CLAIMS

1. Polymer particles comprising the following components (a) and (b) and having an average particle diameter of 50% by volume of equal to or more than 1 nm and equal to or less than 1000 nm:

(a) an amphiphilic polymer; and

(b) a compound exhibiting a change in fluorescence characteristics or light absorption characteristics in response to a change in a specific environmental factor.

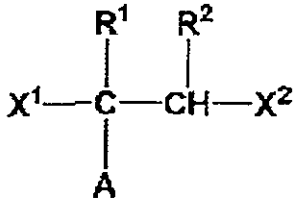
2. Polymer particles comprising the following components (a) and (b) and having an average particle diameter of 50% by volume of equal to or more than 1 nm and equal to or less than 1000 nm:

(a) an amphiphilic polymer; and

(b) a compound exhibiting a change in fluorescence characteristics in response to a change in a specific environmental factor.

3. The polymer particles according to claim 1 or 2, wherein

the (a) is a polymer particle represented by the following general formula (1) and is a terminally branched copolymer having a number average molecular weight of equal to or less than 2.5×10^4,



(1)

wherein, in the formula (1), A represents a polyolefin chain;

R^1 and R^2 each represent a hydrogen atom or an alkyl group having 1 to 18 carbon atoms, and at least one of R^1 and R^2 is a hydrogen atom; and X^1 and X^2 are the same as or different from each other and each represent a group containing a linear or branched polyalkylene glycol group.

4. The polymer particles according to claim 3, wherein

in the terminally branched copolymer represented by the general formula (1), X^1 and X^2 are the same as or different from each other, and are each a group represented by either of the general formulae (2) and (4),



(2)

wherein, in the formula (2), E represents an oxygen atom or a sulfur atom; and X^3 represents a polyalkylene glycol group or a group represented by the general formula (3),



(3)

wherein, in the formula (3), R^3 represents an (m+1)-valent hydrocarbon group; Gs are the same as or different from each other and each represent a group represented by $-OX^4$ or $-NX^5X^6$ (X^4 to X^6 each represent a polyalkylene glycol group); and m is the bonding number for R^3 to group G, and represents an integer of 1 to 10,

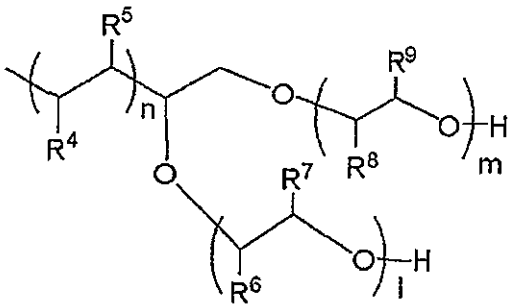


(4)

wherein, in the formula (4), X^7 and X^8 are the same as or different

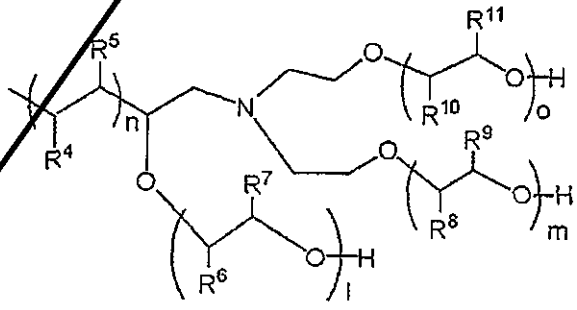
from each other and each represent a polyalkylene glycol group or a group represented by the general formula (3).

5. The polymer particles according to claim 4, wherein the terminally branched copolymer is represented by the following general formula (1a) or (1b),



(1a)

wherein, in the formula (1a), R^4 and R^5 each represent a hydrogen atom or an alkyl group having 1 to 18 carbon atoms, and at least one of R^4 and R^5 is a hydrogen atom; R^6 and R^7 each represent a hydrogen atom or a methyl group, and at least one of R^6 and R^7 is a hydrogen atom; R^8 and R^9 each represent a hydrogen atom or a methyl group, and at least one of R^8 and R^9 is a hydrogen atom; l + m represents an integer of equal to or more than 2 and equal to or less than 450; and n represents an integer of equal to or more than 20 and equal to or less than 300,



(1b)

wherein, in the formula (1b), R^4 and R^5 each represent a hydrogen atom or an alkyl group having 1 to 18 carbon atoms, and at least one

of R^4 and R^5 is a hydrogen atom; R^6 and R^7 each represent a hydrogen atom or a methyl group, and at least one of R^6 and R^7 is a hydrogen atom; R^8 and R^9 each represent a hydrogen atom or a methyl group, and at least one of R^8 and R^9 is a hydrogen atom; R^{10} and R^{11} each represent a hydrogen atom or a methyl group, and at least one of R^{10} and R^{11} is hydrogen atom; l + m + o represents an integer of equal to or more than 3 and equal to or less than 450; and n represents an integer of equal to or more than 20 and equal to or less than 300.

6. The polymer particles according to any one of claims 1 to 5, wherein the average particle diameter of 50% by volume is equal to or more than 1 nm and equal to or less than 30 nm.

7. The polymer particles according to any one of claims 1 to 6, wherein the (b) is a temperature-sensitive fluorescent dye.

8. The polymer particles according to claim 7, further comprising a non-temperature-sensitive fluorescent dye as a reference for the temperature-sensitive fluorescent dye.

9. The polymer particles according to claim 7 or 8, wherein the temperature-sensitive fluorescent dye is selected from a complex compound of a rare earth element selected from europium (Eu), lanthanum (La), samarium (Sm), gadolinium (Gd), terbium (Tb), dysprosium (Dy), thulium (Tm), ytterbium (Yb), and lutetium (Lu) with β-diketone chelating compounds, or a complex compound of iridium (Ir) with aromatic compounds.

10. The polymer particles according to claim 9, wherein the temperature-sensitive fluorescent dye is tris(thenoyltrifluoroacetonate)europium (III) (Eu (III)$(TTA)_3$) or a derivative thereof.

11. The polymer particles according to any one of claims 1 to 8, wherein the (b) is fluorescent protein.

12. The polymer particles according to any one of claims 1 to 6, wherein the (b) is an oxygen-sensitive fluorescent dye or a pH-sensitive fluorescent dye.

13. The polymer particles according to claim 12, wherein the oxygen-sensitive fluorescent dye is tris(2-phenylpyridine)iridium(III) (Ir(III)$(ppy)_3$) or a derivative thereof, and the pH-sensitive fluorescent dye is pyranine.

14. The polymer particles according to any one of claims 1 to 6, wherein the (b) is a chromic material.

15. The polymer particles according to claim 14, wherein the chromic material is a photochromic dye.

16. The polymer particles according to claim 15, wherein the photochromic dye is a naphthopyran derivative.

17. An aqueous dispersion having the polymer particles according to any one of claims 1 to 16 dispersed in water and/or a solvent which dissolves a part of water or dissolves all of water in an arbitrary ratio.

18. A mixed composition comprising the following (A), (B), and (C), and if necessary, (D):

(A) the polymer particles according to any one of claims 1 to 16;

(B) a metal alkoxide and/or a partial hydrolysis condensate thereof;

(C) water and/or a solvent which dissolves a part of water or dissolves all of water in an arbitrary ratio; and

(D) a catalyst for a sol-gel reaction.

19. An organic/inorganic composite comprising the polymer particles according to any one of claims 1 to 16 and a metal oxide.

20. A sensor comprising any of the polymer particles according to any one of claims 1 to 16, the aqueous dispersion according to claim 17, the mixed composition according to claim 18, and the organic/inorganic composite according to claim 19.

21. A temperature detecting component comprising the polymer particles according to any one of claims 7 to 10.

22. An oxygen detecting component or ion concentration detecting component comprising the polymer particles according to claim 12 or 13.

23. A chromic article comprising the polymer particles according to any one of claims 14 to 16.

24. The chromic article according to claim 19, which is a photochromic optical article.

CLAIMS

1. An article comprising polymer particles,

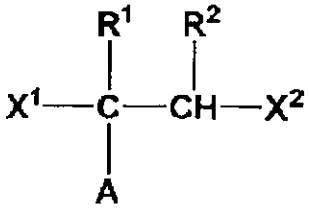
wherein the polymer particles comprising the following components (a) and (b) and having an average particle diameter of 50% by volume of equal to or more than 1 nm and equal to or less than 1000 nm:

(a) an amphiphilic polymer; and

(b) a compound exhibiting a change in fluorescence characteristics or light absorption characteristics in response to a change in a specific environmental factor,

the article is selected from a group consisting of a sensor, a temperature detecting component, an oxygen detecting component, an ion concentration detecting component and a chromic article,

the (a) is a terminally branched copolymer having a number average molecular weight of equal to or less than 2.5×10^4 represented by the following general formula (1),



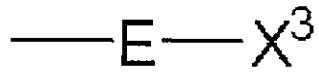
(1)

in the formula (1), A represents a polyolefin chain; R^1 and R^2 each represent a hydrogen atom or an alkyl group having 1 to 18 carbon atoms, and at least one of R^1 and R^2 is a hydrogen atom; and X^1 and X^2 are the same as or different from each other and each represent a group containing a linear or branched polyalkylene glycol group, and

the (b) is selected from a group consisting of a temperature-sensitive fluorescent dye, temperature-sensitive fluorescent dye, a pressure-sensitive fluorescent dye, an oxygen-sensitive fluorescent dye, a metal (metal ion)-sensitive fluorescent dye, a metal (metal ion)-sensitive fluorescent protein, a pH (acid and base)-sensitive fluorescent dye and a chromic material.

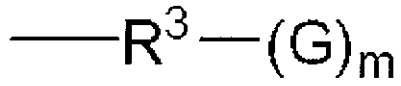
2. The article according to claim 1,

wherein, in the terminally branched copolymer represented by the general formula (1), X^1 and X^2 are the same as or different from each other, and are each a group represented by either of the general formulae (2) and (4),



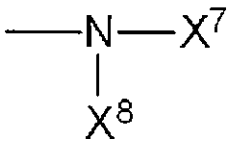
(2)

in the formula (2), E represents an oxygen atom or a sulfur atom; and X^3 represents a polyalkylene glycol group or a group represented by the general formula (3),



(3)

in the formula (3), R^3 represents an (m+1)-valent hydrocarbon group; G represents a group represented by $-OX^4$ or $-NX^5X^6$ (X^4 to X^6 each represents a polyalkylene glycol group), G exists as one or a plurality, and each G may be the same or different from each other; and m is the bonding number for R^3 to group G, and represents an integer of 1 to 10,

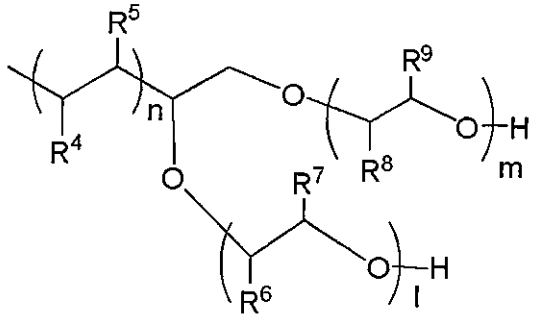


(4)

in the formula (4), X^7 and X^8 are the same as or different from each other and each

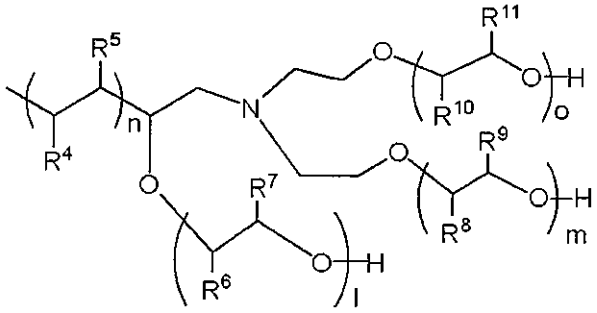
represent a polyalkylene glycol group or a group represented by the general formula (3).

3. The article according to claim 2,
wherein the terminally branched copolymer is represented by the following general formula (1a) or (1b),



(1a)

in the formula (1a), R^4 and R^5 each represent a hydrogen atom or an alkyl group having 1 to 18 carbon atoms, and at least one of R^4 and R^5 is a hydrogen atom; R^6 and R^7 each represent a hydrogen atom or a methyl group, and at least one of R^6 and R^7 is a hydrogen atom; R^8 and R^9 each represent a hydrogen atom or a methyl group, and at least one of R^8 and R^9 is a hydrogen atom; l + m represents an integer of equal to or more than 2 and equal to or less than 450; and n represents an integer of equal to or more than 20 and equal to or less than 300,



(1b)

in the formula (1b), R^4 and R^5 each represent a hydrogen atom or an alkyl group having 1 to 18 carbon atoms, and at least one of R^4 and R^5 is a hydrogen atom; R^6 and R^7 each represent a hydrogen atom or a methyl group, and at least one of R^6 and R^7 is a hydrogen atom; R^8 and R^9 each represent a hydrogen atom or a methyl group, and at least one of R^8 and R^9 is a hydrogen atom; R^{10} and R^{11} each represent a hydrogen atom or a methyl group, and at least one of R^{10} and R^{11} is hydrogen atom; l + m + o represents an integer of equal to or more than 3 and equal to or less than 450; and n represents an integer of equal to or more than 20 and equal to or less than 300.

4. The article according to any one of claims 1-3,
wherein the average particle diameter of 50% by volume of the polymer particles is equal to or more than 1 nm and equal to or less than 30 nm.

5. The article according to any one of claims 1-4,
wherein the article is a sensor or a temperature detecting component, and
the (b) is a temperature-sensitive fluorescent dye.

6. The article according to claim 5,
wherein the polymer particles further comprise a non-temperature-sensitive fluorescent dye as a reference for the temperature-sensitive fluorescent dye.

7. The article according to claim 5 or 6,
wherein the temperature-sensitive fluorescent dye is selected from a complex compound of a rare earth element selected from europium (Eu), lanthanum (La), samarium (Sm), gadolinium (Gd), terbium (Tb), dysprosium (Dy), thulium (Tm), ytterbium (Yb), and lutetium (Lu) with β-diketone chelating compounds, or a complex compound of iridium (Ir) with aromatic compounds.

8. The article according to claim 7,
wherein the temperature-sensitive fluorescent dye is tris(thenoyltrifluoroacetonate)europium (III) (Eu (III)$(TTA)_3$) or a derivative thereof.

9. The article according to any one of claims 1 to 4,
wherein the article is selected from a group consisting of a sensor , a temperature detecting component and an ion concentration detecting component, and
the (b) is an oxygen-sensitive fluorescent dye or a pH-sensitive fluorescent dye.

10. The article according to claim 9,
wherein the oxygen-sensitive fluorescent dye is tris(2-phenylpyridine)iridium(III) (Ir(III)$(ppy)_3$) or a derivative thereof, and the pH-sensitive fluorescent dye is pyranine.

11. The article according to any one of claims 1 to 4,
wherein the article is a chromic article, and
the (b) is a chromic material.

12. The article according to claim 11, wherein the chromic material is a photochromic dye.

13. The article according to claim 12, wherein the photochromic dye is a naphthopyran derivative.

14. The article according to any one of claims 1 to 10,
wherein the article is a sensor, the sensor comprising an ~~An~~ aqueous dispersion having the polymer particles containing components (a) and (b), and
the polymer particles are dispersed in water and/or a solvent which dissolves a part of water or dissolves all of water.

15. The article according to any one of claims 1 to 10,
wherein the article is a sensor, the sensor comprising a mixed composition comprising the following (A), (B), and (C), and if necessary, (D):
(A) the polymer particles containing components (a) and (b);
(B) a metal alkoxide and/or a partial hydrolysis condensate thereof;
(C) water and/or a solvent which dissolves a part of water or dissolves all of water in an arbitrary ratio; and
(D) a catalyst for a sol-gel reaction.

16. The article according to any one of claims 1 to 10,
wherein the article is a sensor, the sensor comprising a organic/inorganic composite comprising the polymer particles containing components (a) and (b) and a metal oxide.

17. The article according to any one of claims 11 to 13,
the chromic article being a photochromic optical article.