part of the phosphor-containing resin layer corresponding to the different part.

[0010]

The present inventors made earnest investigations concerning the uniformity of color or luminance of a semiconductor light-emitting element having a phosphor-containing resin sheet bonded thereon, the ease of production of the element, the degree of freedom in design thereof, and so on, and consequently the present inventors found that in order to improve all these characteristics, a machining shape and arrangement of the phosphor-containing resin sheet on a base material are very important.

[Solution to Problem]

[0011]

~~That is, the present invention pertains to a resin sheet laminate having a resin sheet containing a phosphor and a resin on or over a long base material, wherein subdivisions of the resin sheet are repeatedly arranged in a lengthwise direction of the long base material.~~

According to a first aspect of the present invention, there is provided a resin sheet laminate having a resin sheet containing a phosphor and a resin on or over a long base material, wherein subdivisions of the resin sheet are repeatedly arranged in a lengthwise direction of the long base material.

According to a second aspect of the present invention, there is provided a method for producing a semiconductor light-emitting element with a phosphor-containing resin sheet using the resin sheet laminate according to any one of claims 1 to 9, comprising at least: an alignment step of opposing one subdivision of the phosphor-containing resin sheet on the long base material to an emission surface of one semiconductor light-emitting element, and an adhering step of adhering the one

subdivision of the phosphor-containing resin sheet to the emission surface of the one semiconductor light-emitting element by pressing with a pressure tool, wherein adhesion of the phosphor-containing resin sheet to the semiconductor light-emitting element is sequentially performed by performing the steps (A) and (B) repeatedly.

[Advantageous Effects of Invention]

[0012]

In accordance with embodiments of the present invention, an LED having uniform luminance and color can be produced by an easy process.

[Brief Description of Drawings]

[0013]

such as a phosphor emitting green light, a phosphor emitting blue light, a phosphor emitting yellow light, and a phosphor emitting red light. Specific examples of the phosphor used in the present invention include publicly known phosphors such as inorganic phosphors, organic phosphors, fluorescent pigments and fluorescent dyes. Examples of the organic phosphors include an allylsulfoamide-melamineformaldehyde cocondensation dye and a perylene phosphor, and a perylene phosphor is preferably used since it can be used for a long term. Examples of the fluorescent material particularly preferably used in the present invention include inorganic phosphors. Hereinafter, the inorganic phosphor used in the present invention will be described.

[0034]

Examples of a phosphor emitting green light include SrAl2O4:Eu, Y2SiO5:Ce,~~Tb,~~ MgAl11O19:Ce, Tb, Sr7Al12O25:Eu, and (at least one of Mg, Ca, Sr and Ba)Ga2S4:Eu.

[0035]

Examples of a phosphor emitting blue light include Sr5(PO4)3Cl:Eu, (SrCaBa)5(PO4)3Cl:Eu, (BaCa)5(PO4)3Cl:Eu, (at least one of Mg, Ca, Sr and Ba)2B5O9Cl:Eu, Mn, (at least one of Mg, Ca, Sr and Ba)(PO4)6Cl2:Eu, and Mn.

[0036]

Examples of a phosphor emitting green-yellow light include an yttrium-aluminum oxide phosphor activated with at

least cerium, an yttrium-gadolinium-aluminum oxide phosphor activated with at least cerium, an yttrium-aluminum-garnet oxide phosphor activated with at least cerium, and an yttrium-gallium-aluminum oxide phosphor activated with at least cerium (the so-called YAG-based phosphors). Specifically, Ln3M5O12:R (Ln is at least one selected from among Y, Gd and La, M includes at least one of Al and Ca, and R is a lanthanoid-based phosphor) and (Y1-xGax)3(Al1-yGay)5O12:R (R is at least one selected from among Ce, Tb, Pr, Sm, Eu, Dy and Ho, and 0 < Rx < 0.5, 0 < y < 0.5) can be used.

[0037]

Examples of a phosphor emitting red light include Y2O2S:Eu, La2O2S:Eu, Y2O3:Eu, and Gd2O2S:Eu.

[0038]

Further, examples of a phosphor emitting light compatible with a blue LED which is currently mainstream include YAG-based phosphors such as Y3(Al,Ga)5O12:Ce, (Y,Gd)3Al5O12:Ce, Lu3Al5O12:Ce and Y3Al5O12:Ce; TAG-based phosphors such as Tb3Al5O12:Ce; silicate-based phosphors such as a (Ba,Sr)2SiO4:Eu phosphor, a Ca3Sc2Si3O12:Ce phosphor and a (Sr,Ba,Mg)2SiO4:Eu phosphor; nitride-based phosphors such as (Ca,Sr)2Si5N8:Eu, (Ca,Sr)AlSiN3:Eu and CaSiAlN3:Eu, oxynitride-based phosphors such as Cax (Si,Al)12(O,N)16:Eu; and a (Ba,Sr,Ca)Si2O2N2:Eu phosphor, a Ca8MgSi4O16Cl2:Eu phosphor, SrAl2O4:Eu, and Sr4Al14O25:Eu.

defoaming is also preferably performed in a vacuum or under a reduced pressure.

[0067]

Next, the sheet solution is applied onto a base material and dried. The sheet solution can be applied by using a reverse roll coater, a blade coater, a slit die coater, a direct gravure coater, an offset gravure coater, ~~a reverse roll coater, a blade coater,~~ a kiss coater, screen printing, a natural roll coater, an air knife coater, a roll blade coater, a baribar roll blade coater, a two stream coater, a rod coater, a wire bar coater, a coating applicator, a dip coater, a curtain coater, a spin coater, a knife coater or the like. In order to achieve uniformity of the thickness of the sheet, the sheet solution is preferably applied with a slit die coater. Further, the phosphor-containing resin sheet of the present invention can also be produced by using a printing method such as screen printing, gravure printing, or planographic printing. Particularly, screen printing is preferably used.

[0068]

A sheet can be dried by using a common heating apparatus such as a hot air drier or an infrared drier. A common heating apparatus such as a hot air drier or an infrared drier is used for thermally curing the sheet. In this case, thermal curing is usually performed under the conditions of a temperature of 40 to 250°C and a heating time of 1 minute to 5 hours, and

[0092]

Further, when the array pitch of subdivisions of the phosphor-containing resin sheet and the array pitch of the semiconductor light-emitting elements are the same, a plurality of subdivisions of the phosphor-containing resin sheet and a plurality of semiconductor light-emitting elements can be simultaneously adhered to each other by pressing the resin sheet and the elements. That is, in the step (ED), when two or more subdivisions of a plurality of opposed subdivisions of the phosphor-containing resin sheet are simultaneously pressed, the two or more subdivisions of the phosphor-containing resin sheet can be adhered to two or more emission surfaces of the semiconductor light-emitting elements.

[0093]

A variation of the second example is a method in which, by pressing simultaneously two or more subdivisions of a plurality of opposed subdivisions of the phosphor-containing resin sheet in the step (D), the two or more subdivisions of the phosphor-containing resin sheet are adhered to two or more emission surfaces of the semiconductor light-emitting elements. Fig. 7 shows an example in which three subdivisions of the phosphor-containing resin sheet 2 are simultaneously adhered to three semiconductor light-emitting elements 9 by pressing by use of a pressure tool 13 of batch process. In Fig. 7, the number of the subdivisions of the phosphor-containing resin

that of the pressure tool 7 to be brought into contact with the base material 1 in concurrence with the adhesion or after adhesion.

[0097]

As shown in Fig. 8(c), even when the pressure tool 7 is raised to release pressing, the base material 1 does not peel off by itself from the phosphor-containing resin sheet 2 when an adhesive power between the base material 1 and the phosphor-containing resin sheet 2 is relatively high.

[0098]

As shown in Fig. 8(d), the base material 1, the phosphor-containing resin sheet 2 and the semiconductor light-emitting element 9 are sent rightward in the drawing in a state of being adhered to one another.

[0099]

As shown in Fig. 8(e) and Fig. 8(f), a second subdivision of the phosphor-containing resin sheet 2 is adhered to a second semiconductor light-emitting element 9 by the pressure tool 7, and the resin sheet laminate and the semiconductor light-emitting element are further sent rightward in the drawing.

[0100]

In Fig. 8(g), the base material 1 is pulled up starting from an end of the semiconductor light-emitting element 9 upon arrival of the first subdivision of the phosphor-containing resin sheet 2 and the

one of claims 10 to 14, wherein the pressure tool performs pressing from the semiconductor light-emitting element side in the adhering step.

[Claim 17]

The method for producing a semiconductor light-emitting element with a phosphor-containing resin sheet according to any one of claims 10 to 16, wherein the base material is peeled off by using a peeling tool different from the pressure tool after the subdivision of the phosphor-containing resin sheet is adhered to the emission surface of the semiconductor light-emitting element.

[Claim 18]

The method for producing a semiconductor light-emitting element with a phosphor-containing resin sheet according to any one of claims 10 to 17, wherein the pressure tool presses a part of the subdivision to be pressed first and presses a different region thereafter in the adhering step.

[Claim 19]

The method for producing a semiconductor light-emitting element with a phosphor-containing resin sheet according to claim 17, wherein the pressure tool is a pressure roller.

[Claim 20]

The method for producing a semiconductor light-emitting element with a phosphor-containing resin sheet according to any one of claims ~~9~~10 to 18, wherein heating is performed together