

and publications referred in this application, if any, are hereby incorporated herein in entirety by reference.

We claim:

1. A method of detecting an analyte, comprising providing a magnetic affinity complex and a signal affinity complex in a fluidic network comprising a plurality of fluidic zones, wherein the plurality of fluidic zones comprises a sample zone, a cleaning zone, and a detection zone, wherein the fluidic network is functionally coupled to a vibration element, and wherein the signal affinity complex comprises a SERS-active nanoparticle, a fluorescent nanoparticle, an optical nanoparticle, a MRI-active nanoparticle, and optionally comprises a catalytic element,
 - introducing a sample suspected of comprising an analyte into the sample zone, wherein the analyte combines with the magnetic affinity complex and the signal affinity complex to form a sandwich binding complex,
 - activating a microcoil array or a mechanically movable permanent magnet functionally coupled to the fluidic network to thereby move the sandwich binding complex to the detection zone without fluidic movement of a fluid in the plurality of the fluidic zones, and
 - detecting the presence of the sandwich binding complex within the detection zone using a detection element functionally coupled to the fluidic network.
2. The method of claim 1, wherein the detection element is an optical detection element or an electrical detection element.
3. The method of claim 1, wherein the signal affinity complex comprises a SERS-active nanoparticle, an optical nanoparticle, or a fluorescent nanoparticle.
4. The method of claim 1, wherein the signal affinity complex comprises a catalytic element.
5. The method of claim 4, wherein the catalytic element is selected from the group consisting of alkaline phosphatase, horseradish peroxidase, glucose oxidase, glucose oxidase and horseradish peroxidase, firefly luciferase, *Renilla luciferase*, bacterial luciferase, an enzyme or analogs or combinations thereof.
6. The method of claim 4, wherein the catalytic element is conjugated through a functionalized polymer.
7. The method of claim 4, wherein a reaction substrate for the catalytic element is in the detection zone.
8. The method of claim 7, wherein the reaction substrate is selected from the group consisting of Lumi-Phos 480, Lumi-Phos 530, Lumi-Phos Plus, Lumi-Phos APS-5, Lumigen TMA-6, Lumigen PS-atto, Lumigen PS-1, Lumigen PS-2, Lumigen PS-3, H₂O₂ with an oxidizable compound, Lumi-Gal 530, Amplex Red, 3,5,3',5'-tetramethylbenzidine (TMB), glucose, O₂, ATP, Mg²⁺, luciferin, aminoluciferin, quinoliny luciferin, coelentrazine, aldehyde, FMNH₂, and analogs and derivatives, and combinations thereof.
9. The method of claim 4, wherein the fluidic zones contain an appropriate buffer.
10. The method of claim 1, wherein before the sandwich binding complex reaches the detection zone, it is moved to the cleaning zone, wherein the vibration element is activated to aggregate and de-aggregate the binding complex to thereby remove unbound signal affinity complex.
11. A method of detecting an analyte, comprising providing a magnetic affinity complex and a signal analyte complex in a fluidic network comprising a plurality of fluidic zones, wherein the plurality of fluidic zones comprises a sample zone, a cleaning zone, and a detection zone, wherein the fluidic network is functionally coupled to a vibration element, and wherein the magnetic signal affinity complex comprises a SERS-active nanoparticle, a fluorescent nanoparticle, and optionally comprises a catalytic element,
 - introducing a sample suspected of comprising an analyte into the sample zone, wherein the analyte combines with the magnetic affinity complex to form a magnetic binding complex,
 - activating a microcoil array or a mechanically movable permanent magnet functionally coupled to the fluidic network to thereby move the magnetic binding complex within the fluidic zone or to another fluidic zone without fluidic movement of a fluid in the plurality of the fluidic zones,
 - displacing the analyte from the magnetic binding complex with the signal analyte complex to form a competitive binding complex,
 - optionally activating the array of microcoils or mechanically movable permanent magnet to move the competitive binding complex within the fluidic network prior to detecting the competitive binding complex and/or the unbound signal analyte complex, and
 - detecting the presence of the unbound signal analyte complex within the detection zone using a detection element functionally coupled to the fluidic network, wherein the detection element is an optical detection element or an electrical detection element.
12. The method of claim 11, wherein the signal analyte complex comprises a SERS-active nanoparticle, an optical nanoparticle, or a fluorescent nanoparticle.
13. The method of claim 11, wherein the signal analyte complex comprises a catalytic element.
14. The method of claim 13, wherein the catalytic element is selected from the group consisting of alkaline phosphatase, horseradish peroxidase, glucose oxidase, glucose oxidase and horseradish peroxidase, firefly luciferase, *Renilla luciferase*, bacterial luciferase, an enzyme or analogs or combinations thereof.
15. The method of claim 13, wherein the catalytic element is conjugated through a functionalized polymer.
16. The method of claim 13, wherein a reaction substrate for the catalytic element is in the detection zone.
17. The method of claim 16, wherein the reaction substrate is selected from the group consisting of Lumi-Phos 480, Lumi-Phos 530, Lumi-Phos Plus, Lumi-Phos APS-5, Lumigen TMA-6, Lumigen PS-atto, Lumigen PS-1, Lumigen PS-2, Lumigen PS-3, H₂O₂ with an oxidizable compound, Lumi-Gal 530, Amplex Red, 3,5,3',5'-tetramethylbenzidine (TMB), glucose, O₂, ATP, Mg²⁺, luciferin, aminoluciferin, quinoliny luciferin, coelentrazine, aldehyde, FMNH₂, and analogs and derivatives, and combinations thereof.
18. The method of claim 13, wherein the fluidic zones contain an appropriate buffer.
19. A method of detecting an analyte, comprising providing a coded magnetic affinity complex and a magnetic signal affinity complex in a fluidic network comprising a plurality of fluidic zones, wherein the plurality of fluidic zones comprises a sample zone, a cleaning zone, and a detection zone, wherein the fluidic network is functionally coupled to a vibration element, and wherein the magnetic signal affinity complex comprises a SERS-active nanoparticle, a fluorescent nanoparticle,