Abstract:
Provided is a laser induced thermal imaging (LITI) donor film, and more particularly, a Donor film for LITI process having an LITI component used in an LITI process or similar processes.
Description

Title of Invention: DONOR FILM FOR LITI PROCESS

Technical Field

[1] The following disclosure relates to a laser induced thermal imaging (LITI) donor film, and more particularly, to an Donor film for LITI process having an LITI component used in an LITI process or similar processes.

Background Art

[2] Recently, display devices have been developed toward to consume less energy and have superior visibility. For this reason, there is competition in the development of display devices using an organic light emitting diode (OLED) which is known to consume less energy as compared with the existing light emission manner.

[3] In order to implement full color in these display devices using an OLED, it is very important to perform color patterning on light emitting elements. Resultantly, there is a difference in implementation effect depending on the method of forming an organic film of the OLED, which determines a color of the light emitting element. The organic film is formed in the OLED by a deposition method, an inkjet method, a laser induced thermal imaging (LITI) method, or the like. Among them, the laser induced thermal imaging method, conventionally called LITI, allows the organic film to be formed in the OLED by converting light emitted from laser into heat energy and transferring a transfer layer onto a substrate of the OLED. This transferring method is disclosed in Korean Patent Registration No. 10-0700828 and the like. The LITI method has advantages in formation of high-resolution patterns, uniformity of film thickness, ability to implement multiple layers, and expandability to large-sized mother glasses.

[4] In this LITI method, a decisive medium for forming patterns on a substrate of the light emitting element by converting light into heat energy is an Donor film for LITI process including a transfer layer having red pixel regions (R), green pixel regions (G), and blue pixel regions (B). The Donor film for LITI process has a structure where a base film, a light-to-heat conversional layer, and a pattern-directing layer are sequentially laminated. This Donor film for LITI process optionally includes an interlayer between the light-to-heat conversional layer and the transfer layer in order to prevent a material contained in the light-to-heat conversional layer from being transferred onto the transfer layer.

[5] According to the LITI process, when laser is applied onto an Donor film for LITI process, light energy of the laser is converted into light energy in the light-to-heat conversional layer, and the light-to-heat conversional layer and the interlayer are volume-expanded by the heat energy whereby this volume expansion leads the transfer layer to
be transferred onto an OLED substrate. However, in the LITI process, the laser, which is irradiated in order to induce volume expansion of the light-to-heat conversional layer and the interlayer, is absorbed into or scattered from optical defects present inside the base film, to thereby prevent the laser from being irradiated onto the light-to-heat conversional layer or onto a desired position of the light-to-heat layer, and thus the transfer layer may not be partially transferred.


Disclosure of Invention

Technical Problem

7. The present inventors studied a partial untransferring phenomenon of a transfer layer, and found that the phenomenon results from optical defects inside a base film. Therefore, the present inventors secure an optimal base film for a donor film applied for a laser induced thermal imaging (LITI) process and thus uses the film to provide a donor film having improved LITI processability.

8. An embodiment of the present invention is directed to providing a Donor film for LITI process capable of solving the partial untransferring phenomenon of the transfer layer at the time of an LITI process, and more specifically, in order to manufacture a donor film having improvement in a untransferring phenomenon of the transfer layer, an embodiment of the present invention is directed to providing a donor film to which a base film is applied, the base film having reduced optical defects absorbing/scattering laser.

Solution to Problem

9. In one general aspect, there is provided an Donor film for LITI process including a polyester base film where the number of defects having a size of $1.5 \mu m$ or greater in an area of $448 \times 336 \mu m$ is $5$ or less and a b-value of resin color is $4.0$ or lower.

10. Here, in the base film, a ratio of effective defects according to Equation 1 below is $10\%$ or lower:

\[
\text{Ratio of Effective Defects} \% = \left[ \frac{\text{Number of Defects having a size of } 5 \mu m \text{ or larger}}{\text{Total Number of Defects having a size of } 5 \mu m \text{ or larger}} \right] \times 100.
\]

11. [Equation 1]

12. The Donor film for LITI process may further include a light-to-heat conversion layer and an interlayer.

13. The Donor film for LITI process may further include a primer layer between the base film and the light-to-heat conversion layer.

14. The Donor film for LITI process may further include a transfer layer on the interlayer.

Advantageous Effects of Invention
As set forth above, according to the present invention, the base film of which optical defects are solved is applied to a donor film in an LITI process, thereby improving the partial untransferring phenomenon of the transfer layer and thus improving pixel defects of an organic light emitting device (OLED).

**Brief Description of Drawings**

- FIG. 1 shows one embodiment of the present invention;
- FIG. 2 shows another embodiment of the present invention;
- FIG. 3 shows still another embodiment of the present invention;
- FIG. 4 is an image for illustrating one method of determining a size of an optical defect according to the present invention;
- FIG. 5 is an image for illustrating another method of determining a size of an optical defect according to the present invention;
- FIG. 6 is an image for illustrating still another method of determining a size of an optical defect according to the present invention;
- FIG. 7 is an image for illustrating still another method of determining a size of an optical defect according to the present invention;
- FIG. 8 is an image for illustrating still another method of determining a size of an optical defect according to the present invention; and
- FIG. 9 is an image for illustrating another method of determining a size of an optical defect according to the present invention.

**Detailed Description of Main Elements**

- 10: base film
- 20: light-to-heat conversion layer
- 30: interlayer
- 40: primer layer
- 50: transfer layer

**Mode for the Invention**

Hereinafter, respective constitutions of the present invention will be described in more detail.

**Base Film**

The present inventors found that a partial untransferring phenomenon of a transfer layer results from optical defects inside a base film when a polyester film is used as a base film, and then completed the present invention.

Therefore, the research of factors causing optical defects of the polyester film confirmed that the optical defects of the polyester film are due to a catalyst and an electrostatic pinning agent used at the time of polyester resin polymerization. It was confirmed that metal components contained in the catalyst and the electrostatic pinning
agent were precipitated or used to form a complex within the resin, and then was present inside the polyester after preparation of the resin, thereby acting as optical defects at the time of manufacturing a film and thus causing the absorption/scattering of laser irradiated at the time of an LITI process.

Therefore, the present inventors found that, in the manufacturing of a polyester film used as a base film at the time of manufacturing of a donor film, a polyester film having reduced internal optical defects are manufactured by reducing contents of a catalyst and a pinning agent within ranges in which pinning property are not affected during a film manufacturing process, whereby a donor film having an improvement in the partial untransferring phenomenon of a transfer layer could be provided, and thus completed the present invention.

Particularly, the present inventors found that the optical defects could be solved when the metal content in a metal compound used as a catalyst was 150ppm or less, and more specifically 100~150ppm at the time of polyester resin polymerization and the total metal content in alkali metal or alkali earth metal used as an electrostatic pinning agent was 50ppm or less, and more specifically 10~50ppm at the time of polyester resin polymerization, and thus a polyester film having high light transmittance could be manufactured.

In addition, the present inventors found that, a phosphorous compound may be further used in order to give thermal stability to the polyester resin, and here, since phosphorous (P) contained in the phosphorous compound is also a metal component, the optical defects could be solved when the phosphorous compound was added within the range satisfying Equation 2 below, and thus a polyester film having high light transmittance could be manufactured.

\[ 0.5 < \frac{[P]}{[Me]} \leq 1.5 \]

(where in Equation 2, \([P]\) means equivalent of phosphorous in a phosphorous compound, and \([Me]\) means total equivalent of metal in a metal compound used as a pinning agent).

In Equation 1 above, the equivalent means the number of moles of an ion included in the metal atoms. Also, it is expressed by the product of the number of moles of a metal atom in the metal compound, which is fed in PET resin, and the number of ions included in the metal atom. That is, the equivalent of metal is introduced by Equations 2 to 4 below.

\[ \text{Atom content} = \text{feeding amount} \times \text{atomic weight} \div \text{molecular weight} \] (Equation 2)

\[ \text{Number of moles of atom} = \text{atom content} \div \text{atomic weight} \] (Equation 3)

\[ \text{Equivalent of metal atom} = \text{number of moles of metal atom} \times \text{number of ions included in metal atom} \] (Equation 4).
Ex.) Equivalent of [Mg] = number of moles of [Mg] fed x 2(+)

The polyester resin may be a general polyester homopolymer or polyester copolymer that may be prepared by an esterification or transesterification reaction, for example, a melting polycondensation method of dicarboxylic acid or an ester derivative thereof and diol or an ester derivative thereof.

The dicarboxylic acid or the ester derivative thereof may be terephthalic acid, 2,6-naphthalene dicarboxylic acid, isophthalic acid, phthalic acid, 5-sodium sulfone isophthalic acid, 1,4-cyclohexane dicarboxylic acid, 1,3-cyclohexane dicarboxylic acid, or ester derivatives thereof.

The diol or the ester derivative thereof may be any one or a mixture of at least two selected from the group consisting of ethylene glycol, 1,3-propanediol, 1,4-butanediol, 1,6-hexanediol, neopentyl glycol, 1,4-cyclohexanediethanol, bisphenol A, and bisphenol S.

In the present invention, as the catalyst, any catalyst that can be used at the time of polyester polycondensation may be used without limitation. More preferably, a metal catalyst such as tin, antimony, or the like, may be used, and specifically, for example, an antimony compound, a germanium compound, a titanium compound, or the like may be used. Here, the metal content in the catalyst is preferably 150ppm or less, and more specifically 100~150ppm in the polyester resin composition. If the metal content in the catalyst is below 100ppm, the use of the catalyst may be less effective. If the metal content in the catalyst is above 150ppm, the metal may be precipitated or form a complex due to excessive use of the metal, causing optical defects.

In the present invention, as the electrostatic pinning agent, any electrostatic pinning agent that can be usually used may be used without limitation, but more preferably, a metal-based pinning agent may be used, and more specifically an alkali metal compound, an alkali earth metal compound, a manganese compound, a cobalt compound, a zinc compound, or the like may be preferably used due to great electrostatic activity thereof. Specific examples thereof may be magnesium acetate, sodium acetate, calcium acetate, lithium acetate, calcium phosphate, magnesium oxide, magnesium hydroxide, magnesium alkoxide, manganese acetate, zinc acetate, or the like, and one thereof or a mixture of two or more thereof may be used. In the case where two or more thereof are mixingly used, the total content of metal is preferably 50ppm or less in the polyester resin composition.

When the total content of metal in the electrostatic pinning agent is 50ppm or less, more specifically 10~50ppm in the polyester resin composition, there can be manufactured a polyethylene terephthalate film capable of solving optical defects and having high light transmittance. If the metal content in the electrostatic pinning agent is 10ppm or less, improvement of drivability due to the use of the pinning agent can not
be obtained, failing to manufacture a uniform film. If the metal content in the electrostatic pinning agent is above 50ppm, agglomeration may occur or complexes may be formed due to the use of excessive metal, causing optical defects.

The polyethylene terephthalate resin used herein may further contain a phosphorous compound in order to give thermal stability thereto, as necessary. Specific examples of the phosphorous compound may be trimethylphosphate, triethylphosphate, phosphoric acid, and the like. The phosphorous compound may give an effect of improving pinning property in addition to thermal stability. Here, since phosphorous (P) contained in the phosphorous compound is also a metal component, the content of phosphorous (P) is preferably 50ppm or less, and more specifically 10~50ppm in the polyester resin composition when the phosphorous compound is added. More preferably, within the range of phosphorous (P) satisfying Equation 2 below, a polyethylene terephthalate film capable of solving optical defects and having high light transmittance can be manufactured.

\[ 0.5 < \frac{[P]}{[Me]} < 1.5 \]  

(where in Equation 2, [P] means equivalent of phosphorous in a phosphorous compound, and [Me] means total equivalent of metal in a metal compound used as a pinning agent).

Equation 2 expresses an equivalent ratio of a negative ion from phosphorous to a positive ion from metal. Since the current applied to a casting drum is generally negative (-) current, the polyester resin composition preferably exhibits positive (+) current in order to give pinning property to the film. For this reason, it is preferable to control the equivalent ratio to thereby exhibit the positive (+) current when the phosphorous compound is added as above. If the equivalent ratio in Equation 2 is below 0.5, drivability and heat resistance may be deteriorated at the time of film manufacturing, resulting in reducing productivity and incurring a thermochromic phenomenon of the film, and thermal dimensional stability may be deteriorated at the time of application to a subsequent process as a base film. If the equivalent ratio is above 1.5, the optical defects may be increased at the time of manufacturing the base film, and thus the partial untransferring phenomenon of the transfer layer may increasingly occur at the time of application as a donor film. Therefore, within the range of equivalent ratio, there can be manufactured a polyester film having excellent drivability, less optical defects, and high light transmittance.

The polyethylene terephthalate film used as a base film in the present invention is manufactured by melting and extruding a polyethylene terephthalate chip at 270 ~ 290°C, rapidly cooling it at 24°C using large-sized rolls to thereby be made into a sheet form, stretching the obtained sheet in a machine direction (MD) at a stretching ratio of
3-4 times at 100 ~ 120°C and in a transverse direction (TD) at a stretching ratio of 3-4 times at 120 - 140°C, and performing heat treatment at 250°C, to thereby obtain a biaxially stretched polyethyleneterephthalate film. The thus manufactured polyethylene terephthalate film has excellent processability, thermal stability, and transparency, and thereby raises transmittance of the light irradiated during an LITI process and secures thermal dimensional stability, preferably.

In addition, a surface of the polyethyleneterephthalate film may be modified by surface treatment known to those skilled in the art, for example, surface treatment using corona, plasma, or the like, and thus control adhesive property, surface tension, and the like, can be controlled at the time of a subsequent process.

The base film may have a thickness of preferably 0.025-0.15 mm, and more preferably 0.05-0.1 mm, but is not limited thereto.

[Primer Layer]

The present invention may further contain a primer layer between the base film and a light-to-heat conversion layer, as necessary.

The primer layer controls temperature transfer between the base film and an adjacent layer, improves adhesion between the base film and an adjacent layer, and controls the transfer of image forming irradiation to the light-to-heat conversion layer. In the case where the primer layer is formed, the base film and the light-to-heat conversion layer can be prevented from separating in a transferring process using laser. As a material suitable for the primer layer, any one resin or a mixture resin thereof selected from acryl based resin, polyurethane based resin, and polyester based resin may be used. In the case heat-resistant adhesive strength between the primer layer and the base film or the primer layer and the light-to-heat conversion layer is defective, the base film and the light-to-heat conversion layer may be separated from each other in the transfer process using laser. Therefore, it is preferable to select materials having superior adhesion between the base film and the light-to-heat conversion layer, and it is most preferable to use an acryl based primer in the present invention.

[Light-To-Heat Conversion Layer (LTHC layer)]

The light-to-heat conversion layer of the present invention absorbs the light in an infrared-visible light region and then converts some of the light into heat, and is composed of a resin composition containing a thermo-hardenable resin and a light-to-heat conversion material. In the present invention, the resin composition may be composed of a thermo-hardenable resin alone or a mixture resin of a thermo-hardenable resin and a thermo-plastic resin. In the case where the thermo-hardenable resin and the thermo-plastic resin are mixingly used, the thermo-hardenable resin,
including a curing agent, is preferably contained in a content of 50wt.% or more based on the overall resin components. If the content of the thermo-hardenable resin is below 50wt.%, solvent resistance may be deteriorated and thus a solvent of an interlayer may permeate into the light-to-heat conversion layer at the time of coating the interlayer, and the light-to-heat conversion material may not be smoothly dispersed during a light-to-heat conversion material dispersing process, pinholes may be generated at the time of coating.

In addition, the content of the light-to-heat conversion material is contained in a content of 25~40 wt.%. If the content of the light-to-heat conversion material is below 25 wt.%, the transferring process using laser has limitations in swelling the light-to-heat conversion layer, failing to uniformly transfer a desired pattern. If the content of the light-to-heat conversion material is above 40wt.%, an excessive amount of heat may be generated during a laser transfer process, and thus the light-to-heat conversion layer is burnt, failing to transfer the patterns.

The resin composition preferably contains a polyurethane based thermo-hardenable resin, and specific examples of thermo-hardenable polyurethane may include poly-carbonate polyurethane, polyester polyurethane, polyurethane, and the like. Preferably, the polyurethane resin may have a glass transition temperature (Tg) of 10°C or higher, and more specifically 10~50°C. If the glass transition temperature of the polyurethane resin is below the foregoing range, the coating layer may be partially transferred on a contrary surface in an aging process after coating the light-to-heat conversion layer. If the glass transition temperature of the polyurethane resin is above the foregoing range, volume expansion is decreased at the time of laser irradiation, and thus transferring of a desired shape may be difficult.

Examples of the curing agent may be an isocyanate based curing agent, peroxide, epoxy based cross-linking agent, metal chelate based cross-linking agent, an aziridine based cross-linking agent, metal salt, and the like. One of these cross-linking agents may be used alone or two or more thereof may be mixingly used. In addition, a thermo-plastic resin may be added to this composition.

The thermo-plastic resin is used in an amount smaller than the sum amount of the thermo-hardening resin and the cross-linking agent, based on a solid content. Specifically, the thermo-plastic resin is used in a content of below 50 wt.% based on the total content of the resin composition. A polyvinyl chloride polyvinyl acetate copolymer, a polyvinyl chloride homopolymer, or the like may be used as the thermo-plastic resin, and the used resin may have a glass transition temperature of 40°C or higher. If the glass transition temperature thereof is below 40°C, a blocking phenomenon may occur.

The light-to-heat conversion layer is prepared on a substrate including the primer
layer through coating and drying. Since the present layer has a thermo-hardenable type, cross-linking treatment is needed by appropriate heat treatment. The cross-linking treatment may be carried out together with a drying process at a temperature of the drying process, or a separate cross-linking process may be performed after the drying process.

The light-to-heat conversion material means a material that absorbs an incident laser light and then converts the light into heat. As the light-to-heat conversion material, dye (for example, visible light dye, ultraviolet dye, infrared dye, fluorescent dye, radiation polarizing dye, or the like), pigment, metal, a metal compound, a metal film, carbon black, metal oxide, a metal sulfur compound, or the like may be used, and carbon black is more preferably used.

It is preferable to use carbon black having an average particle diameter of preferably 10-30 nm in view of obtaining a flat surface. In addition, as necessary, the carbon black is surface-treated by first-dispersing any one or two or more resins selected from polyvinyl chloride, a polyvinylchloride-polyvinylacetate copolymer, and thermo-hardenable polyurethane, and thus dispersibility in the resin can be further improved. The first-dispersing process may be carried out by adding carbon black to a resin such as polyvinylchloride or the like and using kneading, mixing, or the like. The kneading may be carried out by preparing a preparation liquid containing a solvent and having a solid content of 30-70 wt.% and then using a kneading machine. If the solid content is below 30wt.%, viscosity of the preparation liquid is too low, and thus the dispersion degree of carbon black may be decreased. If the solid content is above 70wt.%, excessive torque is loaded, and thus dispersion may be difficult. The kneaded liquid may be subjected to further milling and filtering processes for optimizing the dispersion degree thereof. The solvent used in the kneading depends on the kind of resin used, and it is preferable to selectively use a solvent that can dissolve the resin. More specifically, for example, a mixture solvent where toluene, methylethylketone, and cyclohexanone are mixed at a weight ratio of 1-5: 1-5:1-5 may be used.

The light-to-heat conversion layer may be formed by kneading, milling, filtering, and coating processes, or may be also formed by milling, filtering, and coating processes. The kneading and milling processes may be carried out for optimizing dispersion of particles, and various methods such as ring milling, sand milling, and the like, may be employed for the milling process.

The milling process may be carried out by several methods, but for example, in the case of employing ring milling, a liquid where residual resin and a solvent are added to the first kneaded liquid such that the solid content of the entire liquid becomes 10wt.%~20wt.% or a mixture liquid of resin/carbon black/solvent (solid content of 10wt.%~20wt.%) is put into a main container of a milling machine, and then a ring
part is filled with 0.5-2.0 mm of zirconium particles to 50-80 volume%, followed by stirring. The stirring may be doubly carried out. First stirring may be carried out for the purpose of putting an inner liquid of a main milling container into an inside of the ring part while circulating, and second stirring may be carried out for the purpose of particle dispersion inside the ring part. As the particles filling the ring part, zirconium particles or other particles for milling may be used. As necessary, the milling process may be carried out by several steps. First milling is carried out through filling of zirconium particles of 2.0 mm, second milling is carried out through filling of particles of 1.5 mm, and third milling is carried out through filling of particles of 0.5 mm, thereby achieving more uniform dispersion of carbon black particles.

Alternatively, the milling process may be sequentially carried out by using a milling machine filled with particles by sizes in regular sequence.

The milling process is preferably carried out while the solid content is within the range of 10wt.%~20wt.%. To a greater or lesser degree, if the solid content is below 10wt.%, particle dispersing efficiency may be deteriorated, and if the solid content is above 20wt.%, liquid stability of the milled liquid may be deteriorated.

The filtering process has a purpose of removing large particles having a particle size of 2.5μm or larger. The coating process may be carried out by a die coating method or a roll coating method, and as necessary, various coating methods may be employed for the coating process. In the case where further cross-linking is separately needed after the coating process, the cross-linking degree may be controlled through separate aging.

In addition, as necessary, dye, such as visible light dye, ultraviolet dye, infrared dye, fluorescent dye, radiation polarization dye, or the like, pigment, organic pigment, inorganic pigment, metal, a metal compound, a metal film, iron cyanide pigment, phthalocyanine pigment, phthalocyanine dye, cyanine pigment, cyanine dye, metal dithiolene pigment, metal dithiolene dye, other absorbing materials, or the like, may be further added.

The light-to-heat conversion layer has a coating amount after drying of preferably 1 - 3.0g/m². If the coating amount after drying the light-to-heat conversion layer is below 1g/m² the light-to-heat conversion layer may be burnt in the transfer process. If the light-to-heat conversion layer is above 3.0g/m² appropriate heat transfer does not occur, resulting in a failure to well transfer the transfer layer.

In the present invention, when the transfer layer is transferred by heat generated from the light-to-heat conversion layer, the interlayer prevents the light-to-heat conversion material present inside the light-to-heat conversion layer from being transferred together with the transfer layer and prevents organic matters present inside the transfer
layer from being burnt by the heat which is generated from the light-to-heat conversion layer and transferred to the transfer layer.

[85] In the present invention, since the interlayer is composed of a UV-hardenable resin and needs to perform a release function of separating the transfer layer also, a fluorine based or silicon based resin having low surface energy is added thereto to thereby control surface energy of the interlayer to 35mN/m or lower. If the surface energy of the interlayer is above 35mN/m, the interlayer may fail to perform the release function and thus the interlayer may not be separated, resulting in a failure to transfer the transfer layer, during the transferring process. Therefore, as the surface energy of the interlayer becomes lower, adhesive strength with the transfer layer is lower, so that smooth transferring can be achieved during the transferring process. Whereas, as the surface energy of the interlayer is higher, adhesive strength with the transfer layer is higher, so that smooth transferring may be difficult.

[86] In addition, the interlayer may have a coating thickness after drying of preferably 1.0~3.0 µm. If the coating thickness after drying of the interlayer is below 1.0 µm, a heat blocking effect may be reduced and thus the transfer layer may be burnt, and a uniform surface shape may not be obtained and thus a surface onto which the transfer layer is transferred may not be uniform, resulting in reducing display resolution. If the coating thickness after drying of the interlayer is above 3 µm, too much heat may be blocked and thus the transfer layer may not be transferred.

[87] More specifically, in the case where surface roughness of the light-to-heat conversion layer is increased, the thickness of the interlayer needs to be increased in order to secure a flat surface shape. Preferably, the interlayer may have a thickness of 2.5~3 µm in the case where a surface roughness value (Ra) of the light-to-heat conversion layer is in the range of 10nm~20nm; 2~3 µm in the case where the surface roughness value (Ra) of the light-to-heat conversion layer is in the range of 5nm~10nm; and 1~3 µm in the case where the surface roughness value (Ra) of the light-to-heat conversion layer is 5 nm or less. More preferably, the surface roughness of the light-to-heat conversion layer is 20 nm or less.

[88] The UV-hardenable resin usable in the interlayer may be urethane acrylate, epoxy acrylate, polyester acrylate, or the like. As an additive used to control surface tension to 35mN/m or less, a reactive or non-reactive fluorine based or silicon based additive may be used. In addition, various additives for removing static electricity may be added into the interlayer.

[89] Specific examples of the fluorine based additive may include a fluorine based compound having a vinyl reaction group, a non-reactive fluorine based additive, and the like. Examples of the silicon based additive may include a polyether modified polydimethyl siloxane copolymer, a polyether modified dimethyl polysiloxane copolymer,
dimethyl polysiloxane based and modified dimethyl polysiloxane based additives, methylalkyl siloxane based and reactive silicon acrylate additives, and the like, and brand names therefor may be BYK-300, BYK-301, BYK-302, and the like, from the BYK Company, but are not limited thereto.

The interlayer may be formed by a bar coating method, a roll coating method, a die coating method, or the like. In addition, the interlayer may be formed in a two-layered structure as necessary, and an aluminum deposition layer may be further formed on the interlayer.

[Transfer Layer]

The transfer layer may be formed to be a uniform layer by a method of deposition, sputtering, solution coating, or the like. The transfer layer typically includes at least one layer for being transferred to a receptor. For example, the transfer layer may be formed by using organic, inorganic, organometallic and other materials containing an electroluminescent material or electrically active material.

More specifically, examples thereof may include poly(phenylene vinylene), poly-para-phenylene, polyfluorene, polydialkylfluorene, polythiophene, poly(9-vinylcarbazole), poly(N-vinylcarbazole-vinylalcohol) copolymer, triarylamine, polynorbonene, polyaniline, polyaryl polyamine, triphenylamine-polyetherketone, and the like, but are not limited thereto.

The transfer layer may further contain at least one material selected from a luminescent material, a hole transferrable organic material, and an electron transferrable organic material, which are known to the art, so as to meet characteristics of an organic light emitting device to be manufactured, and additively contain at least one selected from a non-luminescent low molecular material, a non-luminescent charge transferrable polymer material, and a hardenable organic binder material.

In the present invention, the constitution of this transfer layer is not particularly limited, and any constitution that can be generally used in the art may be used without limitation.

An embodiment of the present invention may include a base film 10, a light-to-heat conversion layer 20, and an interlayer 30, as shown in FIG. 1.

In addition, another embodiment of the present invention may include a base film 10, a primer layer 40, a light-to-heat conversion layer 20, and an interlayer 30, as shown in FIG. 2.

In addition, still another embodiment of the present invention may include a base film 10, a primer layer 40, a light-to-heat conversion layer 20, an interlayer 30, and a transfer layer 50, as shown in FIG. 3.
FIGS. 1 to 3 just shows embodiments exemplified for illustrating the present invention, and the present invention is not limited thereto.

In the present invention, respective layers may be formed by coating or co-extruding following the known method.

Hereinafter, the present invention will be specifically described with reference to examples, but are not limited to the following examples. In addition, it is apparent that the present invention can be changed within identical or equivalent ranges of materials.

Hereinafter, physical properties were measured by the following measurement methods.

1) Resin Color

With respect to color of resin, a b-value of the prepared flame retardant polyester polymer was measured by using a color coordination system (Nippon Denshoku Corporation, Model No. SE-2000).

2) Number of Inner Defects and Ratio of Effective Defects

With respect to an inner defect measurement method, a polyester resin composition chip in a pellet type was melted on a slide glass, and then was made into a sample of 500μm. Defects in the layer at a depth of 180μm thereof were observed at a magnification of 200 times in the presence of transmissive light by using an optical microscope. The number of defects having a size of 1.5μm or larger and the number of defects having a size of 5μm or larger in an area of 448μm x 336μm were calculated by average numbers thereof through five microscope images.

The size of an optical defect was determined by measuring a major axis of a figure or a point set, which is seen as a defect on an optical microscope (see, FIGS. 4 to 9).

The number of inner defects means total number of defects having a size of 1.5μm or larger in an area of 448μm x 336μm and means a value calculated by Equation 1 below.

\[
\text{Ratio of Effective Defects (\%) = } \frac{\text{[Number of Defects having a size of 5μm or larger]}}{\text{[Total Number of Defects having a size of 1.5μm or larger]}} \times 100
\]

3) Transferring Property

Tris(8-hydroxyquinolinato)aluminum (Alq3) was coated on an interlayer to form a transfer layer of 500A which was then transferred by a 1064nm-wavelength Nd YAG laser within an energy range of 100-130W.

When a transferred appearance after transferring is identical to a portion irradiated with laser: O
When an untransferring region is generated in a portion irradiated with laser: X

4) Inherent Viscosity Measurement Method

0.4g of a PET pellet (sample) was put into 100mi of an orthochlorophenol reagent, and was dissolved for 100 minutes. After that, this was carried in an Ubbelohde viscometer, which was maintained in a thermostat at 30°C for 10 minutes, and the fall time of solution was obtained by using a viscometer and an aspirator. Also, the fall time of solvent was obtained by the same method, and then an R.V. value and an I.V. value were calculated by Equations 1 and 2 below.

[Equation 1]
R.V. = Fall Time of Sample/Fall Time of Solvent

[Equation 2]
I.V. = 1/4(R.V.-1)/C + 3/4(ln R.V./C)

[Example 1]
Manufacturing of Polyester Film

Terephthalic acid 1730kg(10.42 kmole) and ethylene glycol 775kg(12.5 kmole) were put into an esterification reactor, and then an esterification reaction thereof was allowed to proceed for 4 hours under conditions of pressure of 1.5kg/cter and temperature of 255°C, thereby preparing a preliminary polymer, bis-P-hydroxyethyl terephthalate (BHEF). Water generated during the reaction was separated through a distillation column, and ethylene glycol further generated after completion of the esterification reaction was also separated through the distillation column.

Magnesium acetate 0.48kg (Mg content per 100 parts by weight of polyester resin composition is 30ppm) was put into the thus prepared BHET based on 1.8 ton, and then antimony trioxide 0.27kg (Sb content per 100 parts by weight of polyester resin composition is 125ppm) as a catalyst was input thereto. The temperature was slowly raised from 240°C to 285°C and at the same time, a polycondensation reaction was allowed to proceed for 4 hours under the high vacuum of 0.3 torr, to thereby preparing a polyester resin having inherent viscosity (IV) of 0.650, which was then cooled and cut to prepare a polyester chip.

The polyester chip was melted and extruded at 280°C, and then rapidly cooled at 24°C by using large-sized rolls, thereby obtaining a polyester sheet. The thus obtained polyester sheet was stretched at 110°C in the machine direction (MD) at a stretching ratio of 3.5 times, and stretched at 130°C in the transverse direction (TD) at a stretching ratio of 3 times, followed by heat treatment at 250°C and cooling, thereby obtaining a polyester film having a thickness of 100μm.

Preparation of Composition (A-1) for Forming Light-To-Heat Conversion Layer
A polyvinyl chloride vinylacetate copolymer (Dow Chemical Company, VMCH grade) 18wt.%, polyurethane resin (Lubrizol Company, ESTANE 5715 grade) 43wt.%, polyisocyanate (Aekyung Chemical Company, AK75 grade) 9 wt.%, and carbon black (Degussa Company, PRINTEX L6 grade) 30 wt.% were added to a mixture solvent where toluene, methylethylketone, and cyclohexanone are mixed at a weight ratio of 1:1:1 such that the solid content was 15 wt.%, to prepare a composition for preparing a light-to-heat conversion layer.

Here, a preparative liquid was prepared by kneading, milling, and filtering processes as follows.

First, for the kneading process, the polyvinyl chloride vinylacetate copolymer was heated and dissolved at 50°C in the mixture solvent where toluene, methylethylketone, and cyclohexanone are mixed at a weight ratio of 1:1:1, to prepare 13 wt.% of a polyvinyl chloride vinylacetate solution. A predetermined amount of carbon black was input into a kneading machine, and then the polyvinyl chloride vinylacetate solution was input thereonto little by little while the kneading machine was operated, followed by kneading for 1 hour.

After completion of the kneading process, the kneaded liquid was input into a main milling container of a ring mill of which 80% is filled with zirconium particles of 1.2 mm, and then 20 wt.% of the polyurethane resin, which was heated and dissolved at 50°C by using the prepared mixture solvent where toluene, methylethylketone, and cyclohexanone are mixed at a weight ratio of 1:1:1, and the mixture solvent (weight ratio of toluene:methylethylketone:cyclohexanone = 1:1:1) are added thereto, to thereby prepare a liquid having a solid content of 15 wt.%. The prepared liquid was input into the milling machine, and then milling was carried out by operating two stirrers in the milling machine. Stirring was carried out for 6 hours while a stirrer used to input a mixed coating liquid into the milling machine was controlled to have a stirring ratio of 1000 rpm and a stir installed at a ring part for particle dispersion was controlled to have a stirring ratio of 2000 rpm.

The milled liquid was filtered by using a filter for filtering out particles of 2.5 μm or greater. The filtered liquid was coated by using Mayer Bar #8, and then dried at 120°C for 30 seconds. Then, if there were no particles of 2.5 μm or greater when the surface state thereof was checked through a microscope, filtering was completed. After filtering, polyisocyanate as a curing agent was input thereonto, followed by stirring for 1 hour, to thereby prepare the composition for forming the light-to-heat conversion layer.

Preparation of Composition (B-l) for Forming Interlayer

A silicon based additive (BYK Company, BYK-302) was added to UV-hardenable urethane acrylate resin (Toyo Ink Company, Lioduras LCH) at 0.2 wt.% of the overall
blended liquid, to prepare a composition for forming an interlayer.

Manufacturing of Donor film for LITI process

The thus manufactured polyester film was used as a base film, and the composition for forming a light-to-heat conversion layer (A-l) was coated on one surface of the base film by a micro gravure coating method, and then dried, to form a light-to-heat conversion layer. Here, the coating amount after drying was allowed to be 1.5g/m². Additively, aging was carried out at 50°C for 3 hours.

The prepared composition for forming an interlayer (B-l) was coated on the light-to-heat conversion layer by using a micro gravure coater, and then dried, to form a hard coating layer. Here, the coating thickness was controlled to be 2.0/μm.

Physical properties of the manufactured film were measured, and the measured results were tabulated in Table 1.

[Example 2]

Terephthalic acid 1730kg (10.42 kmole) and ethylene glycol 775kg (12.5 kmole) were put into an esterification reactor, and then an esterification reaction thereof was allowed to proceed for 4 hours under conditions of pressure of 1.5kg/cirf and temperature of 255°C, thereby preparing a preliminary polymer, bis-p-hydroxyethyl terephthalate (BHET). Water generated during the reaction was separated through a distillation column, and ethylene glycol further generated after completion of the esterification reaction was also separated through the distillation column.

Magnesium acetate 0.27kg (Mg content per 100 parts by weight of polyester resin composition is 17ppm) was put into the prepared BHET based on 1.8 ton thereof; sodium acetate 0.02kg (Na content per 100 parts by weight of polyester resin composition is 2ppm); antimony trioxide 0.27kg (Sb content per 100 parts by weight of polyester resin composition is 125ppm) as a catalyst was input thereto; and trimethyl phosphate 0.18kg (P content per 100 parts by weight of polyester resin composition is 22ppm) as a heat stabilizer was input thereto. Then, the temperature was slowly raised from 240°C to 285°C and at the same time, a polycondensation reaction was allowed to proceed for 4 hours under the high vacuum of 0.3 torr, to thereby prepare a polyester resin having inherent viscosity (IV) of 0.650, which was then cooled and cut to prepare a chip form.

The manufacturing processes of a polyester film and a donor film were carried out by using the thus prepared chip in the same manner as Example 1.

Physical properties of the manufactured film were measured, and the measured results were tabulated in Table 1.

[Comparative Example 1]
Terephthalic acid 1730kg (10.42 kmole) and ethylene glycol 775kg (12.5 kmole) were put into an esterification reactor, and then an esterification reaction thereof was allowed to proceed for 4 hours under conditions of pressure of 1.5kg/cm² and temperature of 255°C, thereby preparing a preliminary polymer, bis-P-hydroxyethyl terephthalate (BHET). Water generated during the reaction was separated through a distillation column, and ethylene glycol further generated after completion of the esterification reaction was also separated through the distillation column.

Magnesium acetate 0.87kg (Mg content per 100 parts by weight of polyester resin composition is 55ppm) was put into the thus prepared BHET based on 1.8 ton thereof, and then antimony trioxide 0.35kg (Sb content per 100 parts by weight of polyester resin composition is 160ppm) as a catalyst was input thereto. The temperature was slowly raised from 240°C to 285°C and at the same time, a polycondensation reaction was allowed to proceed for 4 hours under the high vacuum of 0.3 torr, to thereby manufacturing a polyethylene terephthalate resin having inherent viscosity (IV) of 0.650, which was then cooled and cut to prepare a chip form.

The manufacturing processes of a polyester film and a donor film were carried out by using the thus prepared chip in the same manner as Example 1.

Physical properties of the manufactured film were measured, and the measured results were tabulated in Table 1.

[Comparative Example 2]

Terephthalic acid 1730kg (10.42 kmole) and ethylene glycol 775kg (12.5 kmole) were put into an esterification reactor, and then an esterification reaction thereof was allowed to proceed for 4 hours under conditions of pressure of 1.5kg/cm² and temperature of 255°C, thereby preparing a preliminary polymer, bis-P-hydroxyethyl terephthalate (BHET). Water generated during the reaction was separated through a distillation column, and ethylene glycol further generated after completion of the esterification reaction was also separated through the distillation column.

Magnesium acetate 0.17kg (Mg content per 100 parts by weight of polyester resin composition is 91ppm) was put into the thus prepared BHET based on 1.8 ton thereof; antimony trioxide 0.27kg (Sb content per 100 parts by weight of polyester resin composition is 125ppm) as a catalyst was input thereto; and trimethyl phosphate 0.27kg (P content per 100 parts by weight of polyester resin composition is 33ppm) as a heat stabilizer was input thereto. The temperature was slowly raised from 240°C to 285°C and at the same time, a polycondensation reaction was allowed to proceed for 4 hours under the high vacuum of 0.3 torr, to thereby manufacture a polyethylene terephthalate resin having inherent viscosity (IV) of 0.650, which was then cooled and cut to prepare a chip form.
The manufacturing processes of a polyester film and a donor film were carried out by using the thus prepared chip in the same manner as Example 1.

Physical properties of the manufactured film were measured, and the measured results were tabulated in Table 1.

<table>
<thead>
<tr>
<th>Example</th>
<th>Sb Content in Catalyst (ppm)</th>
<th>Total Content of Metal in Pinning Agent (ppm)</th>
<th>P Content (ppm)</th>
<th>[P]/[Me] Equivalent Ratio</th>
<th>Resin Color (b-value)</th>
<th>Numbe of Defects</th>
<th>Ratio of Effective Defects (%)</th>
<th>Transferring Property (○/×)</th>
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<td>33</td>
<td>0.43</td>
<td>5.3</td>
<td>8.0</td>
<td>37.5</td>
<td>×</td>
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</tbody>
</table>

(In Table 1 above, [P] means equivalent of phosphorous in a phosphorous compound, and [Me] means total equivalent of metal in a metal compound used as a pinning agent.)

As can be seen in Table 1 above, it was confirmed that untransferring of the transfer layer did not occur in Examples 1 and 2 where a film having a b-value of color of 4 or smaller and the number of defects is 5 or smaller was used as a base film.
Claims

[Claim 1] An Donor film for LITI process comprising a polyester base film where
the number of defects having a size of 1.5/μm or greater in an area of
448 ± 336/μm is 5 or less and a b-value of resin color is 4.0 or lower.

[Claim 2] The Donor film for LITI process of claim 1, wherein in the base film, a
ratio of effective defects according to Equation 1 below is 10% or
lower:

[Equation 1]

\[
\text{Ratio of Effective Defects (\%) = \frac{\text{Number of Defects having a size of}}{\text{Total Number of Defects having a size of 5^m or}}\]

\[
\text{larger}]\times 100.
\]

[Claim 3] The Donor film for LITI process of claim 1, wherein the base film is
made of a polyester resin, the polyester resin being controlled such that
a metal content in a catalyst added at the time of synthesizing the
polyester resin is 100~150ppm and a metal content in an electrostatic
pinning agent is 10~50ppm.

[Claim 4] The Donor film for LITI process of claim 3, wherein the polyester resin
may further contain a phosphorous compound as a heat stabilizer, the
phosphorous compound being contained within a range satisfying
Equation 2 below:

[Equation 2]

\[
0.5<[P]/[Me]<1.5
\]

(in Equation 1, [P] means equivalent of phosphorous in the
phosphorous compound, and [Me] means total equivalent of metal in a
metal compound used as a pinning agent).

[Claim 5] The Donor film for LITI process of claim 3, wherein the electrostatic
pinning agent is any one or a mixture of two or more selected from
alkali metals and alkali earth metals.

[Claim 6] The Donor film for LITI process of claim 5, wherein the electrostatic
pinning agent is any one or a mixture of two or more selected from
magnesium acetate, sodium acetate, calcium acetate, lithium acetate,
calcium phosphate, magnesium oxide, magnesium hydroxide,
magnesium alkoxide, manganese acetate, and zinc acetate.

[Claim 7] The Donor film for LITI process of any one of claims 1 to 6, wherein
the Donor film for LITI process comprising a polyester base film, a
light-to-heat conversion layer and an interlayer.

[Claim 8] The Donor film for LITI process of claim 7, further comprising a
primer layer between the base film and the light-to-heat conversion layer.

[Claim 9] The Donor film for LITI process of claim 8, further comprising a transfer layer on the interlayer.
A. **CLASSIFICATION OF SUBJECT MATTER**

**HOIL 51/52(2006.01)i**

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)

HOIL 51/52; G03F 7/11; G11B 5/33; G03F 7/34; C08K 5/49; B32B 3/10; HOIL 51/56; H05B 33/10; B41M 5/40

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: donor film, LITI process, polystyrene base film, the number of defects, metal contents in a catalyst, metal contents in a pinning agent, and similar terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
  * "A" document defining the general state of the art which is not considered to be of particular relevance
  * "E" earlier application or patent but published on or after the international filing date
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  * "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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  * "&" document member of the same patent family

Date of the actual completion of the international search: 26 April 2013 (26.04.2013)

Date of mailing of the international search report: 29 April 2013 (29.04.2013)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
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Form PCT/ISA/210 (second sheet) (July 2009)
**INTERNATIONAL SEARCH REPORT**

Information on patent family members

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