CLAIMS

1. A method of detecting the presence of a target analyte in a sample comprising the steps of:

a) incubating the sample with a surface coated with a first sensing element, wherein the first sensing element is capable of specific binding with the target analyte, and wherein when the target analyte is present in the sample, the target analyte binds to the first sensing element present on the coated surface, concurrently with or followed by;

b) incubating the coated surface of step (a) with a plurality of probe particles, wherein the probe particles are coated with a second sensing element capable of specific interaction with the target analyte bound on the coated surface or capable of specific interaction with the first sensing element on the coated surface;

c) applying a mechanical force to separate the non-specifically bound probe particles of step (b) from the coated surface; and

d) measuring a property that reflects the amount of specifically bound probe particles on the coated surface, wherein the property is selected from the group consisting of particle density, colour density, aggregate size and combinations thereof, or measuring a property that reflects the amount of non-specifically bound probe particles, wherein the property is selected from the group consisting of colour density, aggregate size and combinations thereof;

wherein

the mechanical force is of a magnitude that disrupts non-specific binding between the probe particles and the coated surface while maintaining specific binding between the probe particles and the coated surface mediated by the target analyte.

2. The method according to claim 1, wherein the first sensing element is the same or different as the second sensing element, and wherein the first sensing element and second sensing element are independently selected from the group consisting of biomolecule, bioparticle, material or product derived from microorganisms, or wherein the first sensing element and second sensing element are independently selected from the group consisting of carbohydrate, polysaccharides, lipid, protein, peptide, nucleic acid, antibody, antigen, hormone, enzyme, or chemical compounds.

3. The method according to claim 1, wherein the target analyte is soluble in an aqueous medium or solvent, and wherein the target analyte is dispersed in a liquid medium prior to incubating with the coated surface.

4. The method according to claim 1, wherein the probe particles are non-magnetic, magnetic or superparamagnetic particles, and wherein the size of the probe particles is in the range of 8 nm to 100,000 nm.

5. The method according to claim 1, wherein the mechanical force is generated from a permanent magnet, an electric magnet, a centrifuge, an acoustics, an ultrasonic wave, a laser beam, fluid motion, fluid buoyancy, or gravity, and wherein the mechanical force is in the range of 0.01 pN to 100 pN.

6. The method according to claim 1, wherein the probe particles are magnetic or superparamagnetic particles; and when the property measured is colour density, or aggregate size, or colour density and aggregate size, the step (d) further comprises a step (d0) of condensing the specifically bound probe particles on the coated surface into an aggregate before step (d) by applying a magnetic force on the other side of the coated surface.

7. The method according to claim 1, wherein the probe particles are magnetic or superparamagnetic particles; and the step (c) further comprises providing a second surface to contact the non-specifically bound probe particles separated from the coated surface; and

condensing the non-specifically bound probe particles into an aggregate on one side of the second surface by applying the mechanical force on the other side of the second surface;

wherein the mechanical force is a magnetic force.

8. The method according to claim 7, further comprising measuring the colour density, or aggregate size, or colour density and aggregate size of the aggregate.

9. The method according to claim 6, wherein the magnetic force is generated from a permanent magnet or an electric magnet in the form of a magnetic needle, and wherein the magnetic force is in the range of 0.01 pN to 100 pN.

10. The method according to any one of claims 1 to 9, wherein when steps (a) and (b) are carried out concurrently, a mixture of the sample and the plurality of probe particles is incubated with the coated surface.

11. A system for detecting the presence of a target analyte in a sample comprising:

a) a surface coated with a first sensing element, wherein the first sensing element is capable of specific binding with the target analyte;

b) a plurality of probe particles, wherein the probe particles are coated with a second sensing element capable of specific interaction with the target analyte when present or capable of specific interaction with the first sensing element on the coated surface, thereby forming specifically bound probe particles on the coated surface;

c) a mechanical force capable of separating non-specifically bound probe particles from the coated surface while maintaining specific binding between the probe particles and the coated surface mediated by the target analyte; and

d) a measurement means to measure a property of the specifically bound probe particles, wherein the property is selected from the group consisting of particle density, colour density, aggregate size of the specifically bound probe particles, or a property of the non-specifically bound probe particles, wherein the property is selected from the group consisting of colour density, aggregate size of the non-specifically bound probe particles.

12. The system of claim 11, further comprising a second surface for contacting the non-specifically bound probe particles; and a measurement means to measure a property of the non-specifically bound probe particles, wherein the property is selected from the group consisting of colour density, aggregate size and combinations thereof.

13. An article for detecting a presence of a target analyte in a sample, the article comprising:

at least one test well comprising a bottom surface coated with a first sensing element configured to bind with the target analyte in the sample, wherein the test well is configured to receive the sample and probe particles that are contained in one or more liquid mediums, the probe particles being coated with a second sensing element configured to bind with one selected from the group consisting of the first sensing element and the target analyte, such that the probe particles are specifically bound to the coated surface depending on the presence of the target analyte in the sample; and

a channel connected to the test well at a distance from the bottom surface to allow fluid communication between the channel and the test well, wherein the channel is configured to receive non-specifically bound probe particles in the test well upon an exertion of an external force on the

probe particles which move the non-specifically bound probe particles away from the bottom surface;

wherein

the external force is of a magnitude that disrupts non-specific binding between the probe particles and the coated bottom surface while maintaining specific binding between the probe particles and the coated bottom surface mediated by the target analyte.

14. The article according to claim 13, wherein the channel comprises a probe particles trap configured to contain the non-specifically bound probe particles received by the channel after a removal of the external force exerted on the probe particles.

15. The article according to claim 13, further comprising a system control well including a bottom surface coated with the target analyte, wherein the system control well is configured to receive the sample and probe particles.

16. The article according to claim 13, further comprising a blank control well including a bottom surface coated with non-bait molecules that prohibit binding with the target analyte, wherein the blank control well is configured to receive the sample and probe particles.

17. The article according to claim 13, further comprising a negative control well including a bottom surface coated with the first sensing element, wherein the negative control well is configured to receive the one or more liquid mediums in the absence of the target analyte.

18. The article according to claim 13, wherein the channel is connected to the test well adjacent an opening of the test well, the opening being formed at a top portion of the test well.

19. The article as claimed in claim 18, further comprising an enclosure including an inner surface configured to face the test well and wherein the channel comprises a space defined between the inner surface of the enclosure and a wall extends outwardly from the opening of the test well.

20. A kit for detecting a presence of a target analyte in a sample, the kit comprising:

an article according to any one of claims 13 to 19;

the probe particles coated with a second sensing element, the probe particles being contained in a solution; and

an instrument configured to exert the external force on the probe particles; wherein the external force is of a magnitude that disrupts non-specific binding between the probe particles and the coated bottom surface while maintaining specific binding between the probe particles and the coated bottom surface mediated by the target analyte.

21. The kit according to claim 20, wherein the instrument comprises a magnetic needle and the probe particles comprises magnetic or superparamagnetic particles.

22. The kit according to claim 20, further comprising a syringe for introducing the sample into a dropper bottle for mixing with the solution containing the probe particles to form the one or more liquid mediums and transferring the one or more liquid mediums into the article.

23. A method of using the kit according to claim 20, the method comprising the steps of:

introducing the sample and the probe particles contained in the one or more liquid mediums into the test wells of the article;

exerting the external force on the probe particles to move the non-specifically bound probe particles away from the bottom surface of the test well and into the channel;

analysing the probe particles in at least one selected from the group consisting of the test well and the channel, thereby determining a presence of the target analyte in the sample.

24. The method of using the kit according to claim 23, wherein the step of exerting the external force on the probe particles comprises:

turning the article upside down; and

controlling a movement of the non-specifically bound probe particles into the channel using a magnetic needle.

25. The use of the system according to claim 11 or 12, or the article according to any one of claims 13 to 19, or the kit according to any one of claims 20 to 22 for biomolecule, bioorganelle, bioparticle, cell or microorganism detection.