Claims

1. A formulation comprising:

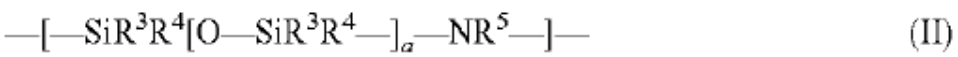
a polymer comprising a first repeating unit M^1 and a second repeating unit M^2; and

surface-modified zirconium dioxide nanocrystals;

wherein the first repeating unit M^1 is represented by formula (I) and the second repeating unit M^2 is represented by formula (II):



$$—[—SiR^1R^2—NR^5—]— \quad (I)$$



$$—[—SiR^3R^4[O—SiR^3R^4—]_a—NR^5—]— \quad (II)$$

wherein R^1, R^2, R^3, R^4 and R^5 are at each occurrence independently from each other selected from the group consisting of hydrogen, organyl and organoheteryl; and

a is an integer from 1 to 60.

2. The formulation according to claim **1**,

wherein the polymer comprises at least one further repeating unit M^1 which is represented by formula (I), wherein the at least one further repeating unit M^1 is different from the first repeating unit M^1.

3. The formulation according to claim **1**,

wherein R^1 and R^2 are at each occurrence independently from each other hydrogen or alkyl having 1 to 20 carbon atoms or phenyl.

4. The formulation according to claim **1**,

wherein R^3 and R^4 are independently from each other hydrogen or alkyl having 1 to 40 carbon atoms or phenyl.

5. The formulation according to claim **1**,
wherein R^5 is at each occurrence independently hydrogen or alkyl having 1 to 20 carbon atoms or phenyl.

6. The formulation according to claim **1**,
wherein the surface-modified zirconium dioxide nanocrystals are at least partially capped with a silicone capping agent and optionally a second capping agent selected from the list consisting of vinyltrimethoxysilane, allyltrimethoxysilane, 1-hexenyltrimethoxysilane, 1-octenyltrimethoxysilane, methyltrimethoxysilane, ethyltrimethoxysilane, propyltrimethoxysilane, propyltriethoxysilane, n-octyltrimethoxysilane, n-octyltriethoxysilane, n-dodecyltrimethoxysilane, n-dodecyltriethoxysilane, n-hexadecyltrimethoxysilane, and/or octadecyltrimethoxysilane.

7. The formulation according to claim **6**,
wherein the silicone capping agent comprises a head group covalently linked to said zirconium dioxide nanocrystals and a tail group, wherein said tail group comprises at least a silicone chain.

8. The formulation according to claim **1**,
wherein said formulation comprises a solvent system with two groups of solvents A) and B),
wherein group A) is one solvent or a mixture of two or more solvents having a boiling point of <90° C. and group B) is one solvent or a mixture of two or more solvents having a boiling point of >90° C.

9. The formulation according to claim **8**,
wherein group A) is selected from the list consisting of esters, ethers and ketones and group B) is selected from the list consisting of esters, ethers, alkanes and aromatic solvents.

10. A method for preparing the formulation according to claim **1**,

wherein a polymer containing a first repeating unit M^1 and a second repeating unit M^2 is mixed with a dispersion of surface-modified zirconium dioxide nanocrystals.

11. An encapsulation material for an LED, obtainable by

(a) providing a formulation according to claim **1**; and

(b) curing said formulation at a temperature of 70 to 300° C. for a period of 1 to 24 h.

12. A LED comprising the encapsulation material according to claim **11**.

13. The LED according to claim **12**,

wherein the encapsulation material is comprised in a converter layer which comprises one or more converters selected from phosphors and/or quantum materials.

14. A method for producing an LED comprising the steps of

(a) applying a formulation according to claim **1** to an LED precursor; and

(b) curing the formulation at a temperature of 70 to 300° C. for a period of 1 to 24 h.

15. The method for producing an LED according to claim **14**,

wherein the formulation which is applied in step (a) to an LED precursor forms part of a converter layer which preferably comprises one or more converters selected from phosphors and/or quantum materials.

16. The method for producing an LED according to claim **14**,

wherein the formulation is applied in step (a) by spray coating.

17. The method for producing an LED according to claim **16**,

wherein the formulation comprises a solvent system with two groups of solvents A) and B),

wherein group A) is one solvent or a mixture of two or more solvents having a boiling point of <90° C. and group B) is one solvent or a mixture of two or more solvents having a boiling point of >90° C.

18. The method for producing an LED according to claim **17**,

wherein group A) is selected from the list consisting of esters, ethers and ketones and group B) is selected from the list consisting of esters, ethers, alkanes and aromatic solvents.