WHAT WE CLAIM IS

1. A process for producing polymer particles, the process comprising:

A) providing a host cell comprising at least one expression construct operably linked to a strong promoter, the expression construct comprising:

(1) at least one nucleic acid sequence encoding a polymer synthase; or

(2) at least one nucleic acid sequence encoding a fusion polypeptide that comprises a polymer synthase and at least one fusion partner;

B) cultivating the host cell under conditions suitable for expression of the expression construct and for formation of polymer particles by the polymer synthase; and

C) separating the polymer particles from the cultivated host cells to produce a composition comprising polymer particles.

2. A process for producing polymer particles, the process comprising:

A) providing a host cell comprising at least one expression construct operably linked to a strong promoter, the expression construct comprising:

(1) at least one nucleic acid sequence encoding a polymer synthase; or

(2) at least one nucleic acid sequence encoding a fusion polypeptide that comprises a polymer synthase and at least one fusion partner; and

(3) at least one nucleic acid sequence encoding a particle forming protein or at least one nucleic acid sequence encoding an additional fusion polypeptide or a combination thereof, wherein the additional fusion polypeptide comprises:

(a) a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and at least one fusion partner, or

(b) at least one polypeptide and a binding domain that binds the fusion partner of the fusion polypeptide or the additional fusion polypeptide;

B) cultivating the host cell under conditions suitable for expression of the expression construct and for formation of polymer particles by the polymer synthase; and

C) separating the polymer particles from the cultivated cells to produce a composition comprising polymer particles.

3. A process for producing polymer particles, the process comprising:

A) providing a host cell comprising at least one expression construct operably linked to a strong promoter, the expression construct comprising:

(1) at least one nucleic acid sequence encoding a polymer synthase; or

(2) at least one nucleic acid sequence encoding a fusion polypeptide that comprises a polymer synthase and at least one fusion partner; and

(3) at least one nucleic acid sequence encoding an additional fusion polypeptide that comprises a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and at least one fusion partner; and

(4) at least one nucleic acid sequence encoding a further fusion polypeptide that comprises a polypeptide and a binding domain that binds the fusion partner of the fusion polypeptide or the additional fusion polypeptide;

B) cultivating the host cell under conditions suitable for expression of the expression construct and for formation of polymer particles by the polymer synthase; and

C) separating the polymer particles from the cultivated cells to produce a composition comprising polymer particles.

4. A process as claimed in claim 1 wherein the host cell further comprises an additional expression construct comprising at least one nucleic acid sequence encoding an additional fusion polypeptide, the fusion polypeptide comprising

a. a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

b. at least one fusion partner.

5. A process as claimed in claim 1 wherein the host cell further comprises an additional expression construct comprising at least one nucleic acid sequence encoding a particle forming protein.

6. A process as claimed in claim 1 wherein the host cell further comprises an additional expression construct comprising at least one nucleic acid sequence encoding a further fusion polypeptide, the fusion polypeptide comprising a polypeptide and a binding domain that binds the fusion partner of the fusion polypeptide.

7. A process for producing polymer particles, the process comprising:

A) providing a cell comprising at least one expression construct operably linked to a strong promoter, the expression construct comprising:

(1) at least one nucleic acid sequence encoding a polymer synthase, the polymer synthase comprising a polymer particle binding domain; or

(2) at least one nucleic acid sequence encoding a fusion polypeptide, the fusion polypeptide comprising a polymer synthase and at least one fusion partner, the polymer synthase comprising a polymer particle binding domain; and

(3) optionally, at least one nucleic acid sequence encoding an additional fusion polypeptide that comprises a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and at least one fusion partner;

B) cultivating the cell under conditions suitable for expression of the expression construct and for formation of polymer particles by the polymer synthase, wherein the polymer synthase remains associated with the particle it forms and wherein any fusion polypeptide present binds a polymer particle; and

C) separating the polymer particles from the cultivated cells to produce a composition comprising polymer particles.

8. A process as claimed in any one of claims 1 to 7 wherein the strong promoter a viral promoter or a phage promoter.

9. A process as claimed in any one of claims 1 to 7 wherein the promoter is a phage promoter.

10. A process as claimed in any one of claims 1 to 7 wherein the promoter is a T7 phage promoter.

11. A process as claimed in any one of claims 1 to 10 wherein the host cell comprises two or more different expression constructs that each encode a different fusion polypeptide.

12. A process as claimed in any one of claims 1 to 10 wherein the host cell comprises three or more different expression constructs that each encode a different fusion polypeptide.

13. A process as claimed in any one of claims 1 to 12 wherein at least about 1% of the surface area of the polymer particles is covered by surface-bound proteins.

14. A process as claimed in any one of claims 1 to 12 wherein at least about 10% of the surface area of the polymer particles is covered by surface-bound proteins.

15. A process as claimed in any one of claims 1 to 12 wherein at least about 50% of the surface area of the polymer particles is covered by surface-bound proteins.

16. A process as claimed in any one of claims 1 to 15 wherein the process produces polymer particles with an average diameter less than about 200 nm.

17. A process as claimed in any one of claims 1 to 15 wherein the process produces polymer particles with an average diameter less than about 150 nm.

18. A process as claimed in any one of claims 1 to 15 wherein the process produces polymer particles with an average diameter less than about 110 nm.

19. A process as claimed in any one of claims 1 to 18 wherein the process produces at least about 20 particles per host cell.

20. A process as claimed in any one of claims 1 to 18 wherein the process produces at least about 40 particles per host cell.

21. A process as claimed in any one of claims 1 to 18 wherein the process produces at least about 60 particles per host cell.

22. A process as claimed in any one of claims 1 to 21 wherein the process produces at least about 20 particles per host cell with an average diameter less than about 110 nm.

23. A process as claimed in any one of claims 1 to 22, further comprising

a. binding a coupling reagent to the fusion partner, or

b. binding a coupling reagent to the fusion partner and binding a substance to the coupling reagent, or

c. binding a substance to the fusion partner, or

d. chemically modifying the polymer synthase or the particle forming protein to form at least one binding domain by contacting the polymer synthase or the protein with a coupling reagent,

e. or a combination thereof.

24. A process as claimed in any one of claims 1 to 22, wherein the fusion partner comprises a binding domain, the process further comprising

a. binding a coupling reagent to the binding domain, or

b. binding a coupling reagent to the binding domain and binding a substance to the coupling reagent, or

c. binding a substance to the binding domain,

d. or a combination thereof.

25. A process as claimed in any one of claims 1 to 24 further comprising adding at least one polypeptide or at least one substance or a combination thereof while cultivating the host cells so that the at least one polypeptide or at least one substance binds to or is incorporated into the polymer particles.

26. A process as claimed in any one of claims 1 to 24 further comprising contacting the polymer particles with adding at least one polypeptide or at least one substance or a combination thereof that binds to or is adsorbed into the polymer particles.

27. A process as claimed in claim 25 or 26 wherein the substance is a lipophilic substance that is incorporated into or adsorbed into the polymer particles.

28. A process as claimed in claim 25 or 26 wherein the substance is one or more skin care agents selected from sunscreen agents, particulate materials, conditioning agents, thickening agents, water-soluble vitamins, water-dispersible vitamins, oil-dispersible vitamins, emulsifying elastomers comprising dimethicone copolyol crosspolymers, non-emulsifying elastomers comprising dimethicone/vinyl dimethicone crosspolymers, oil-soluble skin care actives comprising oil-soluble terpene alcohols, phytosterols, anti-acne actives, beta-hydroxy acids, vitamin B_3 compounds, retinoids, anti-oxidants/radical scavengers, chelators, flavonoids, anti-inflammatory agents, anti-cellulite agents, topical anesthetics, antiperspirants, and fragrances, or a combination thereof.

29. A process as claimed in claim 25 or 26 wherein the substance is one or more cleaning agents selected from

a) enzymes including cellulases, peroxidases, proteases, glucoamylases, amylases, lipases, cutinases, pectinases, reductases, oxidases, phenoloxidases, lipoxygenases, ligninases, pullulanases, tannases, pentosanases, malanases, β-glucanases, and arabinosidases, or

b) anti-redeposition agents including methylcellulose, carboxymethylcellulose, hydroxyethylcellulose, polyacrylate polymers, copolymers of maleic anhydride and acrylic acid, copolymers of maleic anhydride and ethylene, copolymers of maleic anhydride and methylvinyl ether, copolymers of maleic anhydride, and methacrylic acid, or

c) a combination thereof.

30. A process as claimed in claim 25 or 26 wherein the substance is a coloured or fluorescent molecule, a radioisotope, one or more metal ions or a combination thereof.

31. A process as claimed in any one of claims 1 to 30 wherein the fusion partner is selected from a protein, a protein fragment, a binding domain, a target-binding domain, a binding protein, a binding protein fragment, an antibody, an antibody fragment, an antibody heavy chain, an antibody light chain, a single chain antibody, a single-domain antibody, a Fab fragment, an Fc antibody fragment, an Fv antibody fragment, a F(ab')2 antibody

fragment, a Fab' antibody fragment, a single-chain Fv (scFv) antibody fragment, an antibody binding domain, an antigen, an antigenic determinant, an epitope, a hapten, an immunogen, an immunogen fragment, biotin, a biotin derivative, an avidin, a streptavidin, a substrate, an enzyme, an abzyme, a co-factor, a receptor, a receptor fragment, a receptor subunit, a receptor subunit fragment, a ligand, an inhibitor, a hormone, a lectin, a polyhistidine, a coupling domain, a DNA binding domain, a FLAG epitope, a cysteine residue, a library peptide, a reporter peptide, and an affinity purification peptide, or a combination thereof.

32. A process as claimed in any one of claims 1 to 30 wherein the fusion partner comprises

a) an antigen, an antigenic determinant, an epitope, or an immunogen, or

b) an antibody or an antibody fragment, or

c) an antibody binding domain.

33. A process as claimed in any one of claims 1 to 30 wherein the fusion partner comprises an antibody binding domain.

34. A composition comprising a plurality of polymer particles having an average diameter of less than about 200 nm, the polymer particles comprising

A) at least one polymer synthase, or

B) at least one fusion polypeptide comprising a polymer synthase and at least one fusion partner, and

C) optionally,

(1) at least one additional particle forming protein, or

(2) at least one additional fusion polypeptide comprising

(a) a polymer a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(b) at least one fusion partner, or

(3) at least one of (1) and at least one of (2).

35. A composition comprising a plurality of polymer particles having an average diameter of less than about 150 nm, the polymer particles comprising

A) at least one polymer synthase, or

B) at least one fusion polypeptide comprising a polymer synthase and at least one fusion partner, and

C) optionally,

(1) at least one additional particle forming protein, or

(2) at least one additional fusion polypeptide comprising

(a) a polymer a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(b) at least one fusion partner, or

(3) at least one of (1) and at least one of (2).

36. A composition comprising a plurality of polymer particles having an average diameter of less than about 110 nm, the polymer particles comprising

A) at least one polymer synthase, or

B) at least one fusion polypeptide comprising a polymer synthase and at least one fusion partner, and

C) optionally,

(1) at least one additional particle forming protein, or

(2) at least one additional fusion polypeptide comprising

(a) a polymer a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(b) at least one fusion partner, or

(3) at least one of (1) and at least one of (2).

37. A composition as claimed in any one of claims 34 to 36 wherein at least about 1% of the surface area of the polymer particles is covered by surface-bound proteins.

38. A composition as claimed in any one of claims 34 to 36 wherein at least about 10% of the surface area of the polymer particles is covered by surface-bound proteins.

39. A composition as claimed in any one of claims 34 to 36 wherein at least about 50% of the surface area of the polymer particles is covered by surface-bound proteins.

40. A composition as claimed in any one of claims 34 to 39 wherein the composition further comprises at least one substance bound to or incorporated into the polymer particles or a combination thereof.

41. A composition as claimed claim 40 wherein the substance is a lipophilic substance.

42. A composition as claimed in claim 40 wherein the substance is one or more skin care agents selected from sunscreen agents, particulate materials, conditioning agents, thickening agents, water-soluble vitamins, water-dispersible vitamins, oil-dispersible vitamins, emulsifying elastomers comprising dimethicone copolyol crosspolymers, non-emulsifying elastomers comprising dimethicone/vinyl dimethicone crosspolymers, oil-soluble skin care actives comprising oil-soluble terpene alcohols, phytosterols, anti-acne actives, beta-hydroxy acids, vitamin B_3 compounds, retinoids, anti-oxidants/radical scavengers, chelators, flavonoids, anti-inflammatory agents, anti-cellulite agents, topical anesthetics, antiperspirants, and fragrances, or a combination thereof.

43. A composition as claimed in claim 40 wherein the substance is one or more cleaning agents selected from

a) enzymes including cellulases, peroxidases, proteases, glucoamylases, amylases,

ligninases, pullulanases, tannases, pentosanases, malanases, β-glucanases, and arabinosidases, or

b) anti-redeposition agents including methylcellulose, carboxymethylcellulose, hydroxyethylcellulose, polyacrylate polymers, copolymers of maleic anhydride and acrylic acid, copolymers of maleic anhydride and ethylene, copolymers of maleic anhydride and methylvinyl ether, copolymers of maleic anhydride, and methacrylic acid, or

c) a combination thereof.

44. A composition as claimed in claim 40 wherein the substance is a coloured or fluorescent molecule, a radioisotope, one or more metal ions, or a combination thereof.

45. A composition as claimed in any one of claims 34 to 44 wherein the fusion partner is selected from a protein, a protein fragment, a binding domain, a target-binding domain, a binding protein, a binding protein fragment, an antibody, an antibody fragment, an antibody heavy chain, an antibody light chain, a single chain antibody, a single-domain antibody, a Fab antibody fragment, an Fc antibody fragment, an Fv antibody fragment, a F(ab')2 antibody fragment, a Fab' antibody fragment, a single-chain Fv (scFv) antibody fragment, an antibody binding domain, an antigen, an antigenic determinant, an epitope, a hapten, an immunogen, an immunogen fragment, biotin, a biotin derivative, an avidin, a streptavidin, a substrate, an enzyme, an abzyme, a co-factor, a receptor, a receptor fragment, a receptor subunit, a receptor subunit fragment, a ligand, an inhibitor, a hormone, a lectin, a polyhistidine, a coupling domain, a DNA binding domain, a FLAG epitope, a cysteine residue, a library peptide, a reporter peptide, and an affinity purification peptide, or a combination thereof.

46. A composition as claimed in any one of claims 34 to 44 wherein the fusion partner is

a) an antigen, an antigenic determinant, an epitope, or an immunogen, or

b) an antibody or antibody fragment, or

c) an antibody binding domain.

47. A composition as claimed in any one of claims 34 to 44 wherein the fusion partner comprises an antibody binding domain.

48. A composition as claimed in any one of claims 34 to 47 wherein

a. a coupling reagent is bound to the fusion partner, or

b. a coupling reagent is bound to the fusion partner and a substance is bound to the coupling reagent, or

c. a substance is bound to the fusion partner, or

d. the polymer synthase or the particle forming protein has been chemically modified with a coupling reagent to form at least one binding domain, or

e. a combination thereof.

49. A composition as claimed in any one of claims 34 to 47 wherein the fusion partner comprises a binding domain and

a. a coupling reagent is bound to the binding domain, or

b. a coupling reagent is bound to the binding domain and a substance is bound to the coupling reagent, or

c. a substance is bound to the binding domain,

d. or a combination thereof.

50. A composition of polymer particles as claimed in any one of claims 34 to 49 produced according to a process of any one of claims 1 to 33.

51. A polymer particle comprising:

A) at least one polypeptide comprising a polymer synthase; or

B) at least one fusion polypeptide comprising a polymer synthase and at least one fusion partner; and

C) optionally,

(1) at least one polypeptide comprising a particle forming protein, or

(2) at least one additional fusion polypeptide comprising

(a) a polymer a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(b) at least one fusion partner, or

(3) a combination thereof;

wherein at least about 1% of the surface area of the polymer particle is covered by polypeptide.

52. A polymer particle comprising:

A) at least one polypeptide comprising a polymer synthase; or

B) at least one fusion polypeptide comprising a polymer synthase and at least one fusion partner; and

C) optionally,

(1) at least one polypeptide comprising a particle forming protein, or

(2) at least one additional fusion polypeptide comprising

(a) a polymer a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(b) at least one fusion partner, or

(3) a combination thereof;

wherein at least about 10% of the surface area of the polymer particle is covered by polypeptide.

53. A polymer particle comprising:

A) at least one polypeptide comprising a polymer synthase; or

B) at least one fusion polypeptide comprising a polymer synthase and at least one fusion partner; and

C) optionally,

(1) at least one polypeptide comprising a particle forming protein, or

(2) at least one additional fusion polypeptide comprising

(a) a polymer a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(b) at least one fusion partner, or

(3) a combination thereof;

wherein at least about 50% of the surface area of the polymer particle is covered by polypeptide.

54. A polymer particle as claimed in any one of claims 51 to 53 wherein the polymer particle further comprises at least one substance bound to or incorporated into the polymer particle, or a combination thereof.

55. A polymer particle as claimed in claim 54 wherein the substance is a protein or protein fragment, a peptide, a polypeptide, an antibody or antibody fragment, an antibody binding domain, an antigen, an antigenic determinant, an epitope, an immunogen or fragment thereof, a metal ion, a metal ion-coated molecule, biotin, avidin, streptavidin or derivatives thereof, an inhibitor, a co-factor, a substrate, an enzyme, a co-factor, a receptor, receptor subunit or fragment thereof, a ligand, an inhibitor, a monosaccharide, an oligosaccharide, a polysaccharide, a glycoprotein, a lipid, a cell or fragment thereof, a cell extract, a virus, a hormone, a serum protein, a milk protein, a macromolecule, a drug of abuse, or a combination thereof.

56. A polymer particle as claimed in claim 54 wherein the substance is one or more skin care agents selected from sunscreen agents, particulate materials, conditioning agents, thickening agents, water-soluble vitamins, water-dispersible vitamins, oil-dispersible vitamins, emulsifying elastomers comprising dimethicone copolyol crosspolymers, non-emulsifying ers comprising dimethicone/vinyl dimethicone crosspolymers, oil-soluble skin care

actives comprising oil-soluble terpene alcohols, phytosterols, anti-acne actives, beta-hydroxy acids, vitamin B_3 compounds, retinoids, anti-oxidants/radical scavengers, chelators, flavonoids, anti-inflammatory agents, anti-cellulite agents, topical anesthetics, antiperspirants and fragrances, or a combination thereof.

57. A polymer particle as claimed in claim 54 wherein the substance is one or more cleaning agents selected from

a) enzymes including cellulases, peroxidases, proteases, glucoamylases, amylases, lipases, cutinases, pectinases, reductases, oxidases, phenoloxidases, lipoxygenases, ligninases, pullulanases, tannases, pentosanases, malanases, β-glucanases, and arabinosidases, or

b) anti-redeposition agents including methylcellulose, carboxymethylcellulose, hydroxyethylcellulose, polyacrylate polymers, copolymers of maleic anhydride and acrylic acid, copolymers of maleic anhydride and ethylene, copolymers of maleic anhydride and methylvinyl ether, copolymers of maleic anhydride, and methacrylic acid, or

c) a combination thereof.

58. A polymer particle as claimed in claim 54 wherein the substance is a coloured or fluorescent molecule, a radioisotope, one or more metal ions, or a combination thereof.

59. A polymer particle as claimed in any one of claims 51 to 58 wherein the fusion partner is selected from a protein, a protein fragment, a binding domain, a target-binding domain, a binding protein, a binding protein fragment, an antibody, an antibody fragment, an antibody heavy chain, an antibody light chain, a single chain antibody, a single-domain antibody, a Fab antibody fragment, an Fc antibody fragment, an Fv antibody fragment, a F(ab')2 antibody fragment, a Fab' antibody fragment, a single-chain Fv (scFv) antibody fragment, an antibody binding domain, an antigen, an antigenic determinant, an epitope, a hapten, an immunogen, an immunogen fragment, biotin, a biotin derivative, an avidin, a streptavidin, a substrate, an enzyme, an abzyme, a co-factor, a receptor, a receptor fragment, a receptor subunit, a receptor subunit fragment, a ligand, an inhibitor, a hormone, a lectin, a polyhistidine, a coupling domain, a DNA binding domain, a FLAG epitope, a cysteine

residue, a library peptide, a reporter peptide, and an affinity purification peptide, or a combination thereof.

60. A polymer particle as claimed in any one of claims 51 to 58 wherein the fusion partner is:

a) an antigen, an antigenic determinant, an epitope, or an immunogen, or

b) an antibody or antibody fragment, or

c) an antibody binding domain.

61. A polymer particle as claimed in any one of claims 51 to 58 wherein the fusion partner comprises an antibody binding domain.

62. A polymer particle as claimed in any one of claims 51 to 61 wherein

a. a coupling reagent is bound to the fusion partner, or

b. a coupling reagent is bound to the fusion partner and a substance is bound to the coupling reagent, or

c. a substance is bound to the fusion partner, or

d. the polymer synthase or the particle forming protein has been chemically modified with a coupling reagent to form at least one binding domain, or

e. a combination thereof.

63. A polymer particle as claimed in any one of claims 51 to 61 wherein the fusion partner comprises a binding domain and

a. a coupling reagent is bound to the binding domain, or

b. a coupling reagent is bound to the binding domain and a substance is bound to the coupling reagent, or

c. a substance is bound to the binding domain,

d. or a combination thereof.

64. A polymer particle as claimed in any one of claims 51 to 63 produced according to a process of any one of claims 1 to 33.

65. A composition comprising polymer particle as claimed in any one of claims 51 to 63 produced according to a process of any one of claims 1 to 33.

66. A diagnostic reagent comprising a composition of polymer particles as claimed in any one of claims 34 to 50 or comprising one or more polymer particles as claimed in any one of claims 51 to 64.

67. A diagnostic kit comprising a composition of polymer particles as claimed in any one of claims 34 to 50 or comprising one or more polymer particles as claimed in any one of claims 51 to 64.

68. A diagnostic kit as claimed in claim 67 wherein the polymer particles are immobilised on a substrate comprising an ELISA plate, microarray slide or a chromatography matrix, or a combination thereof.

69. A method of detecting and optionally isolating at least one target component in a sample, the method comprising:

(a) providing at least one polymer particle comprising at least one fusion polypeptide covalently or non-covalently bound to the polymer particle, the fusion polypeptide comprising

(i) a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(ii) at least one domain that will bind a target component,

(b) contacting the polymer particle with a sample comprising a target component such that the binding domain binds the target component to form a complex,

(c) detecting the complex, and

(d) optionally separating the complex from the sample.

70. A method as claimed in claim 69 wherein detecting the complex comprises contacting the polymer particle with a labelled molecule that will bind to the complex, to the at least one fusion polypeptide or to the polymer particle, and detecting the labelled molecule.

71. A method as claimed in claim 70 wherein the labelled molecule is a labelled antibody.

72. A method as claimed in any one of claims 69 to 71 wherein the polymer particle comprises

a) a label bound to or incorporated into the polymer particle, or

b) at least one additional fusion polypeptide comprising

(i) a polymer a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(ii) a binding domain that will bind a labelled molecule, or

c) at least one additional fusion polypeptide comprising a reporter protein.

73. A method as claimed in any one of claims 69 to 72 wherein the polymer particle comprises two or more different fusion polypeptides.

74. A method as claimed in claim 69 wherein the polymer particle comprises two or more different fusion polypeptides on the polymer particle surface.

75. A method as claimed in claim 69 wherein the polymer particle comprises three or more different fusion polypeptides on the polymer particle surface.

76. A method as claimed in any one of claims 69 to 75 wherein the polymer particle further comprises at least one compound bound to or incorporated into the polymer particle, or a combination thereof.

77. A method as claimed in claim 76 wherein the compound is a coloured fluorescent molecule, a radioisotope, or one or more metal ions, or a combination thereof.

78. A method as claimed in any one of claims 69 to 77 wherein the binding domain is

a) an antigen, an antigenic determinant, an epitope or an immunogen, or

b) an antibody or antibody fragment, or

c) an antibody binding domain.

79. A method as claimed in any one of claims 69 to 77 wherein the binding domain is Protein A or a ZZ domain.

80. A method as claimed in any one of claims 69 to 77 wherein the target component is selected from a protein, a protein fragment, a peptide, a polypeptide, a polypeptide fragment, an antibody, an antibody fragment, an antibody binding domain, an antigen, an antigen fragment, an antigenic determinant, an epitope, a hapten, an immunogen, an immunogen fragment, a metal ion, a metal ion-coated molecule, biotin, a biotin derivative, avidin, streptavidin, an inhibitor, a co-factor, a substrate, an enzyme, an abzyme, a receptor, a receptor fragment, a receptor subunit, a receptor subunit fragment, a ligand, a receptor ligand, a receptor agonist, a receptor antagonist, a signalling molecule, a signalling protein, a signalling protein fragment, a growth factor, a growth factor fragment, a transcription factor, a transcription factor fragment, an inhibitor, a cytokine, a chemokine, an inflammatory mediator, a monosaccharide, an oligosaccharide, a polysaccharide, a glycoprotein, a lipid, a cell, a cell-surface protein, a cell-surface lipid, a cell-surface carbohydrate, a cell-surface glycoprotein, a cell extract, a virus, a virus coat protein, a hormone, a serum protein, a milk protein, a macromolecule, a drug of abuse, a coupling reagent, a polyhistidine, a pharmaceutically active agent, a biologically active agent, a label, a coupling reagent, a library peptide, an expression construct, a nucleic acid or a combination thereof.

81. A method as claimed in any one of claims 69 to 77 wherein the target component is selected from Interleukin-3 (IL-3), Interleukin-4 (IL-4), Interleukin-5 (IL-5), Interleukin-10 (IL-10), Interleukin-7 (IL-7), Interleukin-1β (IL-1β), Interleukin-6 (IL-6), Interleukin-12p70 (IL-12p70), Granulocyte Macrophage-Colony Stimulating Factor (GM-CSF), cleaved PARP, Bcl-2, and active Caspase-3 protein levels, Interleukin-8 (IL-8), basic Fibroblast Growth Factor (bFGF), Angiogenin (ANG), Vascular Endothelial Growth Factor (VEGF), and Tumor Necrosis Factor (TNF), Interleukin-8 (CXCL8/IL-8), RANTES (CCL5/RANTES), Monokine-induced by Interferon-γ (CXCL9/MIG), Monocyte Chemoattractant Protein-1 (CCL2/MCP-1), or Interferon-γ-induced Protein-10 (CXCL10/IP-10), or a mixture thereof.

82. A method as claimed in any one of claims 69 to 81 wherein the at least one polymer particle is immobilised on a substrate comprising an ELISA plate, microarray slide or a chromatography matrix.

83. A method as claimed in any one of claims 69 to 81 wherein the at least one polymer particle comprises

a. a polymer particle produced according to a process of any one of claims 1 to 33,

b. a composition as claimed in any one of claims 34 to 50, or

c. a polymer particle as claimed in any one of claims 51 to 64.

84. A method of producing recombinant polypeptides, the method comprising culturing a particle-producing host cell that comprises an expression construct comprising a nucleic acid sequence encoding a fusion polypeptide, the fusion polypeptide comprising

(a) a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(b) a polypeptide that forms inclusion bodies when expressed in a cellular expression system,

wherein the culture conditions are suitable for expression of the fusion polypeptide from the expression construct and for formation of polymer particles.

85. A method of producing recombinant polypeptides comprising

(a) providing at least one fusion polypeptide comprising

(i) a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(ii) a polypeptide that forms inclusion bodies when expressed in a cellular expression system, and

(b) contacting the fusion polypeptide with a particle-forming reaction mixture to form at least one polymer particle.

86. A method as claimed in claim 85 wherein the particle forming protein comprises a polymer synthase.

87. A method as claimed in claim 85 wherein the particle-forming reaction mixture comprises a polymer synthase.

88. A method as claimed in any one of claims 1 to 33 wherein the fusion partner is a polypeptide that forms inclusion bodies when expressed in a cellular expression system.

89. A method as claimed in any one of claims 84 to 88 wherein the host cell comprises two or more different expression constructs that each encode a different fusion polypeptide.

90. A method as claimed in any one of claims 84 to 89 including the initial step of selecting a polypeptide that forms inclusion bodies when expressed in a cellular expression system by:

(a) conducting a literature search to identify a polypeptide that has previously been determined to form inclusion bodies when expressed in a cellular expression system; or

(b) expressing a candidate polypeptide in a cell that can not form polymer particles and examining the cell microscopically to determine whether or not the expressed polypeptide forms inclusion bodies.

91. A method as claimed in any one of claims 84 to 90 further comprising

(1) separating the polymer particles from the cells or the reaction mixture to produce a composition comprising polymer particles, and

(2) optionally separating the fusion polypeptide from the polymer particles, and

(3) optionally separating the polypeptide from the fusion polypeptide.

92. A method as claimed in any one of claims 84 to 93 wherein the recombinant polypeptide does not require refolding.

93. A method of identifying a target molecule that binds a receptor polypeptide, the method comprising:

a) providing at least one polymer particle comprising at least one fusion polypeptide, the fusion polypeptide comprising

(i) a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(ii) at least one receptor polypeptide,

b) contacting the at least one polymer particle with at least one target molecule, and

c) identifying a target molecule that binds the receptor polypeptide.

94. A method of identifying a target molecule that binds a receptor ligand, the method comprising:

(a) providing at least one polymer particle comprising at least one fusion polypeptide the fusion polypeptide comprising

(i) a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(ii) at least one receptor ligand,

(b) contacting the at least one polymer particle with at least one target molecule, and

(c) identifying a target molecule that binds the receptor ligand.

95. A method of producing a mixed population of polymer particles comprising:

a) providing a particle-producing host cell containing a mixed population of expression constructs wherein each expression construct comprises a nucleic acid sequence encoding a fusion polypeptide, the fusion polypeptide comprising

(i) a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(ii) at least one polypeptide of interest;

b) inducing the host cell to produce polymer particles and express the expression constructs to produce a mixed population of fusion polypeptides that bind the polymer particles; and

c) optionally separating the mixed population of polymer particles from the host cell.

96. A method of identifying a target molecule that binds a library polypeptide comprising:

(a) providing a mixed population of polymer particles comprising a mixed population of fusion polypeptides, the fusion polypeptides comprising

(i) a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(ii) at least one library polypeptide;

(b) contacting the polymer particles with at least one target molecule;

(c) identifying a target molecule that binds a library polypeptide.

97. A method as claimed in any one of claims 93 to 96 wherein the at least one polypeptide of interest, the at least one library polypeptide or the at least one receptor ligand is selected from a protein, a protein fragment, a binding domain, a target-binding domain, a binding protein, a binding protein fragment, an antibody, an antibody fragment, an antibody heavy chain, an antibody light chain, a single chain antibody, a single-domain antibody, a Fab antibody fragment, an Fc antibody fragment, an Fv antibody fragment, a F(ab')2 antibody fragment, a Fab' antibody fragment, a single-chain Fv (scFv) antibody fragment, an antibody binding domain, an antigen, an antigenic determinant, an epitope, a hapten, an immunogen, an immunogen fragment, biotin, a biotin derivative, an avidin, a streptavidin, a substrate, an enzyme, an abzyme, a co-factor, a receptor, a receptor fragment, a receptor

subunit, a receptor subunit fragment, an inhibitor, a coupling domain, or a combination thereof.

98. A method of identifying a target molecule that binds a fusion polypeptide comprising:

(a) providing a composition of any one of claims 34 to 51 wherein the fusion partner comprises at least one receptor polypeptide, at least one receptor ligand, at least one polypeptide of interest, at least one library polypeptide, or a combination thereof,

(b) contacting the composition with at least one target molecule, and

(c) identifying a target molecule that binds the fusion partner.

99. A method as claimed in any one of claims 93 to 98 wherein identifying the target molecule comprises contacting the polymer particle with a labelled molecule that will bind to the target molecule, to the at least one fusion polypeptide or to the polymer particle, and detecting the labelled molecule.

100. A method as claimed in any one of claims 93 to 99 wherein the polymer particle is immobilised on a substrate comprising an ELISA plate, microarray slide or a chromatography matrix.

101. A diagnostic reagent comprising a polymer particle as defined in any one of claims 69 to 100.

102. A diagnostic kit a polymer particle as defined in any one of claims 69 to 100.

103. A method as claimed in any one of claims 1 to 33 or a composition as claimed in any one of claims 34 to 50 wherein:

(a) 80 % of the particles in the composition have a diameter of between about 10 nm to about 150 nm;

(b) 60 % of the particles in the composition have a diameter of between about 10 nm to about 100 nm;

(c) 45 % of the particles in the composition have a diameter of between about 10 nm to about 80 nm;

(d) 40 % of the particles in the composition have a diameter of between about 10 nm to about 60 nm;

(e) 25 % of the particles in the composition have a diameter of between about 10 nm to about 50 nm; or

(f) 5 % of the particles in the composition have a diameter of between about 10 nm to about 35 nm.

104. An expression construct operably linked to a strong promoter, the expression construct comprising:

(1) at least one nucleic acid sequence encoding a polymer synthase; or

(2) at least one nucleic acid sequence encoding a fusion polypeptide that comprises a polymer synthase and at least one fusion partner.

105. An expression construct operably linked to a strong promoter, the expression construct comprising:

(1) at least one nucleic acid sequence encoding a polymer synthase; or

(2) at least one nucleic acid sequence encoding a fusion polypeptide that comprises a polymer synthase and at least one fusion partner; and

(3) at least one nucleic acid sequence encoding a particle forming protein or at least one nucleic acid sequence encoding an additional fusion polypeptide or a combination thereof, wherein the additional fusion polypeptide comprises

(a) a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(b) at least one fusion partner.

106. An expression construct operably linked to a strong promoter, the expression construct comprising:

(1) at least one nucleic acid sequence encoding a fusion polypeptide that comprises a polymer synthase and at least one fusion partner; and

(3) at least one nucleic acid sequence encoding an additional fusion polypeptide that comprises at least one polypeptide and a binding domain that binds the fusion partner of the fusion polypeptide.

107. A vector comprising an expression of construct of claim 104, 105 or 106.

108. A high copy number vector comprising an expression of construct of claim 104, 105 or 106.

109. A host cell comprising an expression construct or a vector as claimed in any one of claims 104 to 108.

WHAT WE CLAIM IS

1. A method of detecting and optionally isolating at least one target component, the method comprising:

   (a) providing at least one polymer particle comprising at least one fusion polypeptide, wherein the fusion polypeptide is produced *in vivo* in a host cell from an expression construct operably linked to a strong promoter such that at least 20% of the surface area of the polymer particles is covered by fusion polypeptides, the fusion polypeptide being covalently or non-covalently bound to the polymer particle, the fusion polypeptide comprising

      (i) polymer synthase that comprises a polymer particle binding domain, and

      (ii) at least one fusion partner that will bind a target component,

   (b) contacting the polymer particle with a composition comprising a target component such that the fusion partner binds the target component to form a complex,

   (c) detecting and optionally, isolating the complex.

2. A method as claimed in claim 1 wherein the fusion partner that will bind a target component is Protein A or a ZZ domain.

3. A method as claimed in claim 1 or 2 wherein the target component is selected from a protein, a protein fragment, a peptide, a polypeptide, a polypeptide fragment, an antibody, an antibody fragment, an antibody binding domain, an antigen, an antigen fragment, an antigenic determinant, an epitope, a hapten, an immunogen, an immunogen fragment, a metal, a metal-coated molecule, biotin, a biotin derivative, avidin, streptavidin, an inhibitor, a co-factor, a substrate, an enzyme, an abzyme, a receptor, a receptor fragment, a receptor subunit, a receptor subunit fragment, a ligand, a receptor ligand, a receptor agonist, a receptor antagonist, a signalling molecule, a signalling protein, a signalling protein fragment, a growth factor, a growth factor fragment, a transcription factor, a transcription factor fragment, an inhibitor, a cytokine, a chemokine, an inflammatory mediator, a monosaccharide, an oligosaccharide, a polysaccharide, a glycoprotein, a lipid, a cell,

a cell surface protein, a cell-surface lipid, a cell-surface carbohydrate, a cell-surface glycoprotein, a cell extract, a virus, a virus coat protein, a hormone, a serum protein, a milk protein, a macromolecule, a drug of abuse, a coupling reagent, a polyhistidine, a pharmaceutically active agent, a biologically active agent, a label, a coupling reagent, a library peptide, an expression construct, a nucleic acid or a combination thereof.

4. A method of claim 1, 2 or 3, wherein the at least one polymer particle is produced by a process comprising:

A) providing a host cell comprising at least one expression construct operably linked to a strong promoter, the expression construct comprising:

(1) at least one nucleic acid sequence encoding a polymer synthase; or

(2) at least one nucleic acid sequence encoding a fusion polypeptide that comprises a polymer synthase and at least one fusion partner;

B) cultivating the host cell under conditions suitable for expression of the expression construct and for formation of polymer particles by the polymer synthase; and

C) separating the polymer particles from the cultivated host cells to produce a composition comprising polymer particles.

5. A method as claimed in claim 4 wherein the host cell further comprises an additional expression construct comprising at least one nucleic acid sequence encoding an additional fusion polypeptide, the fusion polypeptide comprising

(a) a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

(b) at least one fusion partner.

6. A method as claimed in any one of claims 1 to 5 wherein the strong promoter is a viral promoter or a phage promoter, preferably a T7 phage promoter

7. A method as claimed in any one of claims 4 to 7, wherein the process of producing the at least one polymer particle further comprises adding at least one polypeptide or at least one substance or a combination thereof while cultivating the host cells so that the at least one polypeptide or at least one substance binds to or is incorporated into the polymer particles or further comprising contacting the polymer particles with adding at least one polypeptide or at least one substance or a combination thereof that binds to or is adsorbed into the polymer particles.

8. A method as claimed in claim 7 wherein the substance is a lipophilic substance that is incorporated into or adsorbed into the polymer particles; or a coloured or fluorescent molecule, a radioisotope, one or more metals or a combination thereof.

9. A method of any one of claims 1 to 8 wherein the at least one polymer particle comprises a composition comprising a plurality of polymer particles having an average diameter of less than about 200 nm, or less than about 150 or 110 nm.

10. A method as claimed in any one of claims 1 to 11 wherein at least about 30, 40 or 50% of the surface area of the polymer particles is covered by surface-bound proteins.

11. A method as claimed in claim 9 wherein the composition further comprises at least one substance bound to or incorporated into the polymer particles or a combination thereof.

12. A method as claimed claim 11 wherein the substance is a lipophilic substance; or a coloured or fluorescent molecule, a radioisotope, one or more metals, or a combination thereof.

13. A method as claimed in any one of claims 1 to 12 wherein the fusion partner is selected from a protein, a protein fragment, a binding domain, a target-binding domain, a binding protein, a binding protein fragment, an antibody, an antibody fragment, an antibody heavy chain, an antibody light chain, a single chain antibody, a single-domain antibody, a Fab antibody fragment, an Fc antibody fragment, an Fv antibody fragment, a F(ab')2 antibody fragment, a Fab' antibody fragment, a single-chain Fv (scFv) antibody fragment, an antibody binding domain, an antigen, an antigenic determinant, an epitope, a hapten, an immunogen, an immunogen

fragment, biotin, a biotin derivative, an avidin, a streptavidin, a substrate, an enzyme, an abzyme, a co-factor, a receptor, a receptor fragment, a receptor subunit, a receptor subunit fragment, a ligand, an inhibitor, a hormone, a lectin, a polyhistidine, a coupling domain, a DNA binding domain, a FLAG epitope, a cysteine residue, a library peptide, a reporter peptide, and an affinity purification peptide, or a combination thereof.

14. A method as claimed in any one of claims 1 to 13 wherein

(a) a coupling reagent is bound to the fusion partner, or

(b) a coupling reagent is bound to the fusion partner and a substance is bound to the coupling reagent, or

(c) a substance is bound to the fusion partner, or

(d) the polymer synthase or the particle forming protein has been chemically modified with a coupling reagent to form at least one binding domain, or

(e) a combination thereof.

15. A method as claimed in any one of claims 1 to 13 wherein the fusion partner comprises a binding domain and

(a) a coupling reagent is bound to the binding domain, or

(b) a coupling reagent is bound to the binding domain and a substance is bound to the coupling reagent, or

(c) a substance is bound to the binding domain,

(d) or a combination thereof.

16. A method as claimed in any one of claims 1 to 15 wherein detecting the complex comprises contacting the polymer particle with a label that will bind to the complex, to the at least one fusion polypeptide or to the polymer particle, and detecting the label.

17. A method as claimed in any one of claims 1 to 16 wherein the polymer particle comprises

    (a) a label bound to or incorporated into the polymer particle, or

    (b) at least one additional fusion polypeptide comprising

        (i) a polymer particle binding domain, a polypeptide that comprises a polymer particle binding domain or a particle forming protein that comprises a polymer particle binding domain, and

        (ii) a fusion partner that will bind a labelled molecule, or

    (c) at least one additional fusion polypeptide comprising a reporter protein, or

    (d) any combination of any two or more thereof.

18. A method as claimed in any one of claims 1 to 17 wherein the polymer particle comprises two or more different fusion polypeptides.

19. A method as claimed in any one of claims 1 to 18 wherein the polymer particle further comprises at least one compound bound to or incorporated into the polymer particle, or a combination thereof, wherein the compound is a coloured or fluorescent molecule, a radioisotope, or one or more metals, or a combination thereof.

20. A method as claimed in any one of claims 1 to 19 wherein the fusion partner that will bind a target component further comprises

    (a) an antigen, an antigenic determinant, an epitope or an immunogen, or

    (b) an antibody or antibody fragment, or

    (c) an antibody binding domain.

21. A method as claimed in any one of claims 1 to 20, wherein detection of the complex comprises cell sorting, preferably fluorescence-activated cell sorting.

22. A method as claimed in any one of claims 1 to 21, wherein the fusion partner further comprises an antibody binding domain, preferably Protein G or Protein L.

23. A method as claimed in any one of claims 1 to 22 for diagnosis of a disease or condition.

24. A method of any one of claims 1 to 22 wherein the polymer is selected from poly-betaamino acids, polylactates, polythioesters and polyesters.

25. A method of any one of claims 1 to 24 wherein the polymer synthase is a polyhydroxyalkanoate polymer synthase.