Patent Literature 2: Japanese Patent Application Laid-open No. 2007-273440

Patent Literature 3: Japanese Patent Application Laid-open No. 2002-348568

Patent Literature 4: Japanese Patent Application Laid-open No. 2001-164245

Patent Literature 5: Japanese Patent Application Laid-open No. 2011-241160

Summary

Technical Problem

[0007] However, even these organic light-emitting materials are still insufficient in view of achieving both color reproducibility and durability. In particular, deficient is a technique that also achieves durability when an organic light-emitting material that exhibits light emission with high color purity is used as a component of a color conversion sheet.

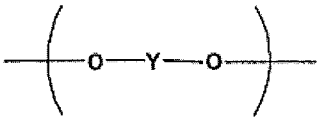
[0008] A problem to be solved by the present disclosure is to achieve both improvement in color reproducibility and durability in a color conversion sheet for use in displays, lighting apparatuses, and the like.

Solution to Problem

[0008a] In an aspect, there is provided a color conversion composition that converts incident light into light with a wavelength longer than that of the incident light, the color conversion composition comprising the following Component (A) and Component (B):

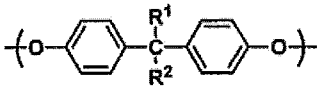
Component (A): an organic light-emitting material; and

Component (B): at least one of a polyester resin having a partial structure represented by General Formula (1) in a molecular structure of the polyester resin and a resin containing a bisphenol structure represented by General Formula (2):



(1)

where Y is a divalent saturated aliphatic hydrocarbon group having at least one of a tertiary carbon and a quaternary carbon, and



(2)

where R^1 and R^2 each represents hydrogen or a C_{1-20} organic group; R^1 and R^2 are the same as or different from each other.

[0008b] In another aspect, there is provided a color conversion sheet comprising a layer of the color conversion composition as defined above or a layer of a cured object of the color conversion composition as defined above.

[0008c] In another aspect, there is provided a light source unit comprising:

a light source; and

the color conversion sheet as defined above.

[0008d] In another aspect, there is provided a display or a lighting apparatus comprising the light source unit as defined above.

[0008e] In another aspect, there is provided an LED chip comprising a light-emitting face provided with the color conversion sheet as defined above.

[0008f] In another aspect, there is provided an LED package comprising one of a cured object of the color conversion composition as defined above and the color conversion sheet as defined above.

[0008g] In another aspect, there is provided a backlight unit or a display or a lighting apparatus, comprising the LED package as defined above.

[0009] The inventors of the present disclosure have found out that the use of either one or both of a

polyester resin having a specific structure and a resin containing a bisphenol structure having a specific structure as components of a binder resin in a color conversion composition inhibits the degradation of an organic light-emitting material and greatly improves the durability of a color conversion sheet.

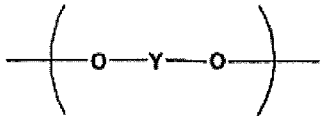
[0010] To solve the problem described above and to achieve the object, a color conversion composition according to the present disclosure converts incident light

into light with a wavelength longer than that of the incident light. The color conversion composition includes the following Component (A) and Component (B):

Component (A): an organic light-emitting material; and

Component (B): at least one of a polyester resin having a partial structure represented by General Formula (1) in a molecular structure of the polyester resin and a resin containing a bisphenol structure represented by General Formula (2):

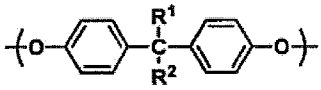
[0011]



(1)

(where Y is a divalent saturated aliphatic hydrocarbon group having at least one of a tertiary carbon and a quaternary carbon)

[0012]

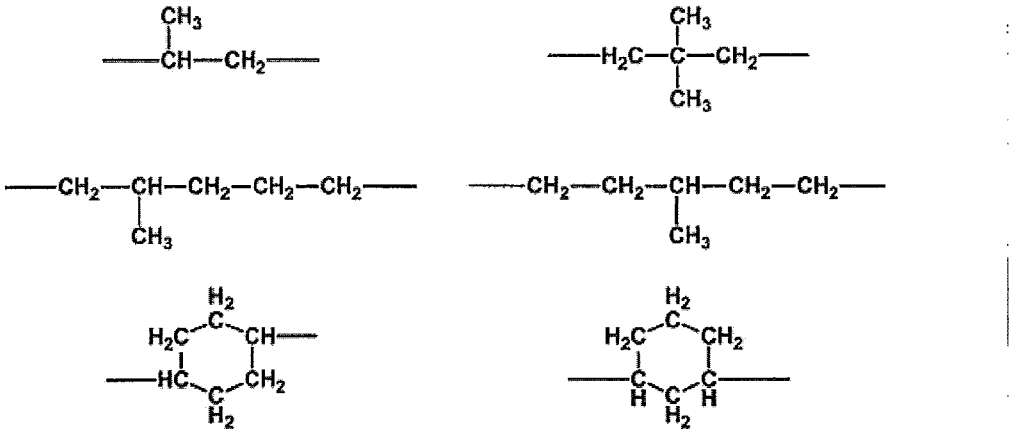


(2)

(where R^1 and R^2 each represents hydrogen or a C_{1-20} organic group; R^1 and R^2 are the same as or different from each other).

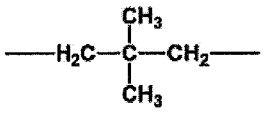
[0013] In the color conversion composition as defined above, Y in the General Formula (1) is at least one selected from groups of the following structures:

[0014]



[0015] In the color conversion composition as defined above, Y in the General Formula (1) contains a group of the following structure:

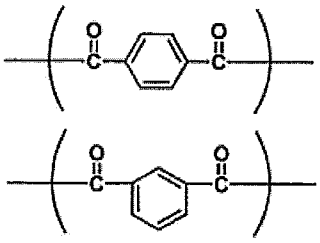
[0016]



[0017] In the color conversion composition as defined above, when a weight ratio of the partial structure represented by the General Formula (1) to a total amount of the polyester resin contained as the Component (B) is represented as m_1% by weight, m_1 satisfies $10 \leq m_1 \leq 60$.

[0018] In the color conversion composition as defined above, the polyester resin has at least one of a partial structure represented by General Formula (3) and a partial structure represented by General Formula (4) in the molecular structure of the polyester resin:

[0019]



(3)

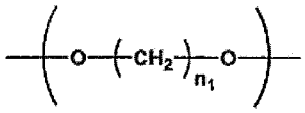
(4)

[0020] In the color conversion composition as defined above, the polyester resin has at least the partial structure represented by the General Formula (3) in the molecular structure of the polyester resin, and when a weight ratio of the partial structure represented by the General Formula (3) to a total amount of the polyester resin contained as the Component (B) is represented as m_2% by weight, m_2 satisfies $20 \leq m_2 \leq 70$.

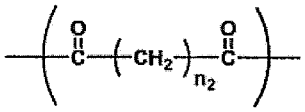
[0021] In the color conversion composition as defined above, when a weight ratio of the partial structure represented by the General Formula (3) to a total amount of the polyester resin contained as the Component (B) is represented as m_2% by weight, and a weight ratio of the partial structure represented by the General Formula (4) to a total amount of the polyester resin contained as the Component (B) is represented as m_3% by weight, m_2 and m_3 satisfy $20 \leq m_2 + m_3 \leq 70$.

[0022] In the color conversion composition as defined above, the polyester resin has at least one of a partial structure represented by General Formula (5) and a partial structure represented by General Formula (6) in a molecular structure of the polyester resin:

[0023]



(5)



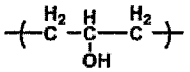
(6)

(where n_1 and n_2 are natural numbers, in which $2 \leq n_1 \leq 10$ and $2 \leq n_2 \leq 14$).

[0024] In the color conversion composition as defined above, $n_1 = 2$, and $n_2 = 8$.

[0025] In the color conversion composition as defined above, a weight average molecular weight of the polyester resin is 5,000 or more and 100,000 or less.

[0026] In the color conversion composition as defined above, the resin containing the bisphenol structure has at least a structure represented by General Formula (7) in a molecular structure of the resin:

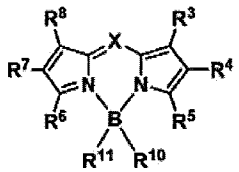


(7)

[0027]

[0028] In the color conversion composition as defined above, a weight average molecular weight of the resin containing the bisphenol structure is 10,000 or more and 100,000 or less.

[0029] In the color conversion composition as defined above, the Component (A) contains a compound represented by General Formula (8):



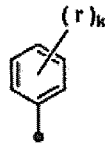
(8)

[0030]

(where X is C-R^9 or N; R^3 to R^{11} are the same as or different from each other and are selected from hydrogen,

an alkyl group, a cycloalkyl group, a heterocyclic group, an alkenyl group, a cycloalkenyl group, an alkynyl group, a hydroxy group, a thiol group, an alkoxy group, an alkylthio group, an aryl ether group, an aryl thioether group, an aryl group, a heteroaryl group, halogen, a cyano group, an aldehyde group, a carbonyl group, a carboxy group, an oxycarbonyl group, a carbamoyl group, an amino group, a nitro group, a silyl group, a siloxanyl group, a boryl group, a phosphine oxide group, and a condensed ring and an aliphatic ring formed between adjacent substituents).

[0031] In the color conversion composition as defined above, X in the General Formula (8) is C-R^9 in which R^9 is a group represented by General Formula (9):



(9)

[0032]

(where r is selected from the group consisting of hydrogen, an alkyl group, a cycloalkyl group, a heterocyclic group, an alkenyl group, a cycloalkenyl group, an alkynyl group, a hydroxy group, a thiol group, an alkoxy group, an alkylthio group, an aryl ether group, an aryl thioether group, an aryl group, a heteroaryl group, halogen, a cyano group, an aldehyde group, a carbonyl group, a carboxy group, an oxycarbonyl group, a carbamoyl group, an amino group, a nitro group, a silyl group, a siloxanyl group, a boryl group, and a phosphine oxide group; k is an integer of 1 to 3; when k is 2 or more, rs are the same as or different from each other).

[0033] In the color conversion composition as defined above, R^3, R^5, R^6, and R^8 in the General Formula (8) are the same as or different from each other and are substituted or unsubstituted phenyl groups.

[0034] In the color conversion composition as defined above, R^3, R^5, R^6, and R^8 in the General Formula (8) are the same as or different from each other and are substituted or unsubstituted alkyl groups.

[0035] In the color conversion composition as defined above, the Component (A) contains a light-emitting material that exhibits light emission with a peak wavelength observed in a region of 500 nm or more and 580 nm or less by using excitation light in a wavelength range of 400 nm or more and 500 nm or less.

[0036] In the color conversion composition as defined above, the Component (A) contains the following Light-Emitting Material (a) and Light-Emitting Material (b):Light-Emitting Material (a): a light-emitting material that exhibits light emission with a peak wavelength observed in a region of 500 nm or more and 580 nm or less by using excitation light in a wavelength range of 400 nm or more and 500 nm or less, and Light-Emitting Material (b): a light-emitting material that exhibits light emission with a peak wavelength observed in a region of 580 nm or more and 750 nm or less by being excited by at least either excitation light in a wavelength range of 400 nm or more and 500 nm or less or light emission from the Light-Emitting Material (a).

[0037] In the color conversion composition as defined above, a content w_a of the Light-Emitting Material (a) and a content w_b of the Light-Emitting Material (b) have a relation of $w_a \geq w_b$.

[0038] In the color conversion composition as defined above, the light-emitting material that exhibits light emission with a peak wavelength of 500 nm or more and 580 nm or less by using the excitation light in a wavelength range of 400 nm or more and 500 nm or less is

the compound represented by the General Formula (8).

[0039] In the color conversion composition as defined above, the Light-Emitting Material (b) is the compound represented by the General Formula (8).

[0040] A color conversion sheet according to the present disclosure includes a layer of the color conversion composition as defined above or a layer of a cured object of the color conversion composition as defined above.

[0041] In the color conversion sheet as defined above further includes a barrier layer.

[0042] A light source unit according to the present disclosure includes: a light source; and the color conversion sheet as defined above.

[0043] In the light source unit as defined above, the light source is a light-emitting diode having maximum emission in a range of 400 nm or more and 500 nm or less.

[0044] A display according to the present disclosure includes the light source unit as defined above.

[0045] A lighting apparatus according to the present disclosure includes the light source unit as defined above.

[0046] An LED chip according to the present disclosure includes a light-emitting face provided with the color conversion sheet as defined above.

[0047] An LED package according to the present disclosure includes a cured object of the color conversion composition as defined above.

[0048] An LED package according to the present disclosure includes the color conversion sheet as defined above.

[0049] A backlight unit according to the present disclosure includes the LED package as defined above.

[0050] A display according to the present disclosure includes the LED package as defined above.

[0051] A lighting apparatus according to the present disclosure includes the LED package as defined above.

Advantageous Effects

[0052] The color conversion composition and the color conversion sheet containing the same according to the present disclosure achieve both high color purity and durability and thus produce an effect of making it possible to achieve both high color reproducibility and high durability. The light source unit, the display, and the lighting apparatus according to the present disclosure use the color conversion sheet and thus produce an effect of making it possible to achieve both high color reproducibility and high durability.

Brief Description of Drawings

[0053] FIG. 1 is a schematic sectional view of an example of a color conversion sheet according to an embodiment of the present invention.

FIG. 2 is a schematic sectional view of another example of the color conversion sheet according to the embodiment of the present invention.

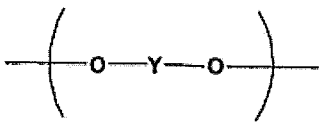
FIG. 3 is a schematic sectional view of still another example of the color conversion sheet according to the embodiment of the present invention.

CLAIMS

1. A color conversion composition that converts incident light into light with a wavelength longer than that of the incident light, the color conversion composition comprising the following Component (A) and Component (B):

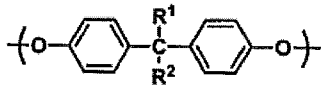
Component (A): an organic light-emitting material; and

Component (B): at least one of a polyester resin having a partial structure represented by General Formula (1) in a molecular structure of the polyester resin and a resin containing a bisphenol structure represented by General Formula (2):



(1)

where Y is a divalent saturated aliphatic hydrocarbon group having at least one of a tertiary carbon and a quaternary carbon, and

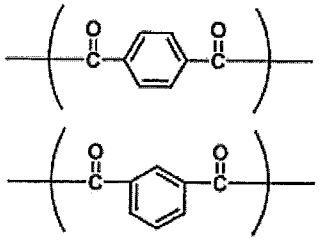


(2)

where R^1 and R^2 each represents hydrogen or a C_{1-20} organic group; R^1 and R^2 are the same as or different from each other.

2. The color conversion composition according to claim 1, wherein when a weight ratio of the partial structure represented by the General Formula (1) to a total amount of the polyester resin contained as the Component (B) is represented as m_1% by weight, m_1 satisfies $10 \leq m_1 \leq 60$.

3. The color conversion composition according to claim 1 or 2, wherein the polyester resin has at least one of a partial structure represented by General Formula (3) and a partial structure represented by General Formula (4) in the molecular structure of the polyester resin:



(3)

(4)

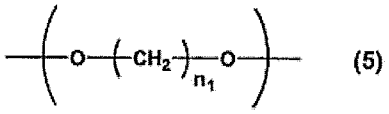
4. The color conversion composition according to claim 3, wherein

the polyester resin has at least the partial structure represented by the General Formula (3) in the molecular structure of the polyester resin, and

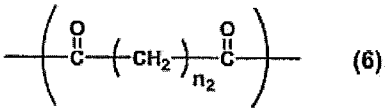
when a weight ratio of the partial structure represented by the General Formula (3) to a total amount of the polyester resin contained as the Component (B) is represented as m_2% by weight, m_2 satisfies $20 \leq m_2 \leq 70$.

5. The color conversion composition according to claim 3 or 4, wherein when a weight ratio of the partial structure represented by the General Formula (3) to a total amount of the polyester resin contained as the Component (B) is represented as m_2% by weight, and a weight ratio of the partial structure represented by the General Formula (4) to a total amount of the polyester resin contained as the Component (B) is represented as m_3% by weight, m_2 and m_3 satisfy $20 \leq m_2 + m_3 \leq 70$.

6. The color conversion composition according to any one of claims 1 to 5, wherein the polyester resin has at least one of a partial structure represented by General Formula (5) and a partial structure represented by General Formula (6) in a molecular structure of the polyester resin:



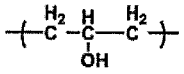
(5)



(6)

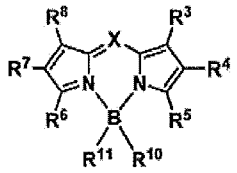
where n_1 and n_2 are natural numbers, in which $2 \leq n_1 \leq 10$ and $2 \leq n_2 \leq 14$.

7. The color conversion composition according to claim 1, wherein the resin containing the bisphenol structure has at least a structure represented by General Formula (7) in a molecular structure of the resin:



(7)

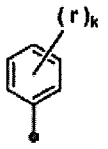
8. The color conversion composition according to any one of claims 1 to 7, wherein the Component (A) contains a compound represented by General Formula (8):



(8)

where X is C-R^9 or N; R^3 to R^{11} are the same as or different from each other and are selected from hydrogen, an alkyl group, a cycloalkyl group, a heterocyclic group, an alkenyl group, a cycloalkenyl group, an alkynyl group, a hydroxy group, a thiol group, an alkoxy group, an alkylthio group, an aryl ether group, an aryl thioether group, an aryl group, a heteroaryl group, halogen, a cyano group, an aldehyde group, a carbonyl group, a carboxy group, an oxycarbonyl group, a carbamoyl group, an amino group, a nitro group, a silyl group, a siloxanyl group, a boryl group, a phosphine oxide group, and a condensed ring and an aliphatic ring formed between adjacent substituents.

9. The color conversion composition according to claim 8, wherein X in the General Formula (8) is C-R^9 in which R^9 is a group represented by General Formula (9):



(9)

where r is selected from the group consisting of hydrogen, an alkyl group, a cycloalkyl group, a heterocyclic group, an alkenyl group, a cycloalkenyl group, an alkynyl group, a hydroxy group, a thiol group, an alkoxy group, an alkylthio group, an aryl ether group, an aryl thioether group, an aryl group, a heteroaryl group, halogen, a cyano group, an aldehyde group, a carbonyl group, a carboxy group, an oxycarbonyl group, a carbamoyl group, an amino group, a nitro group, a silyl group, a siloxanyl group, a boryl group, and a phosphine oxide group; k is an integer of 1 to

3; when k is 2 or more, rs are the same as or different from each other.

10. The color conversion composition according to claim 8 or 9, wherein R^3, R^5, R^6, and R^8 in the General Formula (8) are the same as or different from each other, and R^3, R^5, R^6, and R^8 in the General Formula (8) are substituted or unsubstituted phenyl groups or are substituted or unsubstituted alkyl groups.

11. The color conversion composition according to any one of claims 1 to 10, wherein the Component (A) contains a light-emitting material that exhibits light emission with a peak wavelength observed in a region of 500 nm or more and 580 nm or less by using excitation light in a wavelength range of 400 nm or more and 500 nm or less.

12. The color conversion composition according to any one of claims 1 to 11, wherein the Component (A) contains the following Light-Emitting Material (a) and Light-Emitting Material (b):

Light-Emitting Material (a): a light-emitting material that exhibits light emission with a peak wavelength observed in a region of 500 nm or more and 580 nm or less by using excitation light in a wavelength range of 400 nm or more and 500 nm or less, and

Light-Emitting Material (b): a light-emitting material that exhibits light emission with a peak wavelength observed in a region of 580 nm or more and 750 nm or less by being excited by at least either excitation light in a wavelength

range of 400 nm or more and 500 nm or less or light emission from the Light-Emitting Material (a).

13. The color conversion composition according to claim 12, wherein a content w_a of the Light-Emitting Material (a) and a content w_b of the Light-Emitting Material (b) have a relation of $w_a \geq w_b$.

14. The color conversion composition according to any one of claims 11 to 13 citing claim 8, wherein the light-emitting material that exhibits light emission with a peak wavelength of 500 nm or more and 580 nm or less by using the excitation light in a wavelength range of 400 nm or more and 500 nm or less is the compound represented by the General Formula (8).

15. The color conversion composition according to any one of claims 12 to 14 citing claim 8, wherein the Light-Emitting Material (b) is the compound represented by the General Formula (8).

16. A color conversion sheet comprising a layer of the color conversion composition according to any one of claims 1 to 15 or a layer of a cured object of the color conversion composition according to any one of claims 1 to 15.

17. The color conversion sheet according to claim 16, further comprising a barrier layer.

18. A light source unit comprising:
a light source; and
the color conversion sheet according to claim 16 or 17.

19. A display or a lighting apparatus comprising the light source unit according to claim 24 or 25.

20. An LED chip comprising a light-emitting face provided with the color conversion sheet according to claim 16 or 17.

21. An LED package comprising one of a cured object of the color conversion composition according to any one of claims 1 to 15 and the color conversion sheet according to claim 16 or 17.

22. A backlight unit or a display or a lighting apparatus, comprising the LED package according to claim 21.