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(54) Title: PASTE COMPOSITION FOR SCREEN PRINTING OF CRT SHADOW MASK AND SCREEN PRINTING METHOD USING THE SAME

(57) Abstract

A paste composition for screen printing of a CRT shadow mask composed of 12~32 wt.% of a vehicle, 34~87 wt.% of an electron reflecting material and 0.7~44 wt.% of a frit, and a screen printing method using the paste composition are provided. In the screen printing method using the paste composition, electron reflecting material and thermal radiating material are coated on the surface of the CRT shadow mask to decrease a doming phenomenon due to the thermal expansion of the shadow mask, thereby suppressing the deterioration of image quality caused by the doming phenomenon.
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PASTE COMPOSITION FOR SCREEN PRINTING OF CRT SHADOW MASK AND SCREEN PRINTING METHOD USING THE SAME

5 Technical Field

The present invention relates to a paste composition for screen printing of a cathode ray tube (CRT) shadow mask and a screen printing method using the same, and more particularly, to a paste composition for screen printing of a CRT shadow mask, which is coated on the surface of the shadow mask to suppress a doming phenomenon, and a screen printing method using the same.

Background Art

Generally, as shown in FIG. 1, a CRT includes a panel 1 having a fluorescent layer 2 formed on the inner side thereof, a shadow mask frame assembly 4 fixed to the inner side of the panel 1, being separated from the fluorescent layer 2 by a predetermined distance, and an electron gun 7 and deflection yoke 5, which are installed at a neck portion 6 and a cone portion 8, respectively. Here, the shadow mask frame assembly 4 installed in the panel 1, as shown in FIG. 2, includes a shadow mask 3 having a hole portion 3a with a plurality of electron beam passing hole H and a conclave skirt portion 3b which is extended from the edge of the hole portion 3a, and a frame 9 coupled with the skirt portion 3b for supporting the shadow mask 3. Also, the shadow mask frame assembly 4 is coupled with a spring (not shown) fixed on the side of the frame 9 and a stud pin (not shown) fixed on the inner side of the panel, thereby separating the shadow mask 3 from the fluorescent layer 2 by a predetermined distance.

According to the CRT having the above structure, after the electron beam emitted from the electron gun 7 is selectively deflected by the deflection yoke 5 according to the scanning position of the electron beam on the fluorescent layer 2, the electron beam passes through the electron beam passing holes H of the shadow mask 3 supported by the frame 9 to reach the fluorescent layer, thereby forming an image. Here, only 15~30% of the electron beams pass through the electron beam passing holes H of the shadow mask. The remaining electron beams which
could not pass through the electron beam passing holes H collide with the hole portion 3a of the shadow mask 3, so that the shadow mask 3 and the frame 9 supporting the shadow mask 3 are heated, which causes a doming phenomenon on the shadow mask 3.

Due to the doming phenomenon of the shadow mask 3, the location of the electron beam passing holes H formed on the hole portion 3a of the shadow mask 3 is changed, so that the electron beam emitted from the electron gun 7 is not correctly incident on a fluorescent point of the florescent layer 2.

To solve this problem, according to a conventional method, the interval between the fluorescent layer 2 and the shadow mask 3 is controlled by moving the shadow mask 3.

However, by such a method, the doming phenomenon is suppressed only when the shadow mask 3 is completely domed through a thermal expansion thereof. Thus, decreased resolution due to an initial doming phenomenon cannot be prevented.

In order to prevent the doming phenomenon, a shadow mask made of invar (invariable steel) is disclosed in U.S. Patent Nos. 4,665,338 and 4,420,366. The conventional shadow mask made of invar can resist the thermal expansion, however, has disadvantages in the cost and processing thereof.

As another method for reducing the thermal expansion ratio of the shadow mask, a method of depositing material having a low thermal expansion ratio, such as lead borate, on the surface of the shadow mask is known.

As still another method for preventing the doming phenomenon, a method of coating an insulating material on the surface of the shadow mask is widely known. This method is for preventing the transfer of heat generated by the electron beam to the shadow mask, wherein ceramic is mainly used as the insulating material.

As still yet another method, a material having high thermal radiating coefficient is coated on the surface of the shadow mask or the shadow mask is darkened, to increase a thermal radiating ratio. Also, a method of depositing aqueous suspension including electron reflection material on the surface of the shadow mask has been disclosed by Phillips.
Generally, the thermal insulating material, thermal radiating material, electron reflecting material, etc. are coated on the surface of the shadow mask by a spray method or a sputtering method. According to the spray method, where aqueous suspension is sprayed on the mask surface via a nozzle, some of the holes formed on the shadow mask become clogged even if the spray process is precisely controlled, and the mask surface coated by this method is not even.

On the other hand, according to the sputtering method, wherein gas ions generated during a glow discharge are collided against a target cathode and then the atoms emitted from the target are attached to the substrate of an anode, the coated layer is thin and expensive deposition equipment is required.

In order to solve the defects of the above described coating methods, a new coating method using a screen printing is disclosed.

Disclosure of the Invention

To solve the above problems, it is an object of the present invention to provide a paste composition for screen printing of a CRT shadow mask, which can suppress a doming phenomenon of the shadow mask.

It is another object of the present invention to provide a screen printing method using the above paste composition.

To achieve the first object, there is provided a paste composition for screen printing of a CRT shadow mask which comprises 12 ~ 32 wt% of a vehicle, 34 ~ 87 wt% of an electron reflecting material and 0.7 ~ 44 wt% of a frit.

As the electron reflecting material, bismuth (Bi), tungsten (W), lead (Pb) or the oxides thereof may be used.

Doming phenomenon can be decreased by a thermal radiating effect, as well. For this effect, materials having a high thermal radiating coefficient is added to the above composition. Here, as materials having a high thermal radiating coefficient, carbon, manganese, manganese oxide, aluminum oxide, dark pigment, etc. are used.

Also, preferably, content of the thermal radiating material is 5 ~ 30 wt% based on the electron reflecting material.

To achieve the second object, there is provided a screen printing method
using a paste composition for screen printing of a CRT shadow mask comprising the steps of:

(a) uniformly depositing a paste composition comprising 12 - 32 wt% of a vehicle, 34 - 87 wt% of an electron reflecting material and 0.7 - 44 wt% of a frit on a screen mesh on which a reverse pattern with respect to a shadow mask pattern has been formed; and

(b) putting the shadow mask on a printing substrate and pressing the screen mesh using a squeezer to spread the paste composition, thereby printing the shadow mask.

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Brief Description of the Drawings

FIG. 1 is a cross-sectional diagram of a general cathode ray tube;

FIG. 2 is a perspective view of a general shadow mask frame assembly;

FIG. 3 is a diagram illustrating a screen printing method according to the present invention;

FIG. 4 is a sectional view of a shadow mask from a side to which an electron gun is attached; and

FIG. 5 is a diagram showing points for measuring the landing shift of the shadow mask when the CRT shadow mask is printed using the compositions prepared according to the preferred embodiments and a comparative example.

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Best mode for carrying out the Invention

A printing composition of the present invention includes vehicle, electron reflecting material and frit.

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The vehicle is for controlling the viscosity and concentration of the composition for a smooth printing and enables performing a press process for forming curvature of a shadow mask after a drying process. Here, a solvent is volatilized in the drying process after the printing process and the vehicle itself completely disappears in a darkening process.

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As the vehicle, an tackifier, a binding agent, a solvent, etc. are used being mixed. For example, if the printing composition is an oil paste, terpineol as an tackifier, ethyl cellulose as a binding agent and butyl carbitol are mixed to be used
as the vehicle.

The tackifier is for increasing the close adhesion between each film, and terpineol, silicones and mineral oil are used as the tackifier.

The binding agent includes heat-curable resin such as ethyl cellulose, acrylic resin, epoxy resin and urethane resin and ultraviolet-curable resin. Particularly, it is preferable to use the ultraviolet-curable resin, cured by absorbing ultraviolet rays having the wavelength of 230-400nm, as the binding agent. When the ultraviolet-curable resin is used as the binding agent, a solvent drying process can be omitted unlike a heat-cure resin. Thus, manufacturing process can be simplified and problems caused from the volatilization of solvent can be solved.

The solvent includes organic solvent such as butyl carbitol, acetate, ethyl carbitol, animal oil and vegetable oil.

As the electron reflecting material of the present invention, heavy metal atoms having an atomic number greater than 70 and the oxide thereof are used, and preferably, bismuth (Bi), tungsten (W), lead (Pb) and the oxides thereof are used.

As the frit for promoting the firm adhesion of various materials to the surface of the shadow mask while being glassified in a darkening process performed at 500-600°C, material selected from the group consisting of titanium oxide, zirconium oxide, alumina, lead oxide, boron oxide and silicon oxide are used. These materials are completely glassified (i.e., converted to glass phase) at a predetermined temperature after the completion of the printing, thereby assisting the adhesion of the materials.

According to the present invention, an insulation effect can be achieved by forming an insulation layer on the surface of the shadow mask using the printing composition including only the vehicle and frit.

A screen printing method of the present invention will now be described with reference to FIG. 3.

As shown in FIG. 3, a paste of the printing composition is uniformly deposited on a screen mesh 31 firmly fixed to a rectangular frame 34 using a scraper 32. Here, a shape of the shadow mask to be printed should be plated in the screen mesh 31. The plating process will be described with reference to FIG. 4. Here, the shadow mask shown in FIG. 4 has a plurality of electron beam
passing holes 43 formed to pass the electron beam and a plurality of no-hole portions 42 formed between the electron beam passing holes 43. Also, a plurality of coating layers 41 having a predetermined thickness are formed at one surface of the shadow mask on which the electron beam is incident.

The screen mesh made of stainless steel, polyester or nylon is attached to the frame, and a photoresist is coated on the entire surface of the screen mesh, and then dried. Also, after interposing a shadow mask on the above resultant structure, exposing, etching and drying processes are performed to form the photoresist at portions corresponding to the electron beam passing holes 43 of the shadow mask. Here, the formed photoresist has a reverse phase with respect to a hole pattern of the shadow mask.

Thereafter, an object to be printed, that is, a shadow mask 3, is put on a printing substrate 30, and the screen mesh 31 is then evenly pressed using a squeezer 33 to spread the paste, thereby printing the metal layers 41 on the no-hole portion 42 of the shadow mask. Here, the intended shape of the shadow mask should be formed on the screen mesh 31.

After the printing is completed according to the above method, the organic solvent included in the paste is completely volatilized through a drying process. Thereafter, a forming process for providing a proper curvature to the shadow mask 3 and a darkening process for darkening the surface of the shadow mask 3 are performed according to a general CRT manufacturing process. Particularly, during the darkening process, the frit of the printing composition is glassified to glass phase to adhere the paste to the shadow mask and the organic materials, such as binding agent (resins), remaining after the drying process are completely removed. Here, the conversion of the frit into the glass phase is preferably performed in the temperature range of 250~600°C. Here, the resultant material obtained after the darkening process includes 44~99.3 wt% of electron reflecting material, 0.7~57 wt% of frit and 0~10 wt% of inorganic material.

In the CRT manufacturing process, the darkening process may be performed prior to the forming process. On the other hand, if the forming process is performed after the darkening process, the following process, such as a washing process, can easily be performed, but the adhesive force of the paste is not
maintained. However, this defect can be overcome by controlling the content of the frit.

Hereinafter, the preferred examples of the present invention will be described in detail, however, the present invention is not limited to the following examples.

<Example 1>
23 wt% of a mixture of terpineol, ethyl cellulose, ethyl carbitol and butyl carbitol, 15.4 wt% of frit composed of titanium dioxide, silicon dioxide, lead oxide and zirconium dioxide, and 61.6 wt% of a mixture of bismuth and an oxide thereof were fully mixed to prepare a paste, and then the paste was deposited on a screen mesh.

After putting a shadow mask on a printing substrate, the mesh was evenly pressed using a squeezer to spread the paste, thereby printing the shadow mask.

Then, drying, forming and darkening processes were sequentially performed. Here, the temperature during the conversion of the frit to a glass phase was about 560°C.

<Example 2>
A paste was prepared using the same composition as that of Example 1, except that tungsten, tungsten carbide and tungsten oxide were used instead of bismuth and the oxide thereof.

Then, the printing, drying, forming and darkening processes were performed in the same manner as described in Example 1.

<Example 3>
A paste was prepared using the same composition as that of Example 1, except that an acrylic resin was used instead of ethyl cellulose.

Then, the printing, drying, forming and darkening processes were performed in the same manner as described in Example 1.

<Example 4>
A paste was prepared using the same composition as that of Example 1, except that an epoxy resin was used instead of ethyl cellulose. Then, the printing, drying, forming and darkening processes were performed in the same manner as described in Example 1.

<Example 5>

A paste was prepared using the same composition as that of Example 1, except that an ultraviolet-curable epoxy resin was used instead of ethyl cellulose, and the shadow mask was printed according to the same method described in Example 1. Then, the printed shadow mask was cured by irradiating about 2Kw of ultraviolet rays having the wavelength of 230 ~ 400nm for 5 minutes. Then, the printing, drying, forming and darkening processes were performed in the same manner as described in Example 1.

<Example 6>

A paste was prepared using the same composition as that of Example 1, except that an ultraviolet-curable urethane resin was used instead of ethyl cellulose. Then, the printing, drying, forming and darkening processes were performed in the same manner as described in Example 1.

<Comparative Example 1>

According to a general method, no treatment was performed on the surface of the shadow mask.

When the surface of the shadow mask of AK steel was coated with the compositions prepared in examples 1 and 2, the landing shift of each shadow mask was shown in Table 1. Here, the landing shift of the shadow mask was measured at the points C (L_1=L/3) and D of FIG. 5. As can be seen from Table 1, the landing shift of the shadow mask coated with the compositions prepared in examples 1 and 2 was decreased by about 24 ~ 31% compared with that of the comparative example wherein no treatment was performed on the surface of the shadow mask.
Also, the landing shift of each shadow mask coated with the compositions prepared in Examples 3, 4, 5 and 6 was the same as that of Example 1.

Table 1

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<th>$A_1$(μm)</th>
<th>$B_2$(μm)</th>
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$A_1$ : landing shift of the shadow mask measured at the point $C$

$B_2$ : landing shift of the shadow mask measured at point $D$

Decreased landing shift $^3$ : decreased landing shift of the shadow mask calculated on the basis of the average landing shift of the comparative example

**Industrial Applicability**

According to the present invention, electron reflecting materials and thermal radiating materials are coated on the surface of the CRT shadow mask to decrease the doming phenomenon due to the thermal expansion of the shadow mask, thereby preventing the deterioration of image quality caused by the doming phenomenon.
What is claimed is:

1. A paste composition for screen printing of a CRT shadow mask which comprises 12 ~ 32 wt% of a vehicle, 34 ~ 87 wt% of an electron reflecting material and 0.7 ~ 44 wt% of a frit.

2. A paste composition for screen printing of a CRT shadow mask as claimed in claim 1, further comprising a thermal radiating material.

3. A paste composition for screen printing of a CRT shadow mask as claimed in claim 2, wherein said thermal radiating material is at least one selected from the group consisting of carbon, manganese, manganese oxide, dark pigment and aluminum oxide.

4. A paste composition for screen printing of a CRT shadow mask as claimed in claim 2, wherein content of said thermal radiating material is 5 ~ 30 wt% based on said electron reflecting material.

5. A paste composition for screen printing of a CRT shadow mask as claimed in claim 1, wherein said vehicle is at least one selected from the group consisting of ethyl cellulose, acryl resin, epoxy resin, urethane resin and ultraviolet-curable resin.

6. A paste composition for screen printing of a CRT shadow mask as claimed in claim 1, wherein said electron reflecting material is at least one selected from the group consisting of bismuth (Bi), tungsten (W), lead (Pb) and the oxides thereof.

7. A paste composition for screen printing of a CRT shadow mask as claimed in claim 1, wherein said frit is at least one selected from the group consisting of titanium oxide, zirconium oxide, alumina, silicon oxide, lead oxide and boron oxide.

8. A screen printing method using a paste composition for screen printing of a CRT shadow mask comprising the steps of:

   (a) uniformly depositing a paste composition comprising 12 ~ 32 wt% of a vehicle, 34 ~ 87 wt% of an electron reflecting material and 0.7 ~ 44 wt% of a frit on a screen mesh on which a reverse pattern with respect to a shadow mask pattern has been formed; and

   (b) putting said shadow mask on a printing substrate and pressing said
screen mesh using a squeezer to spread said paste composition, thereby printing
said shadow mask.

9. A screen printing method as claimed in claim 8, wherein said paste
composition further comprises of a thermal radiating material.

10. A screen printing method as claimed in claim 9, wherein said thermal
radiating material is at least one selected from the group consisting of carbon,
manganese, manganese oxide, dark pigment and aluminum oxide.

11. A screen printing method as claimed in claim 9, wherein content of
said thermal radiating material is 5~30 wt% based on said electron reflecting
material.

12. A screen printing method as claimed in claim 8, wherein said vehicle
is at least one selected from the group consisting of ethyl cellulose, acryl resin,
epoxy resin, urethane resin and ultraviolet-curable resin.

13. A screen printing method as claimed in claim 8, wherein said electron
reflecting material is at least one selected from the group consisting of bismuth
(Bi), tungsten (W), lead (Pb) and the oxides thereof.

14. A screen printing method as claimed in claim 8, wherein said frit is at
least one selected from the group consisting of titanium oxide, zirconium oxide,
alumina, silicon oxide, lead oxide and boron oxide.
FIG. 3

FIG. 4

FIG. 5
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC*: H 01 J 9/14, 29/07

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC*: H 01 J; B 23 B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, JAPIO

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>A</td>
<td>EP 0 665 572 A1 (KABUSHIKI KAISHA TOSHIBA) 02 August 1995 (02.08.95), page 5, line 17 - page 8, line 24.</td>
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<td>US 5 152 707 A (DOUGHERTY et al.) 06 October 1992 (06.10.92), column 5, line 64 - column 9, line 63.</td>
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