[0004] Thus, in one aspect the present invention refers to a paper fluidic device for the detection and/or quantification of a target analyte in a sample, the device comprising: a. a lateral flow assay (LFA) comprising a porous matrix; and b. an aqueous two-phase system (ATPS)) disposed within said porous matrix where the porous matrix is configured to and has porosity sufficient to allow the ATPS or components thereof to flow through the porous matrix when the ATPS or components thereof are in a fluid phase and provide separation of a mixed phase into a first phase solution and a second phase solution within said porous matrix. In another aspect, the present invention refers to a method of detecting and/or quantifying a target analyte in a sample comprising: a. applying the sample to a device according to the present invention; and b. detecting a presence or absence and/or quantifying the target analyte on the LFA. Also disclosed herein are devices and methods, comprising lateral flow assay (LFA) technology and aqueous multi-phase systems for the detection of target analytes. In certain examples, these devices and methods utilize the concentrating capabilities of aqueous multi-phase systems in conjunction with LFA to provide an improvement over the detection limit of previous LFA assays by at least about 100 to about 1000 fold, which approaches or meets, and in certain cases exceeds the sensitivity of lab-based assays such as the enzyme-linked immunosorbent assay (ELISA).

[0005] In general, in certain applications, a sample of interest containing a target analyte is applied to an aqueous two phase system (ATPS). As described herein, methods and devices have been developed for concentrating and extracting target analyte from a single phase or interface of the ATPS with subsequent detection of the target analyte on the LFA, where its presence can be detected and/or quantified. Alternatively or additionally, the target analyte can be concentrated and detected and/or quantified on an integrated ATPS-LFA system. Thus, extraction can be bypassed by seamlessly integrating the ATPS with downstream LFA detection. In certain applications described herein, these devices only require a user to add the sample of interest. In various examples, these devices can be used to detect target analytes in biological samples such as a serum, salivea, urine, blood or swab sample.

[0006] The devices disclosed herein, in certain examples, are conveniently assembled to form a portable diagnostic device. The various devices and methods described herein prove to be robust, versatile, scalable, inexpensive, sensitive, simple and accurate, requiring minimal training, power, and equipment. It is noted that while the discussion below is generally with respect to aqueous two-phase systems (ATPS), three-phase or four-phase systems, and even greater phase systems can similarly be implemented.

[0007] To illustrate how these concepts work, examples of these technologies are described herein. These examples are intended to be illustrative and non-limiting. Using the teachings provided herein, numerous other systems that integrate ATPS and lateral flow detection can be readily implemented. It is understood that the examples and examples described herein are for illustrative purposes only and that various modifications or changes in light thereof will be suggested to persons skilled in the art and are to be included within the spirit and purview of this application and scope of

the appended claims. All publications, patents, and patent applications cited herein are hereby incorporated by reference in their entirety for all purposes.

[0008] An example of the subject matter described herein, including the methods, devices, kits, and systems described herein, is a device for the detection and/or quantification of a target analyte in a sample, the device comprising: (a) a lateral flow assay (LFA); and (b) an aqueous two-phase system (ATPS). In certain applications, the ATPS comprises a mixed phase solution that partitions into a first phase solution and a second phase solution. In some examples, the partitioning of the mixed phase into the first phase solution and the second phase solution occurs within the LFA. In certain examples, the partitioning of the mixed phase into the first phase solution and the second phase solution does not occur within the LFA. In certain applications, the target analyte is in contact with the mixed phase solution, and the target analyte partitions into the first phase solution or the second phase solution, as/after the first phase solution or the second phase solution separate. In some examples, the target analyte is in contact with the mixed phase solution, and the target analyte partitions to an interface between the first phase solution and the second phase solution, as/after the first phase solution or the second phase solution separate. In some examples, the target analyte is concentrated upon partitioning.

[0009] In certain examples, the first phase solution comprises a micellar solution and the second phase solution comprises a polymer. In certain examples, the first phase solution comprises a polymer and the second phase solution comprises a micellar solution. In certain applications, the first phase solution comprises a micellar solution and the second phase solution comprises a salt. In certain applications, the first phase solution comprises a salt and the second phase solution comprises a micellar solution. In some examples, the micellar solution comprises a non-ionic surfactant. In some examples, the non-ionic surfactant is selected from the group consisting of a cetomacrogol, a cetostearyl alcohol, a cetyl alcohol, a cocamide, a decyl glucoside, an IGEPAL, an isoceteth, a lauryl glucoside, a monolaurin, a nonidet, a nonoxynol, an NP-40, an octyl glucoside, an oleyl alcohol, a poloxamer, a pentaethylene glycol monododecyl ether, a polysorbate, a polyglycerol, a sorbitan, a stearyl alochol, a Triton-X, and a Tween. In certain applications, the micellar solution is a Triton-X solution. In some examples, the Triton-X solution is selected from a Triton-X-100 solution and a Triton-X-114 solution.

[0010] In some examples, first phase solution comprises a first polymer and the second phase solution comprises a second polymer. In some examples, first/second polymer is selected from polyethylene glycol and dextran. In some examples, the first phase solution comprises a polymer and the second phase solution comprises a salt. In some examples, the first phase solution comprises a salt and the second phase solution comprises a polymer. In some examples, the first phase solution comprises polyethylene glycol and the second phase solution comprises potassium phosphate. In some examples, the first phase solution comprises potassium phosphate and the second phase solution comprises polyethylene glycol. In certain examples, the first phase solution is selected from a Component 1 of Table 1 and the second phase solution is selected from a Component 2 of Table 1 as described herein. In certain examples, the second phase solution is selected from a Component 1 of Table 1 and the first phase solution is selected from a Component 2 of Table 1 as described herein.

[0011] In some examples, the target analyte is selected from a protein, an antigen, a biomolecule, a sugar moiety, a lipid, a nucleic acid, a sterol, and combinations thereof. In certain applications, the target analyte is derived from an organism selected from the group consisting of a plant, an animal, a virus, a fungus, a protozoan, and a bacterium. In one example, the device further comprises a probe, wherein the probe interacts with the target analyte.

[0012] Another example of the methods, devices, kits, and systems described herein is an LFA device that comprises one or more probes that interact with at least 1 target analyte, or at least two different target analytes, or at least 3 different target analytes, or at least 4 different target analytes, or at least 5 different target analytes, or at least 7 different target analytes, or at least 10 different target analytes, or at least 15 different target analytes, or at least 20 different target analytes, or even a greater number of target analytes. In some examples, described herein are at least two different probes, or at least 3 different probes, or at least 4 different probes, or at least 5 different probes, or at least 7 different probes, or at least 10 different probes, or at least 15 different probes, or at least 20 different probes. In certain examples, described herein probe is provided that comprises a material selected from the group consisting of a synthetic polymer, a metal, a mineral, a glass, a quartz, a ceramic, a biological polymer, a plastic, and combinations thereof. In certain examples, provided herein probe is provided that comprises a polymer selected from the group

consisting of polyethylene, polypropylene, cellulose, chitin, nylon, polyoxymethylene (DELRIN®), polytetrafluoroethylene (TEFLON®), polyvinyl chloride, and combinations thereof. In some examples, the polypropylene is polypropylene glycol. In some examples, the polyethylene is polyethylene glycol. In certain examples, probe is provided that comprises a biological polymer selected from the group consisting of dextran and polyethylene glycol, and combinations thereof. In certain examples, a probe is provided that comprises a metal (*e.g.*, a metal selected from the group consisting of gold, silver, titanium, stainless steel, aluminum, platinum, and/or alloys thereof).

[0013] In certain examples of the methods, devices, kits, and systems described herein a probe is provided that comprises a nanoparticle (*e.g.*, a gold nanoparticle). In certain examples, the probe comprises a coating. In various examples, the coating can comprise polyethylene glycol or other polymer (*e.g.*, polypropylene glycol), or graft copolymemrs, *e.g.*, poly(l-lysine)-graft-dextran (PLL-g-dex, a graft copolymer with dextran side chains grafted onto a poly(l-lysine) backbone, and the like). In one illustrative, but non-limiting example, the coating comprises dextran. In another example, the coating comprises a hydrophilic protein. In certain applications, the coating comprises serum albumin. In certain examples, the coating has an affinity for the first phase solution or the second phase solution. In certain examples, the probe comprises a binding moiety that binds the target analyte. In certain examples, the binding moiety is selected from the group consisting of an antibody, a lectin, a protein, a glycoprotein, a nucleic acid, a small molecule, a polymer, and a lipid, and/or combinations thereof. In one example, the binding moiety is an antibody or antibody fragment. In certain examples, the probe comprises a magnetic particle. In certain examples, the methods, devices, kits, and systems comprise a magnet. In certain examples, the magnet is configured to accelerate and/or increase a partitioning of the target analyte into the first phase solution or second phase solution. In one example, the magnet is configured to accelerate and/or increase a flow of the target analyte through the LFA. In certain examples, the magnet is attachable to and/or detachable from the device. In certain applications of the methods, devices, kits, and systems provided herein, a collector configured to be placed in contact with the ATPS is provided, where the target analyte partitions at an interface of the collector and the first phase solution and/or second phase solution. In some examples, the collector comprises

a material selected from a plastic, a mesoporous material, a silica, a polymer (*e.g.*, polypropylene, polyoxymethylene (DELRIN®), polytetrafluoroethylene (TEFLON®), and the like), a magnet, a material with a pore, a material with a groove, and any combination thereof.

[0014] In some examples, the methods, devices, kits, and systems described herein comprise a probe that comprises a detectable label. In some examples, the detectable label is selected from the group consisting of a colorimetric label, a fluorescent label, an enzymatic label, a colorigenic label, a radioactive label, and combinations thereof. In some examples, the LFA comprises a porous matrix. In certain applications the porous matrix is sufficiently porous to allow the mixed phase solution, first phase solution, second phase solution, and/or target analyte to flow through the LFA. In certain examples, provided herein a porous matrix is provided that is sufficiently long and/or deep enough for the mixed phase solution, first phase solution second phase solution and/or target analyte to flow vertically and/or horizontally through the LFA, and any combinations thereof. In some examples, a method, device, kit, or system is provided where the first phase solution flows through the porous matrix at a first rate and the second phase solution flows through the porous matrix at a second rate, where the first rate and the second rate are different. In certain examples, the porous matrix comprises a material selected from cellulose, a fiberglass, a nitrocellulose, polyvinylidene fluoride, a nylon, a charge modified nylon, a polyethersulfone, and combinations thereof. In some examples, an LFA is provided that comprises a target analyte capture moiety, where the target analyte capture moiety interacts with the target analyte. In certain examples, an LFA is provided that comprises a competition assay. In certain examples, an LFA is provided that comprises the target analyte. In certain examples, a method, device, kit and/or system is provided that utilizes an LFA that comprises a sandwich assay. In certain examples, the LFA comprises a probe capture moiety, where the probe capture moiety interacts with the probe or component thereof. In certain examples, the mixed solution phase solution is dehydrated on and/or in the LFA strip, and upon addition of the sample, the mixed phase solution partitions into the first phase solution and the second phase solution.

[0015] In certain examples of the methods, devices, kits, and/or systems described herein an LFA is provided that comprises a well with a sufficient volume to contain a solution. In certain applications, the solution is selected from the group

consisting of: at least a portion of the ATPS, at least a portion of the first phase solution, at least a portion of the second phase solution, a re-suspended solution of the target analyte, and combinations thereof. In further or additional examples, provided is a LFA comprising a well wherein the well is located at a position of the LFA selected from a corner, an end, a center, a junction, an off-center, and a bend. In some examples, the well comprises one or more pads selected from a filter pad, a buffer pad, a surfactant pad, a salt pad, a probe pad, a polymer pad, and combinations thereof. In certain examples, an LFA is provided that comprises a strip. In further or additional examples, provided that the strip is configured according to architecture selected from an architecture depicted in **FIGS. 16, 20** and **62-70**. In further or additional examples, provided is a LFA wherein the strip comprises multiple path routes. In certain applications, the LFA further comprises a dry receiving paper. In some examples, the device comprises a running buffer. In some examples, a device is provided that comprises a port for the administration of a sample (*e.g.*, a biological sample) to the device. In certain applications, a port is provided that is connected to the ATPS. In some examples, an LFA is provided where the ATPS and the LFA are integrated, and where the port is connected to the LFA. In certain examples, the port comprises a structure selected from a tube, a funnel, a valve, a syringe, a straw, a channel, a plunger, a piston, a gravity feed, a pump, and combinations thereof. In some examples, the device does not require a power source. In certain examples, the ATPS and the LFA are integrated before use of the device. In still further or additional examples, the ATPS and the LFA are separate before use of the device. In some examples, the device is configured to insert the LFA into the ATPS.

[0016] In certain examples, methods, devices, systems, and/or kits described herein comprise or utilize a device that comprises: (a) a first component comprising a chamber for containing the ATPS; and (b) a second component that comprises the LFA. In one example of this aspect, a device is provided that comprises an actuator that delivers the sample and/or a target analyte, or both, into the ATPS. In certain examples, a device is provided that further comprises an actuator that delivers a solution to the LFA. In certain applications, an LFA is provided that comprises a solution that is selected from the group consisting of a mixed phase solution, the first phase solution, and the second phase solution, and combinations

thereof. In certain examples, an ATPS and LFA are contained in a single housing. In certain applications, a portable LFA device is provided.

[0017] In certain examples. methods, devices, systems, and/or kits are provided for detecting and/or quantifying a target analyte in a sample where the detecting and/or quantifying comprises: (a) applying a sample to a device according described herein; and (b) detecting a presence or absence of the target analyte on the LFA. In certain examples, the method involves applying the sample to the ATPS. In certain applications, the method involves applying the sample to the LFA, where the LFA and the ATPS are integrated. In certain examples, the method involves concentrating the target analyte in the ATPS. In one example, the method involves concentrating the target analyte in the LFA. In some examples, the method utilizes one or more samples selected from the group consisting of a tissue/fluid from a biological organism (*e.g.*, plant, animal, alga, fungus, *etc.*), a food sample, a chemical sample, a drug sample, and an environmental sample (*e.g.*, water sample, soil sample, *etc.*), and combination thereof. In some examples, a sample is provided that is selected from the group consisting of a blood sample, a serum sample, a plasma sample, a urine sample, a saliva sample, a bronchial lavage, a nasal sample, a fecal sample, a sample from a wound or surgical site, and combinations thereof. In certain examples, the target analyte comprises a biological molecule. In certain examples, the biological molecule is selected from the group consisting of a nucleic acid, a protein, a lipid, a small molecule, a sugar, an antibody, an antigen, an enzyme, and combinations thereof. In certain examples, the sample is derived from source selected from the group consisting of a vertebrate (*e.g.*, a mammal, aves, *etc.*), a bacterium, a virus, a protozoan, an alga, a fungus, a protozoan, a drug, a pathogen, a toxin, an environmental contaminant, and components thereof, and combinations thereof.

[0018] In certain examples, a method, device, kit, and/or system is provided that utilizes a paper fluidic device for detection of a target analyte in a sample, where the paper fluidic device is used in conjunction with an aqueous two-phase system (ATPS). In certain examples the device comprises a porous matrix into which is disposed the ATPS or components thereof, where the porous matrix is configured to and has porosity sufficient to allow the ATPS or components thereof to flow through the porous matrix when the ATPS or components thereof are in a fluid phase.

[0019] In certain examples the paper fluidic device comprises the ATPS or components thereof. In certain examples, the ATPS or components thereof are selected from the group consisting of a first phase solution, a second phase solution, and a mixed phase solution, where the mixed phase solution comprises a mixture of the first phase solution and the second phase solution, and/or combinations thereof. In certain examples, the ATPS and/or components thereof are dehydrated on and/or in at least a first portion of the porous matrix. In certain applications, a paper fluidic device, method, system, and/or kit is provided where the first portion of the porous matrix has a width that is different from a second portion of the porous matrix. In further or additional examples, a paper fluidic device, method, system and/or kit is provided that utilizes a sample to hydrate the ATPS, thereby providing ATPS or components thereof in a fluid phase. In some examples, the paper fluidic device comprises a well for containing a contents selected from the group consisting of the mixed phase solution, the first phase solution, the second phase solution, the sample, and combinations thereof. In certain applications, the paper fluidic device comprises an actuator for releasing the content of the well into and/or on to the porous matrix. In certain examples, the well comprises one or more pads selected from a filter pad, a buffer pad, a surfactant pad, a salt pad, a probe pad, a polymer pad, and combinations thereof. In some examples, the first phase solution and the second phase solution flow through the porous matrix at different rates. In one example, the first phase solution and the second phase solution flow through the porous matrix in different directions. In certain examples, the first phase solution comprises a micellar solution and the second phase solution comprises a polymer. In still certain examples, the first phase solution comprises a micellar solution and the second phase solution comprises a salt. In certain applications, a paper fluidic device is provided that comprises a Triton-X (or other surfactant) micellar solution. In some examples, the first phase solution comprises a polymer and the second phase solution comprises a polymer. In certain examples, the first phase solution comprises a polymer and the second phase solution comprises a salt. In certain examples, is a paper fluidic composition is provided where the first phase solution comprises polyethylene glycol and the second phase solution comprises potassium phosphate.

[0020] In one example, a method, device, system and/or kit is provided that comprises a paper fluidic device where the first phase solution is selected from a

Component 1 of Table 1 and the second phase solution is selected from a Component 2 of Table 1. In certain applications, a device, method, system, and/or kit is provided that is configured according to an architecture depicted in **FIGS. 16, 20** and **62-70**. In certain applications, a porous matrix is provided that comprises a first path and a second path.

[0021] In another example, a method, device, system, and/or kit is provided that comprise or utilizes a paper fluidic device, where a first phase solution preferentially flows through a first path and a second phase solution preferentially flows through a second path. In some examples a paper fluidic device is provided where the composition/device comprises a probe that binds a target analyte to produce a probe-analyte complex. In certain examples, a paper fluidic composition is provided where, in use, the target analyte is bound to a probe in a probe-analyte complex. In some examples, a probe is provided that comprises a magnetic particle. In certain examples, the device comprises and/or the method utilizes a magnetic field oriented to attract a magnetic particle to a portion of the porous matrix, where the force of the magnetic field on the magnetic particle enhances the flow of a probe-analyte complex towards a portion of the porous matrix. In certain examples, a probe is provided that comprises a polymer selected from the group consisting of polyethylene, polypropylene, nylon, polyoxymethylene (DELRIN®), polytetrafluoroethylene (TEFLON®), dextran, and polyvinyl chloride, and combinations thereof. In some examples, the polyethylene is polyethylene glycol. In some examples, the polypropylene is polypropylene glycol. In one example a probe is provided that comprises a biological polymer selected from the group consisting of collagen, cellulose, and chitin. In certain applications a paper fluidic device is provided where the probe comprises a metal selected from the group consisting of gold, silver, titanium, stainless steel, aluminum, platinum, alloys thereof, and/or combinations thereof. In one example, a probe is provided that comprises a nanoparticle (*e.g*, a gold nanoparticle). In certain applications, the probe comprises a coating. In certain examples the coating comprises polyethylene glycol. In one example, the coating comprises dextran. In one example, the coating comprises polypropylene. In one example, the coating comprises polypropylene glycol.In certain examples, the coating comprises a hydrophilic protein. In certain examples, the coating comprises serum albumin. In certain applications a paper

fluidic composition/device is provided where a probe has a coating that has an affinity for the first phase solution or the second phase solution.

[0022] In certain examples of the methods, devices, systems, and/or kits described herein a paper fluidic composition/device is provided that comprises a probe, where the probe further comprises a binding moiety that binds the target analyte. In some examples a paper fluidic device is provided that comprises a binding moiety that is selected from the group consisting of an antibody, a lectin, a protein, a glycoprotein, a nucleic acid, a small molecule, a polymer, a lipid, and/or combinations thereof. In certain examples a probe is provided that comprises a binding moiety that comprises an antibody or antibody fragment. In certain examples a paper fluidic device is provided that comprises a probe that comprises a detectable label. In one example, the detectable label is selected from the group consisting of a colorimetric label, a fluorescent label, an enzymatic label, a colorigenic label, a radioactive label, and combinations thereof. In certain applications a paper fluidic composition is provided that further comprises a dry receiving paper, where the first phase solution or the second phase solution preferentially flows through the porous matrix towards a dry receiving paper.

[0023] In certain examples methods, devices, systems, and/or kits described herein comprise paper fluidic device/composition that, in use, comprises a running buffer, where a first phase solution and/or a second phase solution flow faster through the porous matrix upon contact with the running buffer. In certain applications of the subject matter described herein, provided is a paper fluidic device comprising a porous matrix that comprises a material selected from cellulose, a fiberglass, a nitrocellulose, polyvinylidene fluoride, a nylon, a charge modified nylon, a polyethersulfone, and/or combinations thereof. In one example a paper fluidic device is provided that comprises a porous matrix comprising a target analyte capture moiety, where the target analyte capture moiety interacts with a target analyte or component thereof. In one example, the paper fluidic device further comprises the target analyte. In one example, the porous matrix comprises a probe capture moiety, where the probe capture moiety interacts with the probe or component thereof. In certain examples an LFA is provided that comprises or facilitates a competition assay. In certain examples, the LFA comprises a sandwich assay. In certain examples a paper fluidic composition is provided wherein a porous matrix is configured to concentrate the target analyte as the target analyte flows through the

porous matrix. In certain applications, the paper fluidic device comprises a control analyte, where a comparison of the control analyte and the target analyte on the porous matrix provides a quantification of the target analyte.

[0024] In certain examples a method of detecting a target analyte in a sample is provided where the method comprises: (a) applying the sample to a device described and/or claimed herein; and (b) detecting the presence or absence of the target analyte.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The foregoing summary, as well as the following detailed description, may be better understood when read in conjunction with the appended figures. The figures are intended to be illustrative and not limiting. It will be understood that the disclosure is not limited to the precise arrangements, examples and instrumentalities shown therein.

[0026] **FIG. 1** (Top) Schematic of a typical lateral-flow immunoassay test strip. Two example mechanisms utilized by LFA are shown: sandwich assay (bottom left) and competition assay (bottom right).

[0027] **FIG. 2** shows a schematic representation for analyte concentration using capturing probes with ATPS. The probe captures the target analyte and partitions extremely into one of the phases. The phase containing the concentrated probes can then be collected for subsequent analysis through LFA

[0028] **FIG. 3** shows a schematic representation for analyte concentration using magnetic capturing probes with ATPS. The probe captures the target analyte and partitions into one of the phases. A magnet is applied which further concentrates the magnetic probes into a smaller volume.

[0029] **FIG. 4** shows one illustrative, but non-limiting, design of a portable device that utilizes a piston and plunger to transfer the concentrated analyte from an ATPS to LFA test strips. This device consists of a concentration chamber and a detection chamber. In this example, analyte is concentrated into the bottom bulk phase of the ATPS. To collect a sample, (1) the plunger is depressed. The sample is mixed with the ATPS solution. Subsequently (2), to draw the solution, the tip of the device is inserted in the sample, followed by (3) release of the plunger, and (4) sealing the PEN device with a cap. After (5) the analyte is concentrated to the bottom bulk phase, the detection step is initiated, (6) by rotating the plunger to the "TEST" position, which

CLAIMS

What is claimed is:

1. A paper fluidic device for the detection and/or quantification of a target analyte in a sample, the device comprising:

a. a lateral flow assay (LFA) comprising a porous matrix; and

b. an aqueous two-phase system (ATPS)) disposed within said porous matrix where the porous matrix is configured to and has porosity sufficient to allow the ATPS or components thereof to flow through the porous matrix when the ATPS or components thereof are in a fluid phase and provide separation of a mixed phase into a first phase solution and a second phase solution within said porous matrix.

2. The device of claim 1, wherein the target analyte is in contact with the mixed phase solution, and wherein the target analyte partitions into the first phase solution or the second phase solution within said porous matrix.

3. The device of claim 1, wherein the target analyte is in contact with the mixed phase solution, and wherein the target analyte partitions to an interface of the first phase solution and the second phase solution within said porous matrix.

4. The device according to any one of claims 1-3, wherein the first phase solution comprises a micellar solution and the second phase solution comprises a polymer or a salt, or wherein the first phase solution comprises a first polymer and the second phase solution comprises a second polymer.

5. The device of claim 4, wherein the first/second polymer is selected from polyethylene glycol, polypropylene glycol, dextran, and combinations thereof.

6. The device according to any one of claims 1-3, wherein the first phase solution comprises polyethylene glycol or polypropylene glycol and the second phase solution comprises potassium phosphate.

7. The device according to any one of claims 1-6, wherein the target analyte is selected from the group consisting of a protein, an antigen, a biomolecule, a small organic molecule, a sugar moiety, a lipid, a nucleic acid, a sterol, and combinations thereof.

8. The device according to any one of claims 1-7, wherein the device further comprises a probe, wherein the probe interacts with the target analyte.

9. The device of claim 8, wherein the probe comprises a material selected from the group consisting of a synthetic polymer, a metal, a mineral, a glass, a quartz, a ceramic, a biological polymer, a plastic, and combinations thereof.

10. The device of claim 9, wherein:

the probe comprises a biological polymer selected from the group consisting of dextran, polypropylene glycol , polyethylene glycol, and combinations thereof,

wherein the probe comprises a metal selected from the group consisting of gold, silver, platinum, and combinations thereof,

or wherein the probe comprises a nanoparticle.

11. The device according to any one of claims 9 or 10, wherein the probe comprises a coating.

12. The device of claim 13, wherein the coating comprises polypropylene glycol or polyethylene glycol.

13. The device of claim 12, wherein the coating has an affinity for the first phase solution or the second phase solution and wherein the probe further comprises a binding moiety that binds the target analyte.

14. The device of claim 13, wherein the binding moiety is selected from the group consisting of an antibody, an antibody fragment, a lectin, a protein, a glycoprotein, a nucleic acid, a small molecule, a polymer, a lipid, and combinations thereof.

15. The device according to any one of claims 8-14, wherein the probe comprises a detectable label and the detectable label is selected from the group consisting of a colorimetric label, a fluorescent label, an enzymatic label, a colorigenic label, a radioactive label, and combinations thereof.

16. The device according to any one of claims 1-15, wherein the LFA comprises a target analyte capture moiety, wherein the target analyte capture moiety interacts with the target analyte.

17. The device according to any one of claims 1-16, wherein the LFA comprises a probe capture moiety, wherein the probe capture moiety interacts with the probe or component thereof.

18. The device according to any one of claims 1-17, wherein a component of the first and/or a component of the second phase solution is dehydrated on and/or in the LFA strip.

19. The device of claim 18, wherein the device is configured such that application of the sample to the device hydrates the ATPS or component thereof, thereby providing ATPS or components thereof in the fluid phase.

20. A method of detecting and/or quantifying a target analyte in a sample comprising:

a. applying the sample to a device according to any one of claims 1-19; and

b. detecting a presence or absence and/or quantifying the target analyte on the LFA.