

RTMP

EL DISPLAY AND LUMINOUS DIAL USING SAME

Detailed Description of the Invention

The present invention relates to an EL display and a luminous dial using the same.

Prior Art

In conventional EL displays, when characters, pictorial designs or indicias are displayed, a method of printing an ordinary coating material onto the surface of a transparent substrate of the EL panel (disclosed in, for example, United States Patent 4,775,964), a method of forming beforehand characters, pictorial designs or indicias onto a light transmission sheet (decorative sheet) provided separately from the EL panel, by, for example, printed coating material, and other similar methods have been adopted.

Problems To Be Solved By the Invention

When a coating material is printed on the surface of the transparent substrate of the EL panel, it is necessary to perform printing of the coating material or the like as a separate step after having manufactured a complete EL panel by screen printing or the like. For this reason, the manufacturing process becomes complex. Usually, when forming an EL panel, each relevant layer is sequentially laminated on the transparent electrode deposited on a transparent substrate. In contrast, the step of printing the coating material on the transparent substrate necessitates inverting the EL panel and performing

printing thereon from the opposite side thereof. As a result, it is impossible to perform this step as one of a series of continuous operations.

When characters, pictorial designs, indicias or the like are formed on the light transmission sheet as a separate member from an EL panel, the manufacturing process becomes troublesome in such ways as, for example, necessitating the execution of a step for bonding the light transmission sheet and the EL panel. In addition, since the luminescent surface of the EL panel is coated by the light transmission sheet, a decrease in luminance is unavoidable. Particularly, when low voltage driving is needed such as, for example, when the EL panel is used in a timepiece dial, decrease in the luminance becomes a significant problem.

Further, in each of the two above-mentioned conventional techniques, since indicias such as numerals or the like are each made of an ordinary coating material, although the EL panel per se emits light of high luminance, such numerals or the like do not emit light. Therefore, the display thereof becomes planar with the result that decorativeness becomes somewhat inferior.

In view of the above, the object of the present invention is to provide an EL display which is simple to manufacture and can produce the desired display with no decrease in luminance, and to provide a decorative luminous dial using this EL display.

Means For Solving The Problems

An EL display according to the present invention is formed such that it comprises a transparent substrate having a transparent electrode on one side surface thereof, the transparent electrode having sequentially laminated thereon a print pattern layer formed into a desired display pattern such as a pictorial design or the like, a luminescent layer containing luminescent material, an insulating layer containing high dielectric material, and a rear electrode.

Preferably, a fluorescent layer containing fluorescent pigment or fluorescent dye is adopted as this print pattern layer. In this case, when an electric field is applied to the transparent electrode and the rear electrode, the fluorescent layer produces a secondary luminescence due to light given off from the luminescent layer to thereby display the desired display pattern by luminescence with a color different from the color of portions other than the desired display pattern.

Further, preferably, the EL display is provided with a hole through which an indicator hand shaft having indicator hands secured thereto can pass, whereby the EL display can be constructed as a luminous dial.

Embodiment Mode of the Invention

As illustrated in Fig. 1, an EL display according to the present invention has a transparent electrode 2 formed by depositing indium tin oxide (ITO) on a transparent substrate 1 made of, for example, plastic such as

polyethylene terephthalate (PET). On this transparent electrode 2 there are sequentially formed, by screen printing or the like, a fluorescent layer 3 as an example of a print pattern layer, an electro-luminescent layer 4, an insulating layer 5 and a rear electrode 6. The rear electrode 6 is made of carbon paste, and the insulating layer 5 is prepared by printing and drying an ink wherein barium titanate (BaTiO_3) as a high dielectric material and fluoride resin binder have been mixed with each other and stirred. Also, the electro-luminescent layer 4 is prepared by printing and drying an ink wherein a luminescent material, prepared by doping copper (Cu) onto zinc sulfide as a fluorescent material, and fluoride resin binder have been mixed with each other and stirred. In this embodiment, the fluorescent layer 3 is adopted as the print pattern layer. This fluorescent layer is one prepared by printing and drying an ink wherein fluorescent pigment and fluoride resin binder have been mixed with each other and stirred. Preferably, the amount of fluorescent pigment contained therein is set such that the weight ratio thereof to the binder is more than 3 : 10.

Figs. 2 and 3 illustrate an example wherein the above-mentioned display has been adopted as a dial for a timepiece. The transparent substrate 1 is formed into a dial configuration, and a hole 7 is formed at the center thereof. A draw-out portion 2a of the transparent electrode 2 and a draw-out portion 6a of the rear electrode 6 are provided. On the back of the rear electrode 6 there is provided by lamination a protective coating layer 14 made of resin such as silicon, vinyl chloride, fluoride resin, urethane, butadiene rubber or the like.

The fluorescent layer 3 is formed on the transparent electrode 2 on the rear surface of the transparent substrate 1, and is provided with twelve marks 3a which serve as luminous hour divisions and sixty dots 3b which serve as minute divisions. The EL display per se is formed into a circular dial configuration. When an electric field is applied thereto, the entire surface of the electroluminescent layer 4 emits light. Accordingly, the portion of the electro-luminescent layer 4 having no fluorescent layer 3 thereon (the portion other than that having the time divisions) emits light with a luminescence color peculiar to the electro-luminescent layer 4 (determined by the type, etc. of luminescent material contained therein; in the present embodiment, a bluish-green color). This luminescence color becomes the ground color of the dial. Meanwhile, in the portion of the electro-luminescent layer having the fluorescent layer 3 (the time division portion), the light given off from the electro-luminescent layer 4 enters into the fluorescent layer 3 with the result that the fluorescent layer 3 gives off light as a secondary luminescence. In this embodiment, since a fluorescent pigment having fluorescent orange is used, the time division emits light with high luminance of a fluorescent orange color in the ground color which brightens with the bluish green color. At a time of non-luminescence, the portion having no fluorescent layer 3 thereon has an opalescent ground color (the color of the base material of the electro-luminescent layer) and the time division has an orange color which is the color of the fluorescent pigment when no luminescence occurs (the orange color with no brilliance as compared with the fluorescent orange color rendered when luminescence occurs). Since the fluorescent layer 3 can be easily formed by, for example, a screen printing technique, any desired

complex display pattern can be easily obtained.

The reason why the fluoride resin binder is used in the fluorescent layer, electro-luminescent layer 4 and insulating layer 5 is for the purpose of reducing the amount of water entering into the luminescent material of the luminescent layer by including therein of a fluoride resin binder having high moisture resistance to thereby prevent degradation of the layers due to hydrolysis. This eliminates the necessity of sealing the work with the use of a moisture-proof film. Accordingly, it is possible to use the electro luminescent layer as an electro-luminescent area up to the inner peripheral end of the hole 7.

As illustrated in Fig. 3, an hour hand shaft 8, minute hand shaft 9 and second hand shaft 10 each of which extends from a timepiece mechanical body (not illustrated) passes through the hole 7 of the EL dial which consists of the EL display wherein the transparent substrate 1, transparent electrode 2, fluorescent layer 3, electroluminescent layer 4, insulating layer 5, rear electrode 6 and protective coating layer 14 are laminated, and each of these shafts projects therefrom. An hour hand 11, minute hand 12 and second hand 13 are respectively secured to the indicator hand shafts 8, 9 and 10. Each of these hands is driven by the timepiece mechanical body (not illustrated) and is rotated in front of the EL dial illustrated in Fig. 2 to thereby indicate time.

Various combinations in the luminescence color are possible by changing the type of luminescent material contained in the luminescent layer

4, or the type of fluorescent pigment or dye contained in the fluorescent layer 3. Further, by including pigments or dyes (including fluorescent pigments or dyes) in the luminescent layer 4 as well, variations in the luminescence color can be made wider and simultaneously the tint of the ground color can also be set arbitrarily.

Although in the above-mentioned embodiment the fluorescent layer containing fluorescent pigment or dye is used as the print pattern layer, the present invention is not limited thereto. Namely, the print pattern layer may be provided by an ordinary ink containing dye, pigment or the like (including light shielding ones and semi-transparent ones) having no fluorescence. In this case, display by a tint peculiar to this print pattern layer is made on the luminescence color surface of the luminescent layer 4. When part of the print pattern layer is formed by the same fluorescent layer as in the case of the above-mentioned embodiment and the remainder thereof is formed by an ordinary ink layer, it is possible to obtain wider variations in the display. As mentioned above, in the present invention, by adopting various constructions as that of the print pattern layer, it is possible to widen the scope of variations in the display.

The content of the display made by the print pattern layer is not limited to such divisions as have been stated in the above-mentioned embodiment. Namely, it is also possible to display characters, pictures or the like. In addition, the EL display according to the present invention can be applied not only to a timepiece dial but also to any desired one of various

displays.

Effect of the Invention

According to the present invention, since the print 10 pattern layer formed in a desired display pattern is provided as an inside layer of the EL display, it is possible to make a desired configuration of display with a color different from the ground luminescence color without performing any extra work after the production of the EL display. Namely, the manufacturing process is not only simple to execute but there is no likelihood that brightness decreases as when using a filter.

Particularly, in a case where the fluorescent layer is provided as the print pattern layer, the display configuration emits bright light with a fluorescence color in the EL luminescence color as the ground color. Therefore, the EL display is very attractive and has excellent visual recognizability and therefore is suitable for use in a luminescent dial of which decorativeness is demanded, as in the case of a timepiece dial.

Brief Description of the Drawings

Fig. 1 is an enlarged sectional view illustrating an EL display according to the present invention.

Fig. 2 is a front view illustrating a luminescent dial using the EL display.

Fig. 3 is a sectional view illustrating essential components of the luminescent dial in a state wherein it is adopted in a timepiece.

Description of the Reference Symbols

- 1 --- transparent substrate,
- 2 --- transparent electrode,
- 3 --- fluorescent layer (print pattern layer),
- 4 --- luminescent layer,
- 5 --- insulating layer,
- 6 --- rear electrode,
- 7 --- hole,
- 8, 9, 10 --- indicator hand shafts,
- 11, 12, 13 --- indicator hands.



Claims

Claim 1

An EL display characterized by comprising a transparent substrate having a transparent electrode on one side surface thereof, the transparent electrode having sequentially laminated thereon a print pattern layer formed into a desired display pattern such as a pictorial design or the like, an electro luminescent layer containing luminescent material, an insulating layer containing high dielectric material, and a rear electrode.

Claim 2

An EL display as set forth in claim 1, characterized in that the print pattern layer is a fluorescent layer containing fluorescent pigment or fluorescent dye and, when an electric field is applied to the transparent electrode and the rear electrode, produces a secondary luminescence due to light given off from the electro-luminescent layer to thereby display a desired display configuration by luminescence with a color different from a color of portions other than the desired display configuration.

Claim 3

A luminescent dial using the EL display as set forth in claim 1 or 2, characterized by comprising a hole through which indicator hand shafts respectively having indicator hands secured thereto can pass, the print pattern layer being formed into a configuration of indicias such as divisions, numerals, and the like.