Claims

1. The use of fluorescent nanoparticles comprising an inorganic core, a passivating layer comprising an imidazole component, and specific ligands having a hydrodynamic diameter of the inorganic core with the passivating layer of not more than 15 nm, preferably of not more than 10 nm, particularly preferably of not more than 5 nm, as in vivo contrast agent, characterized in that the nanoparticles show an emission of less than 700 nm, and the contrast agent is suitable for local application in humans.

2. The use as claimed in the preceding claim, characterized in that the nanoparticles are administered or injected systemically, locally or topically.

3. The use as claimed in either of the preceding claims for tissue marking in surgical, endoscopic or minimally invasive interventions.

4. The use as claimed in any of the preceding claims, characterized in that the nanoparticles additionally include at least one modifier.

5. The use as claimed in any of the preceding claims, characterized in that the inorganic core a cluster essentially comprising noble metal atoms, preferably a cluster having 2 to 27 atoms.

6. The use as claimed in any of preceding claims 1 to 4, characterized in that the inorganic core comprises an alloy/semiconductor core, where the core has a homogeneous composition and is characterized by a band-gap energy which is non-linear in relation to the molar ratio of the two semiconductors.

7. The use as claimed in any of claims 1 to 4, characterized in that the inorganic core comprises an alloy of a first semiconductor and of a second semiconductor, where the concentration of the first semiconductor increases gradually from the center of the core to its surface, and the concentration of the second semiconductor decreases gradually from the center of the core to its surface.

8. The use as claimed in either of claims 6 and 7, characterized in that at least one of the semiconductors is a group II-group VI semiconductor or a group III-group V semiconductor.

9. The use as claimed in any of claims 6 to 8, characterized in that the core comprises an alloy selected from the group of the following alloys: CdSeTe, CdSSe, CdSTe, ZnSeTe, ZnCdTe, CdHgS, CdHgTe, InGaAs, GaAlAs, InGaN, InGaP, CdSe or CdTe.

10. The use as claimed in any of the preceding claims, characterized in that the passivating layer comprises at least one compound able to coordinate with a metal atom or metal ion and having a Lewis base function or a heteroaromatic system.

11. The use as claimed in claim 10, characterized in that the imidazole component comprises one or more compounds selected from the following group: histidine, carnosine, anserine, baleine, homocarnosine, histidyl-phenylalanine, cyclo-histidylphenylalanine, 5-amino-4-imidazolecarboxamide, histidylleucine, 2-mercapto-imidazole, boc-histidine, hydrazide, histinol, 1-methylhistidine, 3-methylhistidine, imidazolysine, imidazole-containing ornithine (e.g. 5-methyl-imidazole), imidazole-containing alanine (e.g. (beta)-(2-imidazolyl)-L(alpha)alanine), carzinine, histamine, each of which may in turn be substituted by reactive

groups (for example amino, thiol, carboxyl or carboxamide).

12. The use as claimed in either of claims 10 or 11, characterized in that the passivating layer comprises a crosslinker for crosslinking the imidazole component.

13. The use as claimed in claim 12, characterized in that the crosslinking component comprises an alkylphosphine and/or an alkylphosphine derivative.

14. The use as claimed in any of claims 4 to 13, characterized in that the modifiers are selected from the group of the following compounds: polyethylene glycol, monosaccharides, disaccharides, trisaccharides, low molecular weight polysaccharides, hydrophilic vitamins, lipophilic vitamins, fatty acids, polyalcohols, Teflon, amino acids, nonspecific peptides or proteins, phosphorylcholine, polylactate and derivatives of said compounds.

15. A pharmaceutical composition comprising nanoparticles comprising an inorganic core, a passivating layer and specific ligands having a hydrodynamic diameter of the inorganic core with the passivating layer of not more than 15 nm, preferably of not more than 10 nm, particularly preferably of not more than 5 nm, characterized in that they show an emission of from 600 to 700 nm, preferably from 620 to 650 nm.

16. The pharmaceutical composition comprising nanoparticles as claimed in claim 15, characterized in that they additionally include at least one modifier.

17. The pharmaceutical composition comprising nanoparticles as claimed in either of claims 15 to 16, characterized in that the inorganic core comprises a

cluster essentially comprising noble metal atoms, preferably a cluster with 2 to 27, preferably from the group of gold, silver and copper.

18. The pharmaceutical composition comprising nanoparticles as claimed in either of claims 15 or 16, characterized in that the inorganic core comprises an alloy/semiconductor core, where the core has a homogeneous composition and is characterized by a band-gap energy which is non-linear in relation to the molar ratio of the two semiconductors.

19. The pharmaceutical composition comprising nanoparticles as claimed in either of claims 15 or 16, characterized in that the inorganic core comprises an alloy of a first semiconductor and of a second semiconductor, where the concentration of the first semiconductor increases gradually from the center of the core to its surface, and the concentration of the second semiconductor decreases gradually from the center of the core to its surface.

20. The pharmaceutical composition comprising nanoparticles as claimed in either of claims 18 or 19, characterized in that at least one of the semiconductors is a group II-group VI semiconductor or a group III-group V semiconductor.

21. The pharmaceutical composition comprising nanoparticles as claimed in claim 20, characterized in that the core comprises an alloy selected from the group of the following alloys: CdSeTe, CdSSe, CdSTe, ZnSeTe, ZnCdTe, CdHgS, CdHgTe, InGaAs, GaAlAs, InGaN, InGaP, CdSe and CdTe.

22. The pharmaceutical composition comprising nanoparticles as claimed in any of claims 15 to 21, characterized in that the passivating layer comprises

at least one compound able to coordinate with a metal atom or metal ion and having a Lewis base function or a heteroaromatic system, preferably an imidazole component.

23. The pharmaceutical composition comprising nanoparticles as claimed in claim 22, characterized in that the imidazole component comprises one or more compounds selected from the following group: histidine, carnosine, anserine, baleine, homocarnosine, histidylphenylalanine, cyclohistidylphenylalanine, 5-amino-4-imidazolecarboxamide, histidylleucine, 2-mercaptoimidazole, boc-histidine, hydrazide, histinol, 1-methylhistidine, 3-methylhistidine, imidazolysine, imidazole-containing ornithine (e.g. 5-methyl-imidazole), imidazole-containing alanine (e.g. (beta)-(2-imidazolyl)-L(alpha)alanine), carzinine, histamine, each of which may in turn be substituted by reactive groups (for example amino, thiol, carboxyl or carboxamide).

24. Nanoparticles as claimed in claim 23, characterized in that the crosslinking component comprises an alkylphosphine and/or an alkylphosphine derivative.

25. Nanoparticles as claimed in any of claims 16 to 24, characterized in that the modifier is selected from the following group comprising: polyethylene glycol, monosaccharides, disaccharides, trisaccharides, low molecular weight polysaccharides, hydrophilic vitamins, lipophilic vitamins, fatty acids, polyalcohols, Teflon, amino acids, nonspecific peptides or proteins, phosphorylcholine, polylactate and derivatives of said compounds.

CLAIMS

1. The use of fluorescent nanoparticles comprising an inorganic core, a passivating layer comprising an imidazole component, and specific ligands having a hydrodynamic diameter of the inorganic core with the passivating layer of not more than 15 nm, preferably of not more than 10 nm, particularly preferably of not more than 5 nm, as in vivo contrast agent, characterized in that the nanoparticles show an emission of less than 700 nm, and the contrast agent is suitable for local application in humans.

2. The use as claimed in the preceding claim, characterized in that the nanoparticles are suitable to be administered or injected systemically, locally or topically.

3. The use as claimed in either of the preceding claims suitable for tissue marking in surgical, endoscopic or minimally invasive interventions.

4. The use as claimed in any of the preceding claims, characterized in that the nanoparticles additionally include at least one modifier selected from the group of the following compounds: polyethylene glycol, monosaccharides, disaccharides, trisaccharides, hydrophilic vitamins, lipophilic vitamins, fatty acids, polyalcohols, Teflon, amino acids, phosphorylcholine and polylactate.

5. The use as claimed in any of preceding claims 1 to 4, characterized in that the inorganic core comprises an alloy/semiconductor core, where the core has a homogeneous composition and is characterized by a band-gap energy which is non-linear in relation to the molar ratio of the two semiconductors.

6. The use as claimed in any of claims 1 to 4, characterized in that the inorganic core comprises an alloy of a first semiconductor and of a second semiconductor, where the concentration of the first semiconductor increases gradually from the center of the core to its surface, and the concentration of the second semiconductor decreases gradually from the center of the core to its surface.

7. The use as claimed in either of claims 5 and 6, characterized in that at least one of the semiconductors is a group II-group VI semiconductor or a group III-group V semiconductor.

8. The use as claimed in any of claims 5 to 7, characterized in that the core comprises an alloy selected from the group of the following alloys: CdSeTe, CdSSe, CdSTe, ZnSeTe, ZnCdTe, CdHgS, CdHgTe, InGaAs, GaAlAs, InGaN, InGaP, CdSe or CdTe.

9. The use as claimed in any of claims 1 to 8, characterized in that the imidazole component comprises one or more compounds selected from the following group: histidine, carnosine, anserine, baleine, homocarnosine, histidyl-phenylalanine, cyclo-histidylphenylalanine, 5-amino-4-imidazolecarboxamide, histidylleucine, 2-mercaptoimidazole, boc-histidine, hydrazide, histinol, 1-methylhistidine, 3-methylhistidine, imidazolysine, imidazole-containing ornithine (e.g. 5-methylimidazole), imidazole-containing alanine (e.g. (beta)-(2-imidazolyl)-L(alpha)alanine), carzinine and histamine, each of which may in turn be substituted by reactive groups (for example amino, thiol, carboxyl or carboxamide).

10. The use as claimed in any of claims 1 to 9, characterized in that the passivating layer comprises a crosslinker for crosslinking the imidazole component.

11. The use as claimed in claim 10, characterized in that the crosslinking component comprises an alkylphosphine.

12. An in vivo contrast agent comprising nanoparticles comprising an inorganic core, a passivating layer comprising an imidazole component and specific ligands having a hydrodynamic diameter of the inorganic core with the passivating layer of not more than 15 nm, preferably of not more than 10 nm, particularly preferably of not more than 5 nm, characterized in that they show an emission of from 600 to 700 nm, preferably from 620 to 650 nm.

13. The in vivo contrast agent comprising nanoparticles as claimed in claim 12, characterized in that they additionally include at least one modifier selected from the group of the following compounds: polyethylene glycol, monosaccharides, disaccharides, trisaccharides, hydrophilic vitamins, lipophilic vitamins, fatty acids, polyalcohols, Teflon, amino acids, phosphorylcholine and polylactate.

14. The in vivo contrast agent comprising nanoparticles as claimed in claim 12 or 13, characterized in that the inorganic core comprises an alloy/semiconductor

core, where the core has a homogeneous composition and is characterized by a band-gap energy which is non-linear in relation to the molar ratio of the two semiconductors.

15. The in vivo contrast agent comprising nanoparticles as claimed in either of claims 13 or 14, characterized in that the inorganic core comprises an alloy of a first semiconductor and of a second semiconductor, where the concentration of the first semiconductor increases gradually from the center of the core to its surface, and the concentration of the second semiconductor decreases gradually from the center of the core to its surface.

16. The in vivo contrast agent comprising nanoparticles as claimed in either of claims 14 or 15, characterized in that at least one of the semiconductors is a group II-group VI semiconductor or a group III-group V semiconductor.

17. The in vivo contrast agent comprising nanoparticles as claimed in claim 16, characterized in that the core comprises an alloy selected from the group of the following alloys: CdSeTe, CdSSe, CdSTe, ZnSeTe, ZnCdTe, CdHgS, CdHgTe, InGaAs, GaAlAs, InGaN, InGaP, CdSe and CdTe.

18. The in vivo contrast agent comprising nanoparticles as claimed in any of claims 13 to 17, characterized in that the imidazole component comprises one or more compounds selected from the following group: histidine, carnosine, anserine, baleine, homocarnosine, histidylphenylalanine, cyclohistidyl-phenylalanine, 5-amino-4-imidazolecarboxamide, histidylleucine, 2-mercapto-imidazole, boc-histidine, hydrazide, histinol, 1-methylhistidine, 3-methyl-histidine, imidazolysine, imidazole-containing ornithine (e.g. 5-methyl-imidazole), imidazole-containing alanine (e.g. (beta)-(2-imidazolyl)-L(alpha)alanine), carzinine and histamine, each of which may in turn be substituted by reactive groups (for example amino, thiol, carboxyl or carboxamide).

19. The in vivo contrast agent as claimed in claim 13 to 18, characterized in that the crosslinking component comprises an alkylphosphine.