical and the amount of alcohol in the solvent may be varied from 25 percent to 100 percent, if desired.

The liquid binder, which furnishes charging ions to electrophoretically deposit the carbon material on the electrode and to bind it thereto, may provide from approximately 1 percent to 5 percent by volume of the total liquids in the suspension medium. A number of factors such as the coating time, the desired coating composition, and the configuration and type of electrode to be coated determines the amount of binder to be used. One example of a binder and solvent solution formulated in accordance with one aspect of the invention may employ approximately 78 percent ethyl alcohol, 20 percent distilled water and 2 percent of the binder when used on the anode of some types of tubes.

More specifically, a satisfactory suspension for electrophoretically coating an electrode such as the number two grid of a 6DQ6 electron tube may be made by milling a slurry of 50 grams of micronized graphite in 50 milliliters of ethyl alcohol for about 100 hours. After milling, 200 milliliters of ethyl alcohol, 136 milliliters of distilled water and 15 milliliters of an aqueous solution of aluminum nitrate having a pH range between 3 and 6 are added to the slurry, and the resultant suspension is milled for approximately 24 hours. An equal volume of ethanol is subsequently added to and mixed with the above described suspension to complete the electrophoretic bath.

When an electrode such as a grid is to be coated with graphite, the grid is immersed in the graphite suspension, and the negative lead of a voltage source is connected to the grid. The positive lead of the power supply is coupled to an anode which is also in contact with the suspension and spaced from the electrode. When the circuit thus formed is energized, the suspended charged graphite particles move through the suspension fluid under the influence of the applied electromotive force. After a short interval of time, the potential is removed and the graphite coated grid is withdrawn from the suspension. Subsequently, a low pressure stream of air may be used to blow off the excess coating to dry the grid for handling.

Although several embodiments of the invention have been shown and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. A process of electrophoretically coating a metallic member comprising the steps of immersing the member in a suspension at a position spaced from an electrical terminal; the suspension consisting essentially of particulate graphite dispersed in a solution of a binder and an alcohol solvent for the binder, said binder constituting from one to five percent of the total liquid volume of said suspension solution and consisting essentially of an aqueous solution of aluminum nitrate having a pH range of from 3 to 6; and applying a potential difference between said terminal and the member to cause deposition of said particulate material on the metallic member.

2. A process of electrophoretically coating a metallic member comprising the steps of immersing the member in a suspension at a position spaced from an electrical terminal; the suspension consisting essentially of particu-

late material selected from the group consisting of graphite, lampblack, and boneblack in a solution of a binder and an organic solvent for the binder, said binder constituting from one to five percent of the total liquid volume of said suspension solution and consisting essentially of an aqueous solution of a nitrate having a pH range from 3 to 6 of a metal selected from the group consisting of aluminum, beryllium, titanium, magnesium, and zirconium; and applying a potential difference between said terminal and the member to cause deposition of said particulate material on the metallic member.

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