the catalytic enzyme D binds to and cleaves the nucleic acid duplex at the cleavage site releasing the catalytic nucleic acid A of the PA polynucleotide which is consequently capable of movement through the permeable barrier;

wherein:

the released catalytic nucleic acid A moves through the permeable barrier, hybridises to the catalytic nucleic acid substrate B of a PB polynucleotide, and cleaves the PB polynucleotide to thereby release the partzyme oligonucleotide B1 of the PB polynucleotide which is consequently capable of movement through the permeable barrier;

the released partzyme oligonucleotide B1 moves through the permeable barrier, the sensor arm of each of partzyme oligonucleotides B1 and B2 hybridises to the assembly facilitator oligonucleotide, and the substrate arm of each of partzyme oligonucleotides B1 and B2 hybridises to the catalytic nucleic acid substrate A of a second PA polynucleotide, thereby forming catalytic nucleic acid B which cleaves the second PA polynucleotide to thereby release the catalytic nucleic acid A of the second PA polynucleotide which is consequently capable of movement through the permeable barrier;

and

detecting the cleavage of any said PA and/or PB polynucleotide indicates the presence of the target in the sample.

[0016c] In another aspect, the present disclosure refers to a composition for the detection of a target in a sample, the composition comprising:

a population of polynucleotide A (PA) and a population of polynucleotide B (PB), wherein:

each PA polynucleotide comprises a catalytic nucleic acid A and a catalytic nucleic acid substrate A,

each PB polynucleotide comprises a catalytic nucleic acid B and a catalytic nucleic acid substrate B,

the catalytic nucleic acid A is capable of catalytically modifying the catalytic nucleic acid substrate B and is unable to catalytically modify the catalytic nucleic acid substrate A, and

the catalytic nucleic acid B is capable of catalytically modifying the catalytic nucleic acid substrate A and is unable to catalytically modify the catalytic nucleic acid substrate B,

the PA and/or PB are mobile in the composition;

a selectively permeable barrier capable of separating the PA from the PB; and

(i) two oligonucleotides each capable of hybridising specifically to the catalytic nucleic acid substrate A of a PA polynucleotide, at least one being capable of hybridising specifically to the target, to thereby form a catalytic nucleic acid C capable of cleaving the catalytic nucleic acid substrate A of the PA polynucleotide; or

(ii) a catalytic enzyme D capable of cleaving one or more strands of a nucleic acid duplex formed by hybridisation of the target to the PA;

wherein

the catalytic nucleic acid A and the catalytic nucleic acid B are each a different variety of DNAzyme.

[0016d] In another aspect, the present disclosure refers to a composition comprising:

(i) a population of polynucleotide A (PA), a population of polynucleotide B (PB) and a population of polynucleotide C (PC), wherein

each PA polynucleotide comprises a catalytic nucleic acid A and a catalytic nucleic acid substrate A, and is mobile in the composition,

each PB polynucleotide comprises a partzyme oligonucleotide B1 and a catalytic nucleic acid substrate B,

each PC polynucleotide comprises a partzyme oligonucleotide B2,

wherein:

a substrate arm of the partzyme oligonucleotide B1 is capable of hybridising to the catalytic nucleic acid substrate A,

a substrate arm of the partzyme oligonucleotide B2 is capable of hybridising to the catalytic nucleic acid substrate A, and

the catalytic nucleic acid A is capable of catalytically modifying the catalytic nucleic acid substrate B and is unable to catalytically modify the catalytic nucleic acid substrate A;

(ii) an assembly facilitator oligonucleotide capable of hybridising to a sensor arm of partzyme oligonucleotide B1 and to a sensor arm of partzyme oligonucleotide B2;

(iii) a selectively permeable barrier capable of physically separating the PA from the PB, wherein the PA and PB are unable to permeate the selectively permeable barrier,

wherein hybridisation of the partzyme oligonucleotide B1 substrate arm and the partzyme oligonucleotide B2 substrate arm to the catalytic nucleic acid substrate A, and hybridisation of the partzyme oligonucleotide B1 sensor arm and the partzyme oligonucleotide B2 sensor arm to

the assembly facilitator, forms a catalytic nucleic acid B capable of cleaving the catalytic nucleic acid substrate A; and

(iv) two oligonucleotides each capable of hybridising specifically to the catalytic nucleic acid substrate A of a PA polynucleotide, at least one being capable of hybridising specifically to the target, to thereby form a catalytic nucleic acid C capable of cleaving the catalytic nucleic acid substrate A of the PA polynucleotide; or

(v) a catalytic enzyme D capable of cleaving one or more strands of a nucleic acid duplex formed by hybridisation of the target to the PA, and wherein:

each PC polynucleotide comprises a partzyme oligonucleotide B2 and said catalytic nucleic acid substrate B capable of cleavage by catalytic nucleic acid A; or

each PC polynucleotide comprises a partzyme oligonucleotide B2 and said catalytic nucleic acid substrate A;

and

the catalytic nucleic acid A and the catalytic nucleic acid B are each a different variety of DNAzyme.

[0017] The present disclosure thus addresses at least one of the disadvantages evident in existing target molecule detection and/or signal amplification assays by encompassing, at least in part, the following listed examples 1-59:

CLAIMS

1. A method for determining a presence of a target in a sample, the method comprising:

- providing a reaction mix comprising:

a population of polynucleotide A (PA) and a population of polynucleotide B (PB), wherein

each PA polynucleotide comprises a catalytic nucleic acid A and a catalytic nucleic acid substrate A,

each PB polynucleotide comprises a catalytic nucleic acid B and a catalytic nucleic acid substrate B,

the catalytic nucleic acid A is capable of catalytically modifying the catalytic nucleic acid substrate B and is unable to catalytically modify catalytic nucleic acid substrate A, and

the catalytic nucleic acid B is capable of catalytically modifying the catalytic nucleic acid substrate A and is unable to catalytically modify the catalytic nucleic acid substrate B;

a selectively permeable barrier capable of physically separating the PA from the PB, wherein the PA and PB are unable to permeate the selectively permeable barrier, and the PA and/or PB is/are mobile in the reaction mix; and

(i) two oligonucleotides each capable of hybridising specifically to the catalytic nucleic acid substrate A of a PA polynucleotide, at least one being capable of hybridising specifically to the target, to thereby form a catalytic nucleic acid C capable of cleaving the catalytic nucleic acid substrate A of the PA polynucleotide; or

(ii) a catalytic enzyme D capable of cleaving one or more strands of a nucleic acid duplex formed by hybridisation of the target to the PA;

- contacting:

(i) the PA, the PB, and the oligonucleotide(s) with the sample, and using the selectively permeable barrier to separate the PA from the PB, wherein:

if the target is present in the sample, each of the two oligonucleotides hybridises to the catalytic nucleic acid substrate A of a PA polynucleotide and at least one further hybridises to the target to thereby form the catalytic nucleic acid C which cleaves the PA polynucleotide to thereby release the catalytic nucleic acid A of the PA polynucleotide which is consequently capable of movement through the permeable barrier; or

(ii) the PA, the PB, and the catalytic enzyme D with the sample, and using the selectively permeable barrier to separate the PA from the PB, wherein:

if the target is present in the sample, the target hybridises with a PA polynucleotide to form the nucleic acid duplex which comprises a recognition and cleavage site for the catalytic enzyme D,

the cleavage site for the catalytic enzyme D is not within the catalytic nucleic acid A, and

the catalytic enzyme D binds to and cleaves the nucleic acid duplex at the cleavage site releasing the catalytic nucleic acid A of the PA polynucleotide which is consequently capable of movement through the permeable barrier;

- wherein:

the released catalytic nucleic acid A moves through the permeable barrier, hybridises to the catalytic nucleic acid substrate B of a PB polynucleotide, and cleaves the PB polynucleotide to thereby release the catalytic nucleic acid B of the PB polynucleotide which is consequently capable of movement through the permeable barrier;

the released catalytic nucleic acid B moves through the permeable barrier, hybridises to the catalytic nucleic acid substrate A of a second PA polynucleotide, and cleaves the second PA polynucleotide to thereby release the catalytic nucleic acid A of the second PA polynucleotide which is consequently capable of movement through the permeable barrier;

detecting the cleavage of any said PA and/or PB polynucleotide indicates the presence of the target in the sample;

and

the catalytic nucleic acid A and the catalytic nucleic acid B are each a different variety of DNAzyme.

2. The method according to claim 1, wherein the catalytic nucleic acid C is not capable of cleaving the catalytic nucleic acid substrate B of the PB polynucleotide.

3. The method according to claim 1 or claim 2, wherein any of the PA and/or PB that are mobile in the reaction mix polynucleotides comprises:

an attached component and/or,

a region of self-complementarity providing a secondary structure, and/or

a charged moiety;

that prevents permeation of the polynucleotide across the selectively permeable barrier.

4. The method according to claim 3, wherein the attached component is:

an aptamer hybridised to a ligand, or

a bead (e.g. a magnetic bead), or

a microparticle, or

a nanoparticle, or

a charged moiety.

5. The method according to claim 3 or claim 4, wherein:

the cleavage of the catalytic nucleic acid substrate A releases the attached component or the region of self-complementarity from the catalytic nucleic acid A of the PA polynucleotide which is consequently capable of movement through the permeable barrier, and/or

the cleavage of the catalytic nucleic acid substrate B releases the attached component or the region of self-complementarity from the catalytic nucleic acid B of the PB polynucleotide which is consequently capable of movement through the permeable barrier.

6. The method according to any one of claims 1 to 5, wherein:

the catalytic nucleic acid A and/or the catalytic nucleic acid B is selected from the group consisting of an 8-17 DNAzyme, a 10-23 DNAzyme, a 9-86 DNAzyme, a 12-91 DNAzyme, a GR-5 DNAzyme, a 17E DNAzyme, an RFD-EC1 DNAzyme, an F-8 DNAzyme, a 39-E DNAzyme, an E2 DNAzyme, an Mg5 DNAzyme, an A43 DNAzyme, a DAB22 DNAzyme, a PS2.M DNAzyme, an L-histidine-dependent DNAzyme, and an HRP DNAzyme.

7. The method according to any one of claims 1 to 6, wherein:

(i) the catalytic nucleic acid A is a 10-23 DNAzyme and the catalytic nucleic acid B is an 8-17 DNAzyme; and

the catalytic nucleic acid substrate A is an 8-17 DNAzyme substrate and the catalytic nucleic acid substrate B is an 10-23 DNAzyme substrate; or

(ii) the catalytic nucleic acid A is a 8-17 DNAzyme and the catalytic nucleic acid B is an 10-23 DNAzyme; and

the catalytic nucleic acid substrate A is an 10-23 DNAzyme substrate and the catalytic nucleic acid substrate B is an 8-17 DNAzyme substrate.

8. The method according to any one of claims 1 to 7, wherein:

the two oligonucleotides are provided, each capable of hybridising specifically to the catalytic nucleic acid substrate A of a PA polynucleotide and at least one being capable of hybridising specifically to the target, to thereby form the catalytic nucleic acid C capable of cleaving the catalytic nucleic acid substrate A of the PA polynucleotide;

the target comprises or consists of a protein, analyte, glycoprotein, lipid, lipoprotein, cell, virus, bacterium, archeon, fungus, antibody, metabolite, pathogen, toxin, contaminant, poison, small molecule, polymer, metal ion, metal salt, prion, or any derivative, portion or combination thereof;

the catalytic nucleic acid C comprises an aptamer portion capable of binding to the target;

the method further comprises contacting the sample with an inhibitor that hybridises to the aptamer to thereby render catalytic nucleic acid C inactive;

the inhibitor has lower binding affinity for the aptamer portion than the target; and

when present in the sample the target binds to the aptamer displacing the inhibitor and rendering the catalytic nucleic acid C active, thereby facilitating cleavage of the catalytic nucleic acid substrate A of the PA polynucleotide.

9. The method according to any one of claims 1 to 8, wherein:

the catalytic nucleic acid C is a multi component nucleic acid enzyme (MNAzyme), and

the two partzyme oligonucleotides C1 and C2 are capable of self-assembling to form the MNAzyme only in the presence of the target.

10. The method according to any one of claims 1 to 7, wherein:

the catalytic nucleic acid C is a multi component nucleic acid enzyme (MNAzyme),

the two partzyme oligonucleotides C1 and C2 capable of self-assembling to form the MNAzyme only in the presence of the target,

the target comprises or consists of a polynucleotide; and

the two partzyme oligonucleotides C1 and C2 each hybridise to the polynucleotide during the self-assembly to form the MNAzyme.

11. The method according to claim 9, wherein:

the target comprises or consists of a protein, analyte, glycoprotein, lipid, lipoprotein, cell, virus, bacterium, archeon, fungus, antibody, metabolite, pathogen, toxin, contaminant, poison, small molecule, polymer, metal ion, metal salt, prion, or any derivative, portion or combination thereof;

at least one of the two partzyme oligonucleotides comprises a DNA, RNA or peptide aptamer portion capable hybridising specifically to the target;

the method further comprises contacting the sample with an MNAzyme assembly facilitator oligonucleotide facilitating self-assembly of the two partzyme oligonucleotides into an MNAzyme, and an inhibitor molecule that hybridises to the aptamer rendering the MNAzyme catalytically inactive;

the inhibitor has lower binding affinity for the aptamer portion than the target; and

the target hybridises to the aptamer portion removing the inhibitor and rendering the MNAzyme catalytically active.

12. The method according to any one of claims 1 to 7, wherein:

the target is a polynucleotide,

the catalytic enzyme D is an endonuclease or an exonuclease.

13. The method according to any one of claims 1 to 12, wherein

the release of the catalytic nucleic acid A from the catalytic nucleic acid substrate A of the PA polynucleotide and/or the release of the catalytic nucleic acid B from the catalytic nucleic acid substrate B of the PB polynucleotide separates a fluorophore from a quencher thereby providing a signal to facilitate the detection of the target.

14. The method according to any one of claims 1 to 13, wherein the detection comprises

isolating the released catalytic nucleic acid A and/or the released catalytic nucleic acid B from the reaction mix;

applying the isolated catalytic nucleic acid(s) to a second reaction mix comprising catalytic nucleic acid substrate A and/or catalytic nucleic acid substrate B under conditions suitable for cleavage of the catalytic nucleic acid substrates by the catalytic nucleic acids; and

detecting cleavage of the catalytic nucleic acid substrates by the catalytic nucleic acids.

15. The method according to any one of claims 1 to 13, wherein the detection comprises quantifying the released catalytic nucleic acid A and/or released catalytic nucleic acid B in real time.

16. The method according to any one of claims 1 to 15, comprising:

the cleavage of at least one and fewer than five, at least one and fewer than six, at least one and fewer than seven, at least one and fewer than eight, at least one and fewer than nine, at least one and fewer than ten, at least one and fewer than fifteen, or at least one and fewer than twenty, of the PA polynucleotides, and/or

the cleavage of at least one and fewer than five, at least one and fewer than six, at least one and fewer than seven, at least one and fewer than eight, at least one and fewer than nine, at least one and fewer than ten, at least one and fewer than fifteen, or at least one and fewer than twenty, of the PB polynucleotides,

to facilitate the detection of the target.

17. A method for determining a presence of a target in a sample, the method comprising:

(a) providing a reaction mix comprising:

(i) a population of polynucleotide A (PA), a population of polynucleotide B (PB) and a population of polynucleotide C (PC), wherein

each PA polynucleotide comprises a catalytic nucleic acid A and a catalytic nucleic acid substrate A,

each PB polynucleotide comprises a partzyme oligonucleotide B1 and a catalytic nucleic acid substrate B,

each PC polynucleotide comprises a partzyme oligonucleotide B2,

wherein:

a substrate arm of the partzyme oligonucleotide B1 is capable of hybridising to the catalytic nucleic acid substrate A,

a substrate arm of the partzyme oligonucleotide B2 is capable of hybridising to the catalytic nucleic acid substrate A, and

the catalytic nucleic acid A is capable of catalytically modifying the catalytic nucleic acid substrate B and is unable to catalytically modify the catalytic nucleic acid substrate A;

(ii) an assembly facilitator oligonucleotide capable of hybridising to a sensor arm of partzyme oligonucleotide B1 and to a sensor arm of partzyme oligonucleotide B2;

(iii) a selectively permeable barrier capable of physically separating the PA from the PB, wherein the PA and PB are unable to permeate the selectively permeable barrier, and the PA, PB and PC and are mobile in the reaction mix; and either one of:

(iv) two partzyme oligonucleotides C1 and C2 each capable of hybridising specifically to the catalytic nucleic acid substrate A of a PA polynucleotide and at least one being capable of hybridising specifically to the target, to thereby form a catalytic nucleic acid C capable of cleaving the catalytic nucleic acid substrate A of the PA polynucleotide;

or

(v) a catalytic enzyme D capable of cleaving one or more strands of a nucleic acid duplex formed by hybridisation of the target to the PA;

and

(b) contacting:

(i) the partzyme oligonucleotides C1 and C2 with the sample, and using the selectively permeable barrier to separate the PB from the PA, wherein:

if the target is present in the sample, the substrate arm of each of the partzyme oligonucleotides C1 and C2 hybridises to the catalytic nucleic acid substrate A of a PA polynucleotide and at least one of partzyme oligonucleotides C1 and C2 hybridises to the target forming the catalytic nucleic acid C which cleaves the PA polynucleotide to thereby release the catalytic nucleic acid A of the PA polynucleotide which is consequently capable of movement through the permeable barrier;

or

(ii) the catalytic enzyme D with the sample, and using the selectively permeable barrier to separate the PB from the PA, wherein:

if the target is present in the sample, the target hybridises with a PA polynucleotide to form the nucleic acid duplex which comprises a recognition and cleavage site for the catalytic enzyme D,

the cleavage site for the catalytic enzyme D is not within the catalytic nucleic acid A, and

the catalytic enzyme D binds to and cleaves the nucleic acid duplex at the cleavage site releasing the catalytic nucleic acid A of the PA polynucleotide which is consequently capable of movement through the permeable barrier;

wherein:

the released catalytic nucleic acid A moves through the permeable barrier, hybridises to the catalytic nucleic acid substrate B of a PB polynucleotide, and cleaves the PB

polynucleotide to thereby release the partzyme oligonucleotide B1 of the PB polynucleotide which is consequently capable of movement through the permeable barrier;

the released partzyme oligonucleotide B1 moves through the permeable barrier, the sensor arm of each of partzyme oligonucleotides B1 and B2 hybridises to the assembly facilitator oligonucleotide, and the substrate arm of each of partzyme oligonucleotides B1 and B2 hybridises to the catalytic nucleic acid substrate A of a second PA polynucleotide, thereby forming catalytic nucleic acid B which cleaves the second PA polynucleotide to thereby release the catalytic nucleic acid A of the second PA polynucleotide which is consequently capable of movement through the permeable barrier;

and

detecting the cleavage of any said PA and/or PB polynucleotide indicates the presence of the target in the sample.

18. The method according to claim 17, wherein:

each PC polynucleotide comprises a partzyme oligonucleotide B2 and a catalytic nucleic acid substrate B that is cleavable by catalytic nucleic acid A,

the released catalytic nucleic acid A cleaves the PC polynucleotide to thereby release the partzyme oligonucleotide B2 of the PC polynucleotide, and

detecting the cleavage of any PC polynucleotide indicates the presence of the target in the sample.

19. The method according to claim 17, wherein

each PC polynucleotide comprises a partzyme oligonucleotide B2 and a catalytic nucleic acid substrate A, and

if the target is present in the sample, the substrate arm of each of the partzyme oligonucleotides C1 and C2 hybridises to the catalytic nucleic acid substrate A of the PC polynucleotide and at least one of the partzyme oligonucleotides C1 and C2 hybridises to the target forming the catalytic nucleic acid C which cleaves the PC polynucleotide to thereby release the partzyme oligonucleotide B2 of the PC polynucleotide.

20. The method according to claim 17, wherein if the target is present in the sample, the target hybridises with a PC polynucleotide to form the nucleic acid duplex which comprises a recognition and cleavage site for the catalytic enzyme D,

the cleavage site for the catalytic enzyme D is not within partzyme oligonucleotide B2 of the PC polynucleotide, and

the catalytic enzyme D binds to and cleaves the nucleic acid duplex at the cleavage site to thereby release the partzyme oligonucleotide B2 of the PC polynucleotide.

21. The method according to any one of claims 17 to 19, wherein any of the PA, PB and/or PC polynucleotides that are mobile in the reaction mix comprises:

an attached component and/or,

a region of self-complementarity providing a secondary structure, and/or

a charged moiety;

that prevents permeation of the polynucleotide across the selectively permeable barrier

22. The method according to claim 21, wherein the attached component is:

an aptamer hybridised to a ligand, or

a bead (e.g. a magnetic bead), or a microparticle,

or a nanoparticle, or a charged moiety.

23. The method according to claim 21 or claim 22, wherein:

the cleavage of the catalytic nucleic acid substrate A releases the attached component or the region of self-complementarity from the catalytic nucleic acid A of the PA polynucleotide which is consequently capable of movement through the permeable barrier,

and/or the cleavage of the catalytic nucleic acid substrate B releases the attached component or the region of self-complementarity from the PB polynucleotide which is consequently capable of movement through the permeable barrier.

24. The method according to any one of claims 17 to 23, wherein:

the catalytic nucleic acid C is a multi component nucleic acid enzyme (MNAzyme), and

the two oligonucleotides are two partzyme oligonucleotides capable of self-assembling to form the MNAzyme only in the presence of the target.

25. The method according to claim 24, wherein:

the target comprises or consists of a protein, analyte, glycoprotein, lipid, lipoprotein, cell, virus, bacterium, archeon, fungus, antibody, metabolite, pathogen, toxin, contaminant,

poison, small molecule, polymer, metal ion, metal salt, prion, or any derivative, portion or combination thereof;

at least one of the two partzyme oligonucleotides comprises a DNA, RNA or peptide aptamer portion capable hybridising specifically to the target;

the method further comprises contacting the sample with an MNAzyme assembly facilitator oligonucleotide facilitating self-assembly of the two partzyme oligonucleotides into an MNAzyme, and an inhibitor molecule that hybridises to the aptamer rendering the MNAzyme catalytically inactive;

the inhibitor has lower binding affinity for the aptamer portion than the target; and

the target hybridises to the aptamer portion removing the inhibitor and rendering the MNAzyme catalytically active.

26. The method according to claim 24, wherein:

the target comprises or consists of a polynucleotide; and

the two partzyme oligonucleotides each hybridise to the polynucleotide during the self-assembly to form the MNAzyme.

27. The method according to any one of claims 1 to 26, wherein:

the reaction mix further comprises a population of the catalytic nucleic acid substrate A which is mobile in the reaction mix, each catalytic nucleic acid substrate A of the population comprising a fluorophore molecule and a quencher molecule;

and the catalytic nucleic acid B and/or the catalytic nucleic acid C cleaves members of the population of catalytic nucleic acid substrate A, separating the fluorophore from the quencher to thereby providing a signal facilitating the detection of the target.

28. A composition for the detection of a target in a sample, the composition comprising:

a population of polynucleotide A (PA) and a population of polynucleotide B (PB), wherein:

each PA polynucleotide comprises a catalytic nucleic acid A and a catalytic nucleic acid substrate A,

each PB polynucleotide comprises a catalytic nucleic acid B and a catalytic nucleic acid substrate B,

the catalytic nucleic acid A is capable of catalytically modifying the catalytic nucleic acid substrate B and is unable to catalytically modify the catalytic nucleic acid substrate A, and

the catalytic nucleic acid B is capable of catalytically modifying the catalytic nucleic acid substrate A and is unable to catalytically modify the catalytic nucleic acid substrate B,

the PA and/or PB are mobile in the composition;

a selectively permeable barrier capable of separating the PA from the PB; and

(i) two oligonucleotides each capable of hybridising specifically to the catalytic nucleic acid substrate A of a PA polynucleotide, at least one being capable of hybridising specifically to the target, to thereby form a catalytic nucleic acid C capable of cleaving the catalytic nucleic acid substrate A of the PA polynucleotide; or

(ii) a catalytic enzyme D capable of cleaving one or more strands of a nucleic acid duplex formed by hybridisation of the target to the PA;

wherein

the catalytic nucleic acid A and the catalytic nucleic acid B are each a different variety of DNAzyme.

29. A composition comprising:

(i) a population of polynucleotide A (PA), a population of polynucleotide B (PB) and a population of polynucleotide C (PC), wherein

each PA polynucleotide comprises a catalytic nucleic acid A and a catalytic nucleic acid substrate A, and is mobile in the composition,

each PB polynucleotide comprises a partzyme oligonucleotide B1 and a catalytic nucleic acid substrate B,

each PC polynucleotide comprises a partzyme oligonucleotide B2,

wherein:

a substrate arm of the partzyme oligonucleotide B1 is capable of hybridising to the catalytic nucleic acid substrate A,

a substrate arm of the partzyme oligonucleotide B2 is capable of hybridising to the catalytic nucleic acid substrate A, and

the catalytic nucleic acid A is capable of catalytically modifying the catalytic nucleic acid substrate B and is unable to catalytically modify the catalytic nucleic acid substrate A;

(ii) an assembly facilitator oligonucleotide capable of hybridising to a sensor arm of partzyme oligonucleotide B1 and to a sensor arm of partzyme oligonucleotide B2;

(iii) a selectively permeable barrier capable of physically separating the PA from the PB, wherein the PA and PB are unable to permeate the selectively permeable barrier,

wherein hybridisation of the partzyme oligonucleotide B1 substrate arm and the partzyme oligonucleotide B2 substrate arm to the catalytic nucleic acid substrate A, and hybridisation of the partzyme oligonucleotide B1 sensor arm and the partzyme oligonucleotide B2 sensor arm to the assembly facilitator, forms a catalytic nucleic acid B capable of cleaving the catalytic nucleic acid substrate A; and

(iv) two oligonucleotides each capable of hybridising specifically to the catalytic nucleic acid substrate A of a PA polynucleotide, at least one being capable of hybridising specifically to the target, to thereby form a catalytic nucleic acid C capable of cleaving the catalytic nucleic acid substrate A of the PA polynucleotide; or

(v)_ a catalytic enzyme D capable of cleaving one or more strands of a nucleic acid duplex formed by hybridisation of the target to the PA, and wherein:

each PC polynucleotide comprises a partzyme oligonucleotide B2 and said catalytic nucleic acid substrate B capable of cleavage by catalytic nucleic acid A; or

each PC polynucleotide comprises a partzyme oligonucleotide B2 and said catalytic nucleic acid substrate A;

and

the catalytic nucleic acid A and the catalytic nucleic acid B are each a different variety of DNAzyme.

30. The composition according to claim 28, wherein any of the PA and/or PB comprises:

an attached component and/or,

a region of self-complementarity providing a secondary structure, and/or

a charged moiety;

that prevents permeation of the polynucleotide across the selectively permeable barrier.

31. The composition according to claim 29, wherein any of the PC comprises:

an attached component and/or,

a region of self-complementarity providing a secondary structure, and/or

a charged moiety;

that prevents permeation of the polynucleotide across the selectively permeable barrier.

32. The composition according to claim 30 or claim 31, wherein the attached component is:

an aptamer hybridised to a ligand, or

a bead (e.g. a magnetic bead), or

a microparticle, or

a nanoparticle, or

a charged moiety.

33. The composition of any one of claims 28 to 32, further comprising two oligonucleotides each capable of hybridising specifically to the catalytic nucleic acid substrate A of a PA polynucleotide and at least one being capable of hybridising specifically to the target, to thereby form a catalytic nucleic acid C capable of cleaving the catalytic nucleic acid substrate A of the PA polynucleotide.

34. The composition according to claim 33, wherein:

the catalytic nucleic acid C is a multi component nucleic acid enzyme (MNAzyme), and

the two oligonucleotides are two partzyme oligonucleotides capable of self-assembling to form the MNAzyme only in the presence of the target.

35. The composition of any one of claims 28 to 32, further comprising:

a catalytic enzyme D capable of cleaving one or more stands of a nucleic acid duplex formed by hybridisation of the target to the PA;

wherein:

at least a portion of the PA polynucleotide shares sequence complementarity with the target such that it is capable of hybridising with the target to form a nucleic acid duplex comprising a recognition and cleavage site for the catalytic enzyme D, and

the cleavage site for the catalytic enzyme D is not within the catalytic nucleic acid A of the PA polynucleotide.

36. The composition according to claim 35, wherein:

the target is a polynucleotide,

the catalytic enzyme D is an endonuclease or an exonuclease.

37. The composition according to claim 33, wherein the target comprises or consists of a protein, analyte, glycoprotein, lipid, lipoprotein, cell, virus, bacterium, archeon, fungus, antibody, metabolite, pathogen, toxin, contaminant, poison, small molecule, polymer, metal ion, metal salt, prion, or any derivative, portion or combination thereof;

the catalytic nucleic acid C comprises an aptamer portion capable of binding to the target;

the composition further comprises an inhibitor that hybridises to the aptamer; and

the inhibitor has lower binding affinity for the aptamer portion than the target.

a selectively permeable barrier capable of separating the PA from the PB.

38. The composition according to claim 33 or claim 34, wherein:

the target comprises or consists of a polynucleotide; and

the two partzyme oligonucleotides capable of self-assembling to form the MNAzyme only in the presence of the target can each hybridise to the polynucleotide of the target and the catalytic nucleic acid A substrate of the PA polynucleotide, and thereby self-assemble to form the MNAzyme.

39. The composition according to claim 34, wherein:

the target comprises or consist of a protein, analyte, glycoprotein, lipid, lipoprotein, cell, virus, bacterium, archeon, fungus, antibody, metabolite, pathogen, toxin, contaminant, poison, small molecule, polymer, metal ion, metal salt, prion, or any derivative, portion or combination thereof;

at least one of the two partzyme oligonucleotides capable of self-assembling to form the MNAzyme only in the presence of the target comprises a DNA, RNA or peptide aptamer portion capable hybridising specifically to the target;

the composition further comprises an MNAzyme assembly facilitator oligonucleotide to which the two partzyme oligonucleotides capable of self-assembling to form the MNAzyme only in the presence of the target can each hybridise facilitating self-assembly of the MNAzyme;

the composition further comprises an inhibitor molecule that can hybridise to the aptamer thereby rendering the MNAzyme catalytically inactive;

the inhibitor has lower binding affinity for the aptamer portion than the target; and

the target can hybridise to the aptamer portion to remove the inhibitor and render the MNAzyme catalytically active.

40. The composition according to claim 33, further comprising catalytic nucleic acid A released by cleavage of the PA polynucleotide by the catalytic nucleic acid C and/or by the catalytic nucleic acid B.

41. The composition according to any one of claims 28 to 40, further comprising catalytic nucleic acid B released by cleavage of the PB polynucleotide by the catalytic nucleic acid A.

42. The composition according to any one of claims 28 to 41, wherein:

the catalytic nucleic acid A and/or the catalytic nucleic acid B is selected from the group consisting of an 8-17 DNAzyme, a 10-23 DNAzyme, a 9-86 DNAzyme, a 12-91 DNAzyme, a GR-5 DNAzyme, a 17E DNAzyme, an RFD-EC1 DNAzyme, an F-8 DNAzyme, a 39-E DNAzyme, an E2 DNAzyme, an Mg5 DNAzyme, an A43 DNAzyme, a DAB22 DNAzyme, a PS2.M DNAzyme, an L-histidine-dependent DNAzyme, and an HRP DNAzyme.

43. The composition according to any one of claims 28 to 42, wherein:

(i) the catalytic nucleic acid A is a 10-23 DNAzyme and the catalytic nucleic acid B is an 8-17 DNAzyme; and

the catalytic nucleic acid substrate A is an 8-17 DNAzyme substrate and the catalytic nucleic acid substrate B is a 10-23 DNAzyme substrate; or

(ii) the catalytic nucleic acid A is an 8-17 DNAzyme and the catalytic nucleic acid B is a 10-23 DNAzyme; and

the catalytic nucleic acid substrate A is a 10-23 DNAzyme substrate and the catalytic nucleic acid substrate B is an 8-17 DNAzyme substrate.

44. The composition according to any one of claims 28 to 43, wherein the PB and/or PC are mobile in the composition.

45. The composition according to any one of claims 28 to 44, wherein the PA polynucleotides and/or PB polynucleotides and/or the PC polynucleotides each comprise a fluorophore and a quencher.

46. The composition according to any one of claims 28 to 45, further comprising a population of the catalytic nucleic acid substrate A which is mobile in the composition, each catalytic nucleic acid substrate A of the population comprising a fluorophore molecule and a quencher molecule, wherein the catalytic nucleic acid B is capable of cleaving members of the population of catalytic nucleic acid substrate A, separating the fluorophore from the quencher to thereby providing a signal facilitating the detection of the target.

47. The composition according to claim 33 or claim 34, further comprising a population of the catalytic nucleic acid substrate A which is mobile in the composition, each catalytic nucleic acid substrate A of the population comprising a fluorophore molecule and a quencher molecule, wherein the catalytic nucleic acid C is capable of cleaving members of the population of catalytic nucleic acid substrate A, separating the fluorophore from the quencher to thereby providing a signal facilitating the detection of the target.