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(54) **Electroluminescent layer configuration and method for production thereof**

(57) The invention relates to a an electroluminescent layer configuration for an EL-lamp assembly, wherein the transparent or the light reflecting conductor layer/electrode made of metallic thin film is deposited on the surface of a glass substrate by vacuum coating method; wherein the said luminescent layer and the said dielectric layer made of plastic film are laminated together on the surface

of the coated glass sheet and wherein a small space along the longitudinal rim of the glass sheet on the right hand and left hand side is left unlaminated, in order to be able to apply bus bars for electrical contact. More than one pair of luminescent and dielectric plastic film may be stacked together to form a multilayer configuration.

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Description

Field of the Invention

[0001] The present invention relates to an electroluminescent layer configuration and a method for production thereof.

Background of the Invention

[0002] The currently used standard method for the production of inorganic electroluminescent (EL-) lamp is mainly consisting of the screen printing technique. With this method liquidborne slurry of luminescent layer with luminescent phosphor particles mixed with binders and resins is deposited with a screen printing frame onto a transparent carrier strip coated with a transparent surface electrode, such as indium tin oxide (ITO).

[0003] After this process the deposited wet layer must be dried for several hours in a dry chamber with hot convection air of about 80 degrees Celsius.

[0004] Then the dielectric layer of wet barium titanate powder in binder slurry is deposited with a screen printing frame of a slightly bigger size than the previous one for insulation purpose. Then again the dielectric layer must be dried in the dry chamber for several hours.

[0005] Finally, the second electrode of silver or carbon ink is deposited with another screen printing frame of again different size for the contacting purpose and must be put into the dry chamber again for several hours.

[0006] With this method one needs 3 different screen printing frames - which are quite expensive and limited in life time - for a particular size of lamp, 3 different deposition steps with the screen printing machine per one single lamp and 3 drying cycles with several hours per cycle. Since the deposition cycle time with the screen printing machine lasts several minutes, the production volume per day per machine is, therefore, very limited.

[0007] Further, if a lamp with any small difference in dimensions is to be manufactured, another set of 3 screen printing frames for this particular size is needed. The cutting of an EL-lamp to make several smaller lamps out of a bigger one is quite restricted and causes electrical contacting problems. Even if one succeeds in solving the contacting problem, the quality of the lamps is substantially lower than that of the original one. Moreover, there is a non-recyclable material remaining after each screen printing/deposition step which means loss of material.

[0008] Besides the conventional screen printing method there are continuous roll-to-roll deposition systems for high volume production. In WO8804467A1 for instance, Appelberg discloses a continuously moving carrier strip deposition system wherein the first dielectric layer is deposited on the pre-coated transparent electric conductor of the carrier strip. This dielectric layer is cured by an UV radiation lamp in the next station. The luminescent layer consisting of electroluminescent phosphor is deposited electrostatically. The second UV-curable die-

lectric layer is then deposited and the second conductor layer which is a reflector at the same time is vapor-deposited in the last station. This already is a substantial progress in terms of production cycle time reduction. However, it still has the following production sequences: deposition of the first dielectric layer - UV-curing of the first dielectric layer - deposition of the luminescent layer by electrostatic means - deposition of the second dielectric layer - UV-curing of the first dielectric layer - vapor-deposition of the second conductor/reflector. The deposition and UV-curing of the dielectric layer as well as the electrostatic deposition of the luminescent phosphor are the speed limiting stations in the system. E.g. the deposition of the UV-curing resin is difficult on a fast moving substrate due to the viscosity of the resin and its curing time with UV-curing needs more than 10 seconds exposure time which limits the throughput speed of the system.

[0009] In WO891237A1, Sharpless et al. disclose a system with 3 different plastic substrates in a roll form with different pre-coated layer configurations, such as luminescent layer and dielectric layer, as well as conductive layer (electrode) and busbar. These substrates are then laminated together by applying heat and pressure by a pair of heatable pressure rollers. In this case the coating procedures of each layer components are carried out by conventional wet coating method, therefore, there is no substantial reduction of the overall production cycle time with this method.

Object and Brief Description of the Invention

[0010] It is therefore an object of the invention to provide an electroluminescent layer configuration for an electroluminescent lamp and its manufacturing method which is capable of high throughput mass production.

[0011] This is solved by what is disclosed in the independent claims. Advantageous embodiments are described in the dependent claims.

[0012] According to the invention an electroluminescent layer configuration is formed by laminating together at least one luminescent layer and at least one dielectric layer. Thus, the electroluminescent layer configuration, which can be used for an electroluminescent lamp, can be easily produced in large quantities. Particularly the drying of individually deposited wet layers in the screen printing technique or the curing in continuous roll-to-roll deposition systems can be avoided. Generally a substantial simplification of the production steps and reduction of overall production time for this electroluminescent layer configuration is achieved compared to the prior art. Further multi-layer configurations can be formed by either laminating together more than two layers or by repeating a lamination of two layers.

[0013] According to an advantageous embodiment the layer contains electroluminescent phosphor particles mixed with thermoplastic material. This has the advantage that the EL-phosphor particles are protected against

moisture by the plastic matrix formed by the thermoplastic material. Thus, the EL-phosphor particles do not need to be protected against moisture by microcapsules.

[0014] A further advantage is that the transparency of the electroluminescent plastic film can be controlled, as the transparency of the electroluminescent plastic film depends on the density of the EL-phosphor particles inside.

[0015] According to another advantageous embodiment the electroluminescent layer contains wave length converting particles. Thus, the wavelength of light can be shifted to achieve the desired color effect with these active color filters.

[0016] It has been shown to be particularly advantageous if electroluminescent layer and dielectric layer have thicknesses between 50 and 500 microns. Then the light yield from the electroluminescent layer is high and the layers can be processed easily in the laminating process.

[0017] According to another advantageous embodiment the electroluminescent layer configuration comprises at least a metallic layer deposited on at least one side of the electroluminescent layer configuration. Thus, a surface electrode can be formed. Together with this metallic layer a main body for an EL-lamp is produced. This production can be performed on large scale, individual EL-lamps can be formed by cutting and/or stamping them out of this electroluminescent layer configuration in any form and shape.

[0018] The metallic layer is put on an exterior side of the electroluminescent layer configuration. Thus, for the case of a multi-layer configuration the metallic layer is put on the respectively outmost layer.

[0019] The metallic layer can be transparent or light reflecting. Advantageously a light reflecting conductor layer can be used as back electrode put on a "back side" of the electroluminescent layer configuration and a transparent metallic layer put as front electrode on a "front side" of the electroluminescent layer configuration. In this case, by front side the side of the configuration is meant where the light escapes, by back side the opposite side thereof.

[0020] Particularly the metallic layer can be produced by vacuum coating methods such as ion beam assisted sputtering or e-beam evaporation. Thus, high quality metallic films can be produced.

[0021] Alternatively, the metallic layer can be produced by attaching a metallic foil. This is a very simple and cheap process. If putting two electrodes on the configuration, also the depositing process can be used for one electrode, particularly for a transparent front electrode, the attaching process for the other electrode, particularly for the reflecting back electrode.

[0022] According to a further embodiment, the electroluminescent layer configuration comprises a colored film. Thus, a passive color filter can be formed to achieve a desired color effect.

[0023] According to another embodiment, the electro-

luminescent layer configuration further comprises a substrate. This allows an easy production of the metallic film, if the latter is brought onto the substrate, particularly a glass substrate. Advantageously the area of the substrate is larger than that of the configuration, so that a part of the area of the substrate is not occupied. This allows putting further components on said unoccupied space of the substrate and /or the metallic layer. Particularly, bus-bars for the electric contacting are arranged on said unoccupied space of the substrate and /or the metallic layer.

[0024] According to a further embodiment, the class substrate can be laminated together with the configuration by using an interlayer material such as EVA or PVB. This guarantees a good adherence.

[0025] The invention further relates to a method of producing such an electroluminescent layer configuration or an electroluminescence lamp assembly by laminating at least one luminescent and at least one dielectric layer together. Particularly there is heat and pressure applied for the laminating step. Particularly the laminating can be performed with more than two layers or repeatedly performed, thus yielding a multi-layer electroluminescent layer configuration.

[0026] The dielectric and/or electroluminescent layers can be produced by processing a thermoplastic material by a calendar machine or extrusion machine. This allows mass production of these layers.

[0027] Advantageously electroluminescent particles can be mixed with the thermoplastic material in a predetermined mixing ratio. Thus, electroluminescent material can be created with a desired transparency depending on the predetermined mixing ratio. Further the electroluminescent particles are protected against moisture by the plastic matrix formed by the thermoplastic material. As electroluminescent particles particularly phosphor particles can be used.

[0028] According to a further embodiment also wave length converting particles can be added as active color filters to the electroluminescent material, thus achieving a desired color effect.

[0029] According to another embodiment at least one metallic layer is put on at least one side of the electroluminescent layer configuration. Particularly this can be done by vacuum coating methods, such as ion beam assisted sputtering or electron beam evaporation. Alternatively, a metallic foil can be attached to at least one side of the electroluminescent layer configuration. Moreover, the at least one metallic layer is put at the at least one luminescent layer and/or dielectric layer, before the at least one luminescent layer and the dielectric layer are laminated with each other.

[0030] According to still another embodiment of the present invention there is provided a method for producing an electroluminescent lamp using a electroluminescent layer configuration as described above, further comprising the step of cutting and/or stamping the electroluminescent lamp in a desired shape out of the electrolu-

minescent layer configuration.

[0031] The application of the metallic layer can be particularly done before the coating process. This allows easy processing.

[0032] The present invention offers the opportunity for a fully automatic EL-lamp production system that can achieve a large throughput of e.g. more than 1000 m²/hr EL-lamp. Moreover the present invention offers the opportunity for fabricating EL-lamps with a large variety of width such as e.g. over 1.2 m width at a speed over e.g. 15 m/min.

[0033] The productivity of the inventive production system is much higher compared to the conventional screen printing method.

Brief Description of the Figures

[0034] In the following advantageous embodiments of the present invention are described in reference to the attached figures. Similar or corresponding details in the figures are marked with the same reference numerals. In detail,

Fig. 1 shows the cross section of the electroluminescence lamp with luminescent plastic film and dielectric plastic film laminated together and the conductive thin films coated on both sides. The busbars for the electrical contact and a color filter are also attached;

Fig. 2 shows the cross section of the electroluminescence lamp with glass sheet as substrate;

Fig. 3 shows the cross section of the electroluminescence lamp with glass substrate;

Fig. 4 shows the high throughput production system of the electroluminescent lamp;

Fig. 5 shows the high throughput production system of the electroluminescent lamp with glass substrate.

[0035] In Fig. 1 an EL-lamp is depicted formed by an electroluminescent layer configuration comprising a luminescent plastic film laminated together with a dielectric plastic film 2. On both films a metallic film is put onto as thin film surface electrodes 3A and 3B. The bottom thin film electrode 3B or back side electrode is made of a light reflecting conductor such as aluminum or silver. Alternatively, the bottom thin film electrode can be made of a metallic foil. The top thin film electrode 3A or front side electrode is made of a transparent metallic layer such as indium tin oxide in order that light may escape from the layer configuration.

[0036] On the thin film surface electrodes 3A and 3B a bus bar 4 is put onto to realize an electric contacting. An additional color filter 5 is put on the top of the light

emitting side of the EL-lamp to achieve the desired color effects. The area of the additional color filter 5 is smaller than that of the electroluminescent layer configuration, so that the bus bar 4 can be placed on the top thin film surface electrode 3A.

[0037] In Fig. 2 the EL-lamp of Fig. 1 is put onto a glass substrate 6. The area of glass substrate 6, where a metallic layer is deposited onto as bottom thin film electrode 3B is larger than that of the rest of electroluminescent layer configuration comprising the dielectric plastic film 2, the electroluminescent film 1, the top thin film electrode 3A and the color filter 5. Thus, the electric bars 4, 4' can be placed on the bottom thin film electrode.

[0038] In Fig. 3 a multilayer configuration is shown consisting of two dielectric layers 2 and two electroluminescent layers 1.

[0039] In Fig. 4 a production system for an electroluminescent layer configuration is shown. A pre-fabricated luminescent plastic film 1 wound up in a roll 7 and a pre-fabricated dielectric plastic film 2 wound up in roll 8 are laminated together in a laminating oven 9 with heatable laminating roller 10 for applying heat and pressure. Thus, transparent or semitransparent plastic film 2 with high dielectric strength is laminated together with the luminescent film 1 by applying heat and pressure.

[0040] In a vacuum chamber a thin metallic film is deposited on the laminated layer configuration using vacuum coating methods. The thus produced layer configuration is wound up using roll 12.

[0041] The prefabrication of the transparent or semitransparent plastic luminescent plastic film 1 of 50 micron to several hundred micron thickness containing electroluminescent phosphor particles is realized by using an extrusion machine or calendar machine. Thermoplastic material is mixed together with the electroluminescent phosphor in a mixing ratio to reach the desired density of the phosphor in the plastic matrix. One of the benefits of mixing the phosphor in the plastic matrix is that the EL-phosphor particles do not need to have microcapsules to protect against moisture. The transparency of the fabricated plastic film depends on the density of the particles inside. Moreover, wavelength converting particles, so called "active color filters" can be mixed together in this plastic matrix in order to achieve the desired color effect.

[0042] Concerning the metallic layer the laminated film passes through the vacuum chamber 11 to deposit thin film metallic layer for surface electrodes 3A and 3B, which are either a transparent conductor, e.g. indium tin oxide, or light reflecting conductor, e.g. aluminum or silver, by vacuum coating methods, such as ion beam assisted sputtering or e-beam evaporation. Usually, the transparent conductor is coated on the luminescent film 1 and the light reflecting conductor is coated on the dielectric film 2 to form the back electrode. However, the transparent conductor can be deposited on both sides, i.e. on the luminescent film 1 and on the dielectric film 2. In this case the EL-lamp emits light to both sides. Also, the light re-

flecting conductor can be deposited on the luminescent plastic film 1 and the transparent conductor on the dielectric plastic film 2.

[0043] Alternatively, the vacuum coating of the conductive layers can be carried out on the luminescent film 1 and on the dielectric film 2 separately, before laminating them together.

[0044] Alternatively, the conductive reflector thin film layer is replaced by a metallic foil, e.g. aluminum foil, which is attached on one side of the laminated plastic films to form the light reflecting back electrode.

[0045] A cutting as described for Fig. 5 can be used in the system according to Fig. 4, too.

[0046] In Fig. 5 a production system is depicted for an electroluminescent lamp comprising a glass substrate. The glass substrate is transported using a glass conveyor system 13 together with luminescent plastic film 7 and the dielectric plastic film 8 to the laminating oven 9 where the laminating is realized by the laminating rollers 10. The depositing of the one or more metallic layers is done in the vacuum chamber 11. Alternatively, this deposition or attaching can be done before the laminating. At the cutting station 14 the electroluminescent layer configuration is cut or stamped off in the shape desired for the EL-lamp.

[0047] The cutting of the EL-lamp can be carried out "in-line" in desired sizes or the electroluminescent layer configuration is rewound on a roll and transported to a separate cutting and laminating station. After cutting the main body of the EL-lamp in desired size, bus bars 4, 4' for the electric contact can be applied and laminated in transparent protective films, e.g. PET.

[0048] In addition before laminating the EL-lamp with protective films "passive" color filters 5 in many varieties, such as "Eurofilter" of the company Dimatec, can be adhered to achieve the desired color effect.

[0049] Thus, in Fig. 5 it is shown that a sheet glass substrate 6 is transported on a conveyer system 13 into an in-line vacuum chamber 11 to deposit a metallic conductive layer, either transparent or light reflecting, by a vacuum deposition method, such as (ion beam assisted) sputtering or e-beam evaporation. Then in the sequence of firstly the dielectric plastic film 2 and secondly the luminescent plastic film 1 with the EL-phosphor particles inside with pre-coated transparent or light reflecting conductor layer on the outer side, or vice versa with the pre-coated transparent or light reflecting conductor layer on the outer side of the dielectric plastic film are laminated together in an in-line oven on the glass surface with the conductive layer by applying pressure with a roller system.

[0050] Moreover, a small space along the longitudinal rim of the glass on the right and left side is left open, to be able to apply bus bars 4, 4' for electrical contact.

[0051] The laminated glass can now be cut in desired dimensions and the bus bar 4 for the opposite electrode as well as optional passive color filter and protective laminate can be applied. Also, the whole EL-lamp with the

glass substrate can be laminated together with another glass, using interlayer for laminated glass in the architectural field, such as EVA or PVB.

[0052] Thus, EL-lamps and panels are described, more specifically solid-state inorganic EL-lamp sheets consisting of pre-fabricated transparent or semi-transparent plastic sheets for dielectric layer 2 and luminescent layer 1. The transparent thin film surface electrode (s) 3A, as well as thin film metallic reflector layer 3B are deposited directly on the plastic surface by vacuum coating, e.g. by e-beam evaporation or sputtering. The luminescent and dielectric plastic films in roll form are fed into a high throughput roller system and adhered together forming mass production type EL-lamps with very high productivity without curing or drying time. Also, the luminescent phosphor does not have to be protected against humidity by micro-capsules, since they are already protected inside the plastic sheet. Moreover, this EL-lamp can have every dimension and can be cut, stamped and perforated in every shape and form without having electrical contacting problems because the conductive layers are deposited on the outer surface of the dielectric plastic film and luminescent plastic film. The main body of the EL-lamp can then be electrically contacted by bus bars 4, 4' in appropriate size and form, e.g. by silver strips.

[0053] In the following further embodiments of an electroluminescence lamp assembly are described, wherein the luminescent layer and the dielectric layer consist of pre-fabricated, transparent or semitransparent plastic films; the luminescent layer contains electro-luminescent phosphor particles, which are mixed together with the thermoplastic materials and extruded to plastic sheet. The luminescent and the dielectric plastic films are laminated together under heat and pressure.

[0054] This electroluminescence lamp assembly may comprise more than one pair of luminescent and dielectric plastic films stacked together to form a multilayer configuration.

[0055] The luminescent layer contains wavelength converting particles, which act as "active color filter". The thickness of each plastic film is between 50 to 500 microns. A transparent or light reflecting conductor layer as metallic thin film electrode is deposited on the surface of luminescent plastic film and/or on the surface of dielectric plastic film by a vacuum coating method. One of the electrodes is light reflecting metallic foil adhered to the surface of either the luminescent plastic film or the dielectric plastic film. At least one colored film as color filter is attached on the surface of the electroluminescence lamp.

[0056] Further an embodiment of an electroluminescence lamp assembly is described, wherein the transparent or the light reflecting conductor layer/electrode made of metallic thin film is deposited on the surface of a glass substrate by vacuum coating method; wherein the said luminescent layer and the said dielectric layer made of plastic film are laminated together on the surface of the coated glass sheet and wherein a small space along the longitudinal rim of the glass sheet on the right

hand and left hand side is left un laminated, in order to be able to apply bus bars for electrical contact. More than one pair of luminescent and dielectric plastic films may be stacked together to form a multilayer configuration. The thickness of each plastic film is between 50 to 500 microns. A transparent conductor layer or a light reflecting conductor layer as metallic thin film electrode is deposited on the surface of either the luminescent or the dielectric plastic film, whichever is on the outer side, by vacuum coating method. Light reflecting and conducting metallic foil as back electrode is adhered to the surface of either the luminescent or the dielectric plastic film, whichever is on the outer side. The luminescent layer contains wavelength converting particles, which act as "active color filter". At least one colored film as color filter is attached on the surface of the electroluminescence lamp. The electroluminescent lamp with glass substrate is laminated together with another glass, using interlayer material for glass laminating purpose in the architectural field, such as EVA or PVB.

[0057] Further an embodiment of an electroluminescence lamp production system is described, wherein a transparent or semi-transparent luminescent plastic film with a thickness between 50 micron to 500 micron is pre-fabricated by - preferably, but not limited to- extrusion machine or calendar machine and laminated together with high dielectric strength transparent or semitransparent plastic film under heat and pressure exertion. The transparent conductor layer, e.g. indium tin oxide, and/or light reflecting conductor layer, e.g. aluminum or silver, are deposited on luminescent and dielectric plastic films by an in-line vacuum coating method, such as ion beam assisted sputtering or e-beam evaporation, after said plastic films are laminated together. The transparent conductor layer and/or the light reflecting conductor layer are deposited on luminescent and dielectric plastic films by said vacuum coating methods separately, before the said plastic films are laminated together.

[0058] List of Reference Numerals

- | | | |
|----|--|--|
| 1 | luminescent plastic film with electroluminescent phosphor particles inside | |
| 2 | dielectric plastic film | |
| 3A | top thin film electrode | |
| 3B | bottom thin film electrode | |
| 4 | bus bar | |
| 5 | color filter | |
| 6 | glass substrate | |
| 7 | pre-fabricated luminescent plastic film wind up in roll | |
| 8 | pre-fabricated dielectric plastic film wind up in roll | |
| 9 | laminating oven | |
| 10 | heatable laminating rollers | |
| 11 | vacuum chamber for vacuum coating of thin film conductive layer | |
| 12 | wind-up roll of electroluminescent lamp sheet | |
| 13 | glass substrate on conveyor system | |
| 14 | cutting station | |

Claims

1. Electroluminescent layer configuration for use in an electroluminescent lamp comprising at least one luminescent layer (1) and at least one dielectric layer (2) which are laminated together.
2. The electroluminescent layer configuration according to claim 1, wherein said luminescent layer (1) contains electroluminescent phosphor particles mixed with thermoplastic material.
3. The electroluminescent layer configuration according to claim 1 or 2, wherein said luminescent layer (1) contains wave length converting particles.
4. The electroluminescent layer configuration according to any of the previous claims, wherein each of the layers (1, 2) has a thickness between 50 and 500 microns.
5. The electroluminescent layer configuration according to any of the previous claims, further comprising a metallic layer (3A, 3B) which is deposited on at least one side of the electroluminescent layer configuration.
6. The electroluminescent layer configuration according to claim 5, forming a stack, wherein one exterior side of the stack is formed by an electroluminescent layer (1) and another exterior side of the stack by a dielectric layer (2), wherein said metallic layer (3A, 3B) is a transparent, particularly made of indium tin oxide, or light reflecting conductor layer, particularly made of aluminum or silver, put on the electroluminescent layer (1) exterior side and/or the dielectric layer (2) exterior side.
7. The electroluminescent layer configuration according to claim 5 or 6, wherein said metallic layer (3A, 3B) is produced by a vacuum coating method or by a metallic foil.
8. The electroluminescent layer configuration according to any of the previous claims, further comprising a colored film (5).
9. The electroluminescent layer configuration according to any of the previous claims, further comprising a substrate (6) on which the configuration is arranged, particularly a glass substrate on which the metallic film (3B) is put onto.
10. Method of producing an electroluminescent layer configuration comprising the following step:
 - Laminating together at least one luminescent layer (1) and at least one dielectric layer (2) with

a high dielectric constant, thus forming the electroluminescent layer configuration, particularly using rolls (7, 8) for winding up the layers and heat roller (10) for applying heat and pressure.

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11. The method according to claim 10, wherein the laminating step is repeated at least once more with a further luminescent layer (1) and a dielectric layer (2), whereby the thus formed individual laminated layer is stacked to form a multilayer configuration. 10

12. The method according to claims 10 or 11 comprising the further step

- Producing said luminescent layer (1) by processing a thermoplastic electroluminescent material by a calendar or extrusion machine. 15

13. The method according to any of the previous claims 10 to 12, comprising the further step for the producing of said luminescent film (1): 20

- Mixing of electroluminescent particles, particularly electroluminescent phosphor particles, in a thermoplastic material in a predetermined mixing ratio, thus yielding the thermoplastic electroluminescent material. 25

14. The method according to any of the previous claims 10 to 13 comprising the further step for the producing of said luminescent film (1): 30

- Adding wavelength converting particles to said electroluminescent thermoplastic material. 35

15. The method according to any of the previous claims 10 to 14 comprising the following step:

- Putting at least one metallic layer (3A, 3B) on at least one side of the electroluminescent layer configuration, wherein said putting of said metallic layer (3A, 3B) is particularly realized by depositing at least one thin film by a vacuum coating method or by attaching a metallic foil to the electroluminescent layer configuration. 40 45

16. Method for producing an electroluminescent lamp using a electroluminescent layer configuration according to any of the previous claims 1 to 9 comprising the further step: 50

- Cutting and/or stamping the electroluminescent lamp in a desired shape out of the electroluminescent layer configuration. 55

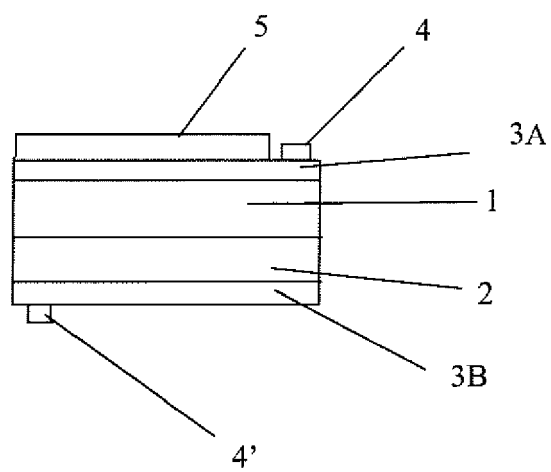


Fig. 1

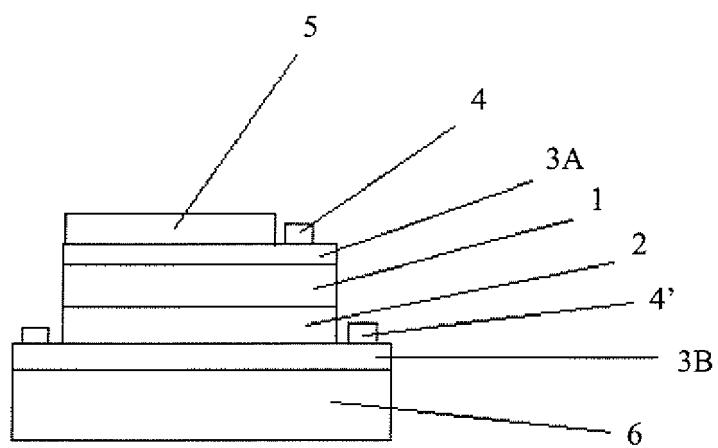


Fig. 2

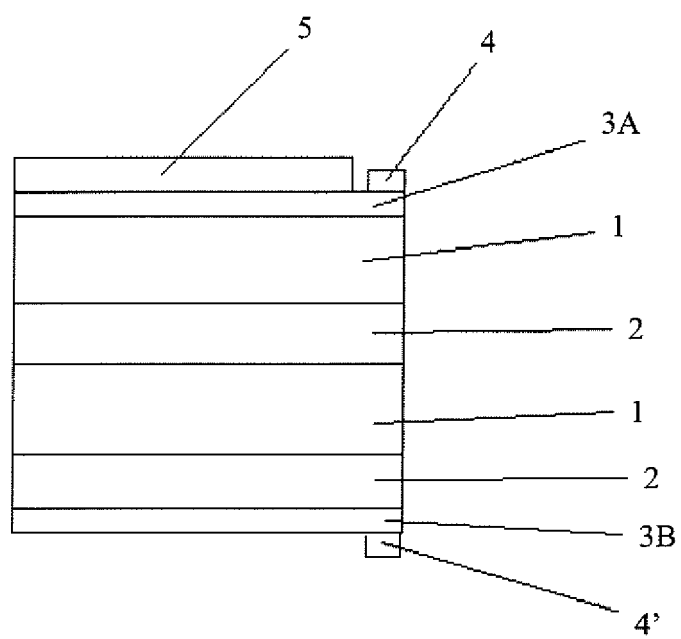


Fig. 3

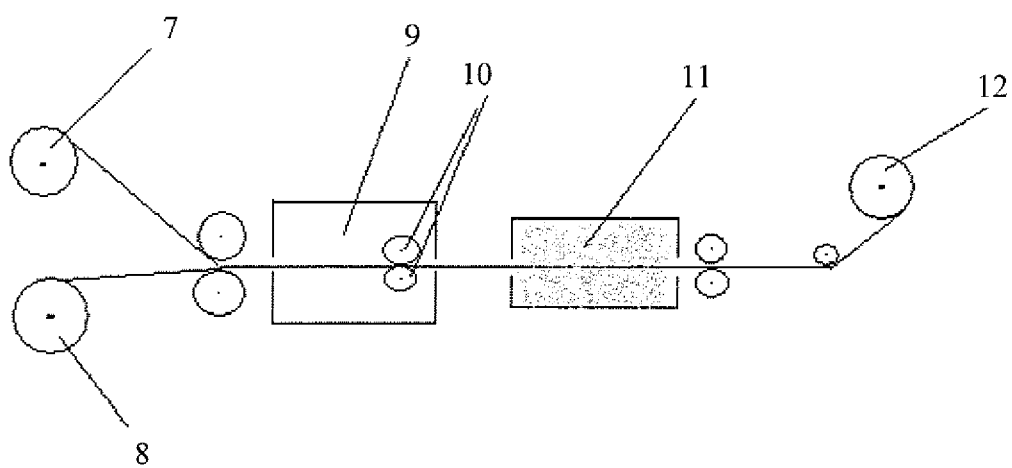


Fig. 4

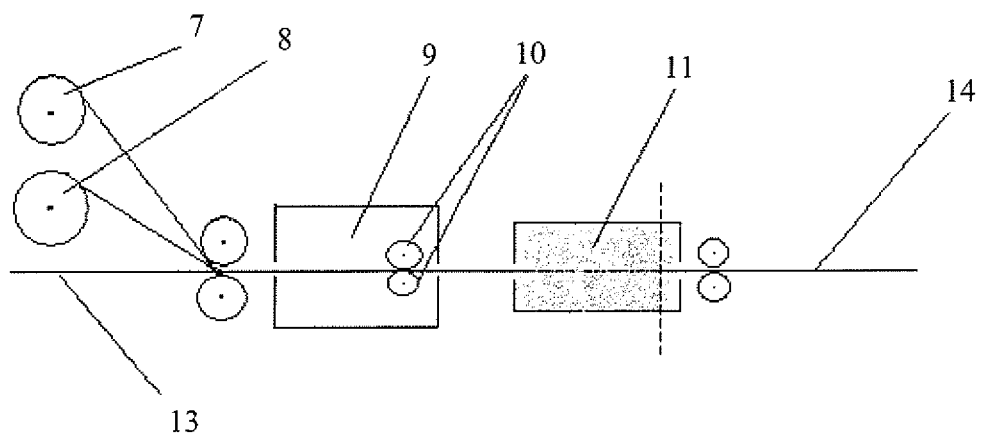


Fig. 5



EUROPEAN SEARCH REPORT

Application Number
EP 08 16 6460

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2002/195931 A1 (GEORGE DOUGLAS A [US] ET AL) 26 December 2002 (2002-12-26) * the whole document *	1-16	INV. H05B33/10
X	WO 2006/025403 A (FUJI PHOTO FILM CO LTD [JP]; SATO TADANOBU; NOGUCHI TAKAFUMI; KAWATO K) 9 March 2006 (2006-03-09) * claim 3 * * paragraphs [0089], [0090] *	1-16	
X	US 4 684 353 A (DESOUZA ANTONIO S [US]) 4 August 1987 (1987-08-04) * claim 1 * * column 3, line 46 - column 5, line 50 *	1-16	
			TECHNICAL FIELDS SEARCHED (IPC)
			H05B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 24 February 2009	Examiner Saldamli, Saltuk
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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 16 6460

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24-02-2009

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REFERENCES CITED IN THE DESCRIPTION

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