

Description

The invention relates to a method of forming a pattern on a substrate.

The invention also relates to a method of manufacturing a display device, a pattern being formed on a surface of said display device.

The invention further relates to a display device manufactured according to a method of the type mentioned in the second paragraph.

For certain applications, some of which will be described hereinafter within the framework of the invention, overlapping patterns can be advantageously formed on the substrate. In general, the aim is to restrict the time necessary for providing such patterns as much as possible.

It is an object of the invention to provide, *inter alia*, a method of the type described in the opening paragraph, which enables overlapping patterns to be rapidly and accurately formed on a substrate.

For this purpose, a method of the type mentioned in the opening paragraph is proposed in claim 1.

A further object of the invention is to provide, *inter alia*, a method of the type mentioned in the second paragraph, by means of which overlapping patterns can be rapidly and accurately formed on a surface of the display device.

For this purpose, a method of the type mentioned in the second paragraph is proposed in Claim 2.

Photosensitive layers as described above are also termed "photo-tacky" layers. This is to be understood to mean that the layer becomes tacky under the influence of light (photons). For simplicity, such layers will hereinafter be termed photo-tacky layers.

Within the framework of the invention, "pattern" is to be understood to mean also a uniform layer.

The invention is based, *inter alia*, on the insight that it is possible to provide two (or more) overlapping patterns on one single photo-tacky layer.

It is assumed that during the second exposure step sufficient material of the photo-tacky layer diffuses through the first-applied powder layer to cause the upper surface of the first-applied powder layer to become tacky, thus causing the next powder layer to adhere to the first powder layer.

As two (or more) powder layers are simultaneously fixed, the method according to the invention is more rapid than a method in which two powder layers are fixed after one another. A further advantage is that, prior to fixing the powder patterns, the mutual position of the powder patterns can be checked.

In an embodiment of the method according to the invention, the surface is a display window and the next powder comprises phosphor particles and the first powder comprises colour-filter particles. This enables a colour-filter layer to be rapidly and accurately provided between the display window and a phosphor layer.

This is important, in particular, when the phosphor particles used are low-energy phosphors, *i.e.* phosphors which luminesce under the influence of electrons having a kinetic energy smaller than approximately 5 KeV.

It is noted, that the use of a "photo-tacky" layer for providing a pattern is known *per se*, and for providing a pattern on a surface of a display device the use of such a photo-tacky layer is known from EP-A-192.301. In said Patent Application a description is given of a method in which a photosensitive layer is provided on a display window of a display device, the tackiness of said layer increasing by photolysis when the layer is exposed to ultraviolet light. Subsequently, the layer is exposed to ultraviolet light, with parts of the layer being covered by a mask. Subsequently, a powder layer, for example containing phosphor particles, is provided on the layer. The phosphor particles adhere to the exposed parts of the photosensitive layer. Loose powder particles, *i.e.* powder particles which do not adhere to the layer, are removed. Next, the powder particles adhering to the layer are fixed on the substrate. In this manner, a single layer is provided on the substrate.

The invention will be explained in greater detail by means of a few exemplary embodiments and with reference to the accompanying drawing, in which

Fig. 1 is a sectional view of a display device manufactured according to the method of the invention;

Fig. 2 is a sectional view of a display window for a display device as shown in Fig. 1.

Figs. 3, 4, 5, 6 and 7 are illustrations of the method according to the invention.

The Figures are diagrammatic and not drawn to scale, corresponding parts in the various embodiments generally bearing the same reference numerals.

Fig. 1 is a sectional view of a display device, in the present example a cathode ray tube, manufactured according to the method of the invention. In a glass envelope 1, which is composed of a display window 2, a cone 3 and a neck 4, there is provided in said neck 4 an electron gun 8 which generates three electron beams 9, 10 and 11. The display window 2 is provided with a display screen 5 on the inside, which display screen comprises, in this example, a large number of triads of phosphor elements. Said elements may consist of lines or dots. Each triad comprises a line having a phosphor luminescing in green, a line having a phosphor luminescing in blue and a line having a phosphor luminescing in red. In this example, the phosphor lines extend transversely to the plane of the drawing. A shadow mask 6 is positioned in front of the display screen, a large number of elongated apertures being formed in said shadow mask through which the electron beams 9, 10 and 11 pass. In operation, the electron beams are deflected across the

display screen 5 by a deflection coil system 12.

Fig. 2 is a sectional view of a display window 2 for a display device as shown in Fig. 1. A display screen (5) is provided on the display window 2. Said display screen comprises phosphor elements 20, 21 and 22 which luminesce in red, green and blue, respectively when electrons impinge on them. Colour-filter layers 23, 24 and 25 are present between the phosphor elements 20, 21 and 22 and the display window 2. Said colour-filter layers filter the light emitted by a phosphor. A blue light-emitting phosphor may also emit, for example, a component of green light. The colour purity of the light emitted by the display device is improved by means of a colour-filter layer which is transparent to blue light but absorbs red and green light. Said colour-filter layer is arranged between the phosphor layer and the display window. This has the advantage, relative to a situation in which colour-filter particles are present among the phosphor particles, that a larger number of electrons impinge on the phosphor particles. This leads to an improved brightness and contrast of the image. This is important, in particular, when in operation the phosphor particles are excited by electrons having a low kinetic energy, i.e. lower than 5 KeV. This is the case, *inter alia*, in certain types of flat cathode ray tubes.

Figs. 3, 4, 5, 6, 7 and 8 are illustrations of the method according to the invention.

A photo-tacky layer 31 is applied to a substrate 30, for example a display window of a display device, the tackiness of said layer increasing when the layer is exposed. Examples of such layers are described in EP-A-192,301. The photo-tacky layer is exposed to ultraviolet light emitted by an ultraviolet source 32. A mask 33 is arranged between the source 32 and the photo-tacky layer 31. The exposed portions 34 of the photo-tacky layer 31 become tacky (Fig. 3). In an example, the portions 34 are exposed using a dose of approximately 5 to 25 milliJoule/cm². The thickness of the photo-tacky layer is approximately a few μm . Subsequently, a powder layer is provided which comprises, for example, colour-filter powder particles. The thickness of the powder layer is, for example, a few tenths of a μm to a few μm . The colour-filter powder particles adhere to the exposed portions 34 of the photo-tacky layer 31. Loose colour-filter powder particles are subsequently removed. The exposed portions 34 are then covered with a pattern 35 of colour-filter particles (Fig. 4).

Subsequently, the photo-tacky layer 31, provided with pattern 35, is again exposed, such that at least partly the already exposed portions 34 are exposed again (Fig. 5). In this second exposure step, the portions 34 are preferably stronger exposed than in the first, above-mentioned exposure step, for example using a dose of approximately 100 to approximately 300 milliJoule/cm². It has been found that a next powder provided after the second exposure adheres to

the pattern 35. The next powder layer has a thickness of, for example, a few μm .

Figs. 3 and 5 show an arrangement in which the surface of the substrate 30 which is covered with the photo-tacky layer 31 faces the light source. This is not to be interpreted in a restrictive manner. In one or both exposure steps, the photo-tacky layer 31 can be exposed through the substrate 30.

It is assumed that during the second exposure step sufficient material of the photo-tacky layer or a sufficient quantity of a constituent of the photo-tacky layer diffuses through the powder layer of the pattern 35 to render the upper surface of the pattern 35 so tacky that the next powder adheres to the pattern 35. In this example, the next powder comprises phosphor particles. Loose phosphor particles are subsequently removed. Portions 34 of the photo-tacky layer 31 are now covered with a pattern 35 of colour-filter particles on which a pattern 36 of phosphor particles is situated (Fig. 6). Both layers are then fixed on the substrate 30 (Fig. 7) in one process step, for example in a manner as described for a single layer in EP-A-192,301.

It will be obvious that the invention is not limited to the example described herein. For example, in a first step a red colour-filter pattern may be provided to which a red phosphor pattern is applied, after which a blue colour-filter pattern is provided next to the red colour-filter pattern, on which blue colour-filter pattern a blue phosphor pattern is provided, after which a green colour-filter pattern is provided next to the red and blue colour-filter patterns, to which green colour-filter pattern a green phosphor pattern is applied, all colour-filter patterns and phosphor patterns then being fixed in one process step. It is alternatively possible to provide three adjacent colour-filter patterns to which a uniform, white light emitting phosphor layer is applied. The first powder layer is not limited to a colour-filter layer. The first powder layer may be a phosphor layer. It is possible, for example, to stack phosphor layers of various colours or compositions, for example having different grain sizes. The first layer may be a colour-filter layer and the second layer may consist of glass particles. The powder particles can be fixed by heating the display window to a temperature above the flow temperature of the glass particles. A glass layer is then formed in which the colour-filter particles are fixed. Subsequently, a phosphor pattern (for example for a cathode ray tube - display device) or an electrode pattern (for example for a LCD (Liquid Crystal Display) - device) can be provided on the glass layer. The surface of the display device may alternatively be, for example, a shadow mask on which a double layer is provided, for example a glass layer to which an index-phosphor pattern is applied. Within the scope of the invention, many variations are possible to those skilled in the art.

Fig. 8 shows, for example, an embodiment in

which colour-filter patterns 35a, 35b and 35c are provided on the display window 30. Colour-filter pattern 35a passes blue light and absorbs red and green light, colour-filter pattern 35b passes red light and absorbs blue and green light, colour-filter pattern 35c passes green light and absorbs red and blue light. Phosphor patterns 36a (comprising a phosphor luminescing in blue), 36b (red phosphor) and 36c (green phosphor) are provided on the colour-filter patterns. The colour-filter patterns overlap each other at locations 39. As a result thereof, a so-called matrix effect is obtained; a strip is provided between the phosphors (at locations 39) which absorbs all the light. In this manner, the separate provision of a matrix pattern is superfluous.

Thus, Fig. 8 shows a display window of a display device, which is provided on one side with at least two colour-filter patterns, said colour-filter patterns overlapping each other in such a manner that said overlaps of the colour-filter patterns form a matrix pattern. It is noted that overlapping colour-filter patterns can also be provided on the display window in a different manner, for example by vacuum evaporation. The method according to the invention enables overlapping colour-filter patterns to be rapidly and accurately provided.

Claims

1. A method of forming a pattern on a substrate (30), wherein a photosensitive layer (31) is applied to the substrate (30) and said layer is thereafter patternwise exposed to photons thereby making the exposed parts (34) sticky, whereafter powder particles are brought into contact with the exposed layer (31) whereby the particles adhere to the exposed parts (34) which are sticky and whereafter residual powder particles are removed from the exposed layer (31), characterized in that thereafter the layer (31) with the adhered powder pattern (35) is exposed to photons according to a second pattern, whereby the second and the first mentioned pattern overlap so that overlapping areas are twice exposed, thereby making the parts exposed according to the second pattern, which parts include overlapping areas on which the first mentioned powder particles are adhered, sticky, whereafter a next powder is brought into contact with the exposed layer whereby the powder particles adhere to the parts exposed according to the second pattern which are sticky, said parts including the overlapping areas and whereafter residual powder particles are removed from the exposed layer, whereby on the overlapping areas two powders (35+36) are adhered, one (36) on top of the other (35), whereafter the adhering powder particles are fixed on

the substrate (2).

2. A method of manufacturing a display device, a pattern being formed on a surface (2) of the display device, wherein a photosensitive layer (31) is applied to the surface (2) and said layer is thereafter patternwise exposed to photons thereby making the exposed parts (34) sticky, whereafter powder particles are brought into contact with the exposed layer whereby the particles adhere to the exposed parts (34) which are sticky and whereafter residual powder particles are removed from the exposed layer (31), characterized in that thereafter the layer (31) with the adhered powder pattern (35) is exposed to photons according to a second pattern, whereby the second and the first mentioned pattern overlap so that overlapping areas are twice exposed, thereby making the parts exposed according to the second pattern, which parts include overlapping areas on which the first mentioned powder particles are adhered, sticky, whereafter a next powder is brought into contact with the exposed layer whereby the powder particles adhere to the parts exposed according to the second pattern which are sticky said parts including the overlapping areas and whereafter residual powder particles are removed from the exposed layer, whereby on the overlapping areas two powders (35+36) are adhered, one (36) on top of the other (35), whereafter the adhering powder particles are fixed on the surface (2).
3. A method as claimed in Claim 2, characterized in that the surface is a display window, the next powder contains phosphor particles and the first powder comprises colour-filter particles.
4. A method as claimed in Claim 3, characterized in that the phosphor particles comprise low-energy phosphors.
5. A method as claimed in Claim 2, characterized in that the next powder comprises glass particles and the first powder comprises colour-filter particles.
6. A method as claimed in Claim 2, characterized in that the first powder comprises colour-filter particles and the next powder comprises colour-filter particles of a different colour.
7. A display device manufactured according to the method as claimed in Claim 2, 3, 4, 5 or 6.



which colour-filter patterns 35a, 35b and 35c are provided on the display window 30. Colour-filter pattern 35a passes blue light and absorbs red and green light, colour-filter pattern 35b passes red light and absorbs blue and green light, colour-filter pattern 35c passes green light and absorbs red and blue light. Phosphor patterns 36a (comprising a phosphor luminescing in blue), 36b (red phosphor) and 36c (green phosphor) are provided on the colour-filter patterns. The colour-filter patterns overlap each other at locations 39. As a result thereof, a so-called matrix effect is obtained; a strip is provided between the phosphors (at locations 39) which absorbs all the light. In this manner, the separate provision of a matrix pattern is superfluous.

Thus, Fig. 8 shows a display window of a display device, which is provided on one side with at least two colour-filter patterns, said colour-filter patterns overlapping each other in such a manner that said overlaps of the colour-filter patterns form a matrix pattern. It is noted that overlapping colour-filter patterns can also be provided on the display window in a different manner, for example by vacuum evaporation. The method according to the invention enables overlapping colour-filter patterns to be rapidly and accurately provided.

Claims

1. A method of forming a pattern on a substrate (30), wherein a photosensitive layer (31) is applied to the substrate (30) and said layer is thereafter patternwise exposed to photons thereby making the exposed parts (34) sticky, whereafter powder particles are brought into contact with the exposed layer (31) whereby the particles adhere to the exposed parts (34) which are sticky and whereafter residual powder particles are removed from the exposed layer (31), characterized in that thereafter the layer (31) with the adhered powder pattern (35) is exposed to photons according to a second pattern, whereby the second and the first mentioned pattern overlap so that overlapping areas are twice exposed, thereby making the parts exposed according to the second pattern, which parts include overlapping areas on which the first mentioned powder particles are adhered, sticky, whereafter a next powder is brought into contact with the exposed layer whereby the powder particles adhere to the parts exposed according to the second pattern which are sticky, said parts including the overlapping areas and whereafter residual powder particles are removed from the exposed layer, whereby on the overlapping areas two powders (35+36) are adhered, one (36) on top of the other (35), whereafter the adhering powder particles are fixed on the substrate (2).
2. A method of manufacturing a display device, a pattern being formed on a surface (2) of the display device, wherein a photosensitive layer (31) is applied to the surface (2) and said layer is thereafter patternwise exposed to photons thereby making the exposed parts (34) sticky, whereafter powder particles are brought into contact with the exposed layer whereby the particles adhere to the exposed parts (34) which are sticky and whereafter residual powder particles are removed from the exposed layer (31), characterized in that thereafter the layer (31) with the adhered powder pattern (35) is exposed to photons according to a second pattern, whereby the second and the first mentioned pattern overlap so that overlapping areas are twice exposed, thereby making the parts exposed according to the second pattern, which parts include overlapping areas on which the first mentioned powder particles are adhered, sticky, whereafter a next powder is brought into contact with the exposed layer whereby the powder particles adhere to the parts exposed according to the second pattern which are sticky said parts including the overlapping areas and whereafter residual powder particles are removed from the exposed layer, whereby on the overlapping areas two powders (35+36) are adhered, one (36) on top of the other (35), whereafter the adhering powder particles are fixed on the surface (2).
3. A method as claimed in Claim 2, characterized in that the surface is a display window, the next powder contains phosphor particles and the first powder comprises colour-filter particles.
4. A method as claimed in Claim 3, characterized in that the phosphor particles comprise low-energy phosphors.
5. A method as claimed in Claim 2, characterized in that the next powder comprises glass particles and the first powder comprises colour-filter particles.
6. A method as claimed in Claim 2, characterized in that the first powder comprises colour-filter particles and the next powder comprises colour-filter particles of a different colour.
7. A display device manufactured according to the method as claimed in Claim 2, 3, 4, 5 or 6.



Patentansprüche

1. Verfahren zur Musterbildung auf einem Substrat (30), wobei eine photoempfindliche Schicht (31) auf dem Substrat (30) angebracht wird und diese Schicht danach bemustert mit Photonen belichtet wird, wobei die belichteten Teile (34) klebrig werden, wonach Pulverteilchen mit der belichteten Schicht (31) in Kontakt gebracht werden, die Teilchen an den belichteten Teilen (34) haften, die klebrig sind, und danach restliche Pulverteilchen von der belichteten Schicht (31) entfernt werden, dadurch gekennzeichnet, daß anschließend die Schicht (31) mit dem anhaftenden Pulvermuster (35) mit Photonen nach einem zweiten Muster belichtet werden, wobei das zweite und das erstgenannte Muster einander derart überlappen, daß überlappende Bereiche zweimal belichtet werden, wodurch die Teile entsprechend dem zweiten Muster belichtet werden, diese Teile überlappende Bereiche umfassen, auf denen die erstgenannten Pulverteilchen angehaftet sind, angehaftet und klebrig sind, wonach ein folgendes Pulver mit der belichteten Schicht in Kontakt gebracht wird, wobei die Pulverteilchen an den entsprechend dem zweiten Muster belichteten Teilen haften, die klebrig sind, diese Teile die überlappenden Gebiete umfassen, und anschließend restliche Pulverteilchen von der belichteten Schicht entfernt werden, wobei an den überlappenden Gebieten zwei Pulver (35+36) anhaften, eines (36) auf dem anderen (35), wonach die anhaftenden Pulverteilchen auf dem Substrat (2) fixiert werden.

2. Verfahren zur Herstellung einer Bildwiedergabeanordnung, wobei ein Muster auf einer Oberfläche (2) der Bildwiedergabeanordnung (1) gebildet wird, eine photoempfindliche Schicht (31) auf der Oberfläche (2) angebracht wird, und diese Schicht danach mit den Photonen bemustert belichtet werden, wodurch die belichteten Teile (34) klebrig werden, wonach Pulverteilchen mit der belichteten Schicht in Kontakt gebracht werden, wobei die Teilchen an den belichteten Teilen (34) haften, die klebrig sind, und wonach restliche Pulverteilchen von der belichteten Schicht (31) entfernt werden, dadurch gekennzeichnet, daß anschließend die Schicht (31) mit dem anhaftenden Pulvermuster (35) mit Photonen entsprechend einem zweiten Muster belichtet werden, wobei das zweite und das erstgenannte Muster einander derart überlappen, daß überlappende Bereiche zweimal belichtet werden, wodurch die Teile entsprechend dem zweiten Muster belichtet werden, diese Teile überlappende Bereiche umfassen, auf denen die erstgenannten Pulverteilchen anhaften, klebrig sind, wonach ein folgen-

des Pulver mit der belichteten Schicht in Kontakt gebracht wird, wobei die Pulverteilchen an den entsprechend dem zweiten Muster belichteten Teilen haften, die klebrig sind, diese Teile die überlappenden Bereiche umfassen, und danach restliche Pulverteilchen von der belichteten Schicht entfernt werden, wobei auf den überlappenden Bereichen zwei Pulver (35+36) anhaften, eines (36) auf dem anderen (35), wonach die anhaftenden Pulverteilchen auf der Oberfläche (2) fixiert werden.

3. Verfahren nach Anspruch 2, dadurch gekennzeichnet, daß die Oberfläche ein Bildwiedergabefenster ist, das folgende Pulver Leuchtstoffteilchen enthält und das erste Pulver Farbfilterteilchen enthält.

4. Verfahren nach Anspruch 3, dadurch gekennzeichnet, daß die Leuchtstoffteilchen Niederenergieleuchtstoffe enthalten.

5. Verfahren nach Anspruch 2, dadurch gekennzeichnet, daß das folgende Pulver Glasteilchen enthält, und das erste Pulver Farbfilterteilchen enthält.

6. Verfahren nach Anspruch 2, dadurch gekennzeichnet, daß das erste Pulver Farbfilterteilchen enthält, und das folgende Pulver Farbfilterteilchen einer anderen Farbe enthält.

7. Bildwiedergabeanordnung in der Herstellung mit dem Verfahren nach Anspruch 2, 3, 4, 5 oder 6.

Revendications

1. Procédé de formation d'une configuration sur un substrat (30), dans lequel une couche photosensible (31) est appliquée au substrat (30) et ladite couche est ensuite exposée selon une configuration à des photons, ce qui a pour effet de rendre les parties exposées (34) collantes, après quoi des particules de poudre sont amenées en contact avec la couche exposée (31), de telle sorte que les particules adhèrent aux parties exposées (34) qui sont collantes et, ensuite, les particules de poudre résiduelles sont éliminées de la couche exposée (31), caractérisé en ce que, ensuite, la couche (31) avec la configuration de poudre collée (35) est exposée à des photons selon une deuxième configuration, si bien que la deuxième configuration et la première configuration mentionnée se chevauchent, de sorte que les zones qui se chevauchent sont exposées deux fois, ce qui a pour effet de rendre collantes les parties exposées selon la deuxième configura-



- ration, qui comprennent des zones chevauchantes auxquelles les particules de poudre mentionnées en premier lieu adhèrent, après quoi une poudre suivante est amenée en contact avec la couche exposée, de telle sorte que les particules de poudre adhèrent aux parties exposées selon la deuxième configuration qui sont collantes, lesdites parties comprenant les zones de chevauchement, et, ensuite, les particules de poudre résiduelles sont éliminées de la couche exposée, si bien que deux poudres (35 + 36) sont collées dans les zones chevauchantes, une (36) par-dessus l'autre (35), après quoi les particules de poudre adhérentes sont fixées sur le substrat (2).
2. Procédé de fabrication d'un dispositif d'affichage, une configuration étant formée sur la surface (2) du dispositif d'affichage, dans lequel une couche photosensible (31) est appliquée à la surface (2) et ladite couche est ensuite exposée selon une configuration à des photons, ce qui a pour effet de rendre collantes les parties exposées (34), après quoi des particules de poudre sont amenées en contact avec la couche exposée, de telle sorte que les particules adhèrent aux parties exposées (34) qui sont collantes et, ensuite, les particules de poudre résiduelles sont éliminées de la couche exposée (31), caractérisé en ce qu'ensuite la couche (31) avec la configuration de poudre collée (35) est exposée à des photons selon une deuxième configuration, si bien que la première configuration et la deuxième configuration mentionnée en premier lieu se chevauchent, de sorte que les zones chevauchantes sont exposées deux fois, ce qui a pour effet de rendre collantes les parties exposées selon la deuxième configuration, lesdites parties comprenant des zones chevauchantes sur lesquelles les particules de poudre mentionnées en premier lieu sont collées, après quoi une poudre suivante est amenée en contact avec la couche exposée, de sorte que les particules de poudre adhèrent aux parties exposées selon la deuxième configuration qui sont collantes, lesdites parties comprenant des zones chevauchantes et, ensuite, les particules de poudre résiduelles sont éliminées de la couche exposée, de sorte que deux poudres (35 + 36) sont collées sur les zones chevauchantes, une (36) par-dessus l'autre (35), après quoi les particules de poudre adhérentes sont fixées à la surface (2).
3. Procédé selon la revendication 2, caractérisé en ce que la surface est une fenêtre d'affichage, la poudre suivante comprenant des particules de luminophores et la première couche comprend des particules filtrantes de couleur.
4. Procédé selon la revendication 3, caractérisé en ce que les particules de luminophores comprennent des luminophores à faible énergie.
5. Procédé selon la revendication 2, caractérisé en ce que la poudre suivante comprend des particules de verre et la première poudre comprend des particules filtrantes de couleur.
6. Procédé selon la revendication 2, caractérisé en ce que la première couche comprend des particules filtrantes de couleur et la poudre suivante, des particules filtrantes de couleur d'une couleur différente.
7. Dispositif d'affichage fabriqué selon le procédé des revendications 2, 3, 4, 5 ou 6.