

SPECIFICATION

Method of blackening steel components

The invention relates to a method of blackening steel components, in particular steel components of cathode ray tubes. Examples of such steel components are shadow masks and shadow mask frames for colour display tubes.

It is known from VALVO Berichte XVIII, 1/2 (1974) 84-87 that the shadow mask of colour display tubes is heated by impinging electrons. An undesired spontaneous local expansion of the shadow mask is often associated with said heating. This leads to so-called landing errors. These landing errors result in colour defects since the electron beams no longer impinge upon the luminescent elements associated with them. Therefore it is generally endeavoured to keep the temperature of the mask as low and as spatially constant as possible.

Several methods are known to keep the surface of the shadow mask as cool as possible. According to the above-mentioned VALVO Berichte the mask is blackened by oxidation of its surface in an oxidation furnace in which a black iron oxide is formed at its surface. As a result of this blackening an effective radiation of the thermal energy produced by electron bombardment must be effected. The disadvantages of this method are as follows: on the one hand the thermal emission power of such black layers depends on the composition of the iron oxide formed in question which in several circumstances may also become brown; on the other hand, iron oxide tends to deteriorate in a vacuum under heating by electron bombardment. Both effects lead to a decrease of the thermal emission power. In addition, iron oxide layers take up the electrons and their energy and are heated thereby.

In order to provide blacker and simultaneously heat-withstanding layers on the mask surface, it is already known from DE-AS 24 23 732 to use an electroless plating bath which contains nickel compounds or cobalt compounds. The layer formed is subjected to a strong oxidation acid and is then fired in air at approximately 450°C. A disadvantage of the layers manufactured according to this method consists in that they also take up the electrons and their energy. In addition, the known plating baths comprise substances which are known to be detrimental to health and may be carcinogenic.

A mask coating with bismuth to reduce the passage of X-rays through the glass envelope of the colour display tube is known from US-PS 35 62 518. Blackening of the bismuth layer is not suggested: it is not stated either in what manner the bismuth is provided on the shadow mask. According to Ullmann's Encyklopädie der technischen Chemie (Ullmann's Encyclopedia of Technical Chemistry), 3rd edition, vol. 18 (Munich-Berlin-Vienna 1967) p. 640, bismuth coating can be provided on metallic articles, electrolytically (or by electrodeposition) and by vapour deposition. However, these

methods have several disadvantages. For example, vapour deposition processes are technically expensive and require high investment and electrodeposition requires much energy and pollutes the environment.

It is therefore an object of the invention to provide an alternative method according to which steel components can be blackened without having to take the disadvantages of the already known methods. In particular, a high thermal emissive power of the surface of the shadow mask in the overall infra-red wavelength range from 1 to 30 μm and simultaneously a high electron reflective power should be achieved. Furthermore, the method should result in reproducible results with a simple process control.

According to the invention this object is achieved in that an adherent bismuth layer is provided on the steel components by electroless plating in a bismuth salt solution comprising bismuth oxynitrate, and the steel components thus coated are heated in an oxidizing atmosphere, for example in air, at a temperature between 350 and 650°C for such a period of time that a black layer is formed on the surface of the bismuth-coated part.

The electroless plating is preferably carried out in an acid medium while adding a surface active agent.

Examples for acid media are dilute sulphuric acid, tartaric acid solution and oxalic acid solution, in particular in water.

Examples for surface active agents are commercially available dish washing detergents, in particular those containing alkylpolyglycoethersulphates and alkylbenzenesulphonates in addition to non-ionic surface active agents.

The invention will be described hereinafter with reference to an Example:

EXAMPLE

A plating bath is obtained by stirring 3 g of bismuth oxynitrate and 10 g of tartaric acid and one litre of water. With stirring continued, 1 g of a dish washing detergent is then added. For instance a dish washing detergent commercially available under the trade mark "Pril" may be used. Cleaned and degreased steel components are then immersed in said liquid. After approximately 15 minutes and adhering bismuth layer has deposited on the surface of the steel components. By heating and stirring the plating liquid the deposition rate of the bismuth can be increased. After rinsing with water and drying, the coated parts are heated in air at 460° for 1 hour.

This treatment produces a homogeneous, adherent blackening of the surface which has a very high emissive power in the infrared wavelength range from 1 to 30 μm , is stable against electron bombardment up to 50 kV in a vacuum and on the basis of the high atomic number of bismuth ($Z = 83$) has an extremely high electron reflective power. As compared with usual iron oxide layers approximately 20% of the

thermal emissive power ($3 < \lambda < 30 \mu\text{m}$) and an electron reflection increased by approximately 30% at 25 kV acceleration voltage is gained with correspondingly prepared bismuth black layers.

5 CLAIMS

1. A method of blackening steel components, characterized in that an adherent bismuth layer is provided on the steel components by electroless plating in a bismuth salt solution comprising

10 bismuth oxynitrate, and the steel components thus

coated are heated in an oxidizing atmosphere at a temperature between 350 and 650°C for such a period of time that a black layer is formed on the surface of the bismuth-coated parts.

15 2. A method claimed in Claim 1, characterized in that the electroless plating is carried out in an acid medium with the addition of a surface active agent.

20 3. A method of blackening steel components, substantially as herein described with reference to the Example.



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