CLAIMS

What is claimed is:

1. A sensing cartridge comprising:

a first member comprising a first surface and a second surface opposite the first surface, the first member configured to:

receive on the first surface, a feed solution of whole blood comprising plasma, cellular components in the plasma, and solutes in the plasma, the solutes comprising ammonium (NH_4^+) and at least one other solute, and

present at the second surface, plasma with ammonium (NH_4^+) while retaining the cellular components and the at least one other solute;

a second member having a surface in interfacial contact with the second surface of the first member, wherein the interfacial contact produces a tension at the surface of the second member, the second member configured to:

wick plasma with ammonium (NH_4^+) from the first member via capillary action resulting from the tension at the surface of the second member, and

act on ammonium (NH_4^+) in the plasma to shift a phase equilibrium of the ammonium to ammonia (NH_3) gas;

a third member coupled to the second member, wherein the third member is configured to prevent liquid permeation produced by the shift in the phase equilibrium of the ammonium to the ammonia gas; and

a fourth member coupled to the third member, wherein the fourth member is configured to act on the ammonia gas.

2. The sensing cartridge of claim 1, wherein the first member comprises a membrane filter with an average pore diameter size between .002 μm and 0.05 μm, and a void volume between 0.5 microliters (μL) per square centimeter (cm^2) (μL/cm^2) and 60 μL/cm^2.

3. The sensing cartridge of claim 1, wherein the first member comprises an asymmetric membrane having a first average pore diameter size at the first surface and a second average pore diameter size at the second surface, wherein the first average pore diameter size is

between 75 micrometers (μm) and 125 μm and the second average pore diameter size is between 0.5 μm and 1.0 μm.

4. The sensing cartridge of claim 1, wherein the second member includes a wicking layer comprising at least one of a woven paper, a non-woven paper, a membrane, a structure of natural fiber, a structure of synthetic fiber, a porous material, and a material.

5. The sensing cartridge of claim 1, wherein the second member includes at least one of a process, an additive, and a catalyst to act on the ammonium in the plasma to shift the phase equilibrium of the ammonium to the ammonia gas.

6. The sensing cartridge of claim 1, wherein the second member comprises nanophotonic materials configured to heat when irradiated with light in a visible spectrum to change a temperature of the plasma wicked into the second member to affect solubility of the ammonium in the plasma.

7. The sensing cartridge of claim 1, wherein the third member is a hydrophobic, porous material that allows the ammonia gas to diffuse through the third member.

8. The sensing cartridge of claim 1, wherein the fourth member is an ammonia gas responsive layer with a polymer coating on a transparent substrate, and wherein the ammonia gas responsive layer includes at least one of an indicator, a reactant, and a molecule that interacts with the ammonia gas.

9. The sensing cartridge of claim 1, wherein respective edges of the first member and the second member are melted together to provide the interfacial contact.

10. A system comprising:

a sensing cartridge that includes:

a first member comprising a first surface and a second surface opposite the first surface, the first member configured to:

receive on the first surface, a feed solution of whole blood comprising plasma, cellular components in the plasma, and solutes in the plasma, the solutes comprising ammonium (NH_4^+) and at least one other solute, and

present at the second surface, plasma with ammonium (NH_4^+) while retaining the cellular components and the at least one other solute;

a second member having a surface in interfacial contact with the second surface of the first member, wherein the interfacial contact produces a tension at the surface of the second member, the second member configured to:

wick plasma with ammonium (NH_4^+) from the first member via capillary action resulting from the tension at the surface of the second member, and

act on ammonium (NH_4^+) in the plasma to shift a phase equilibrium of the ammonium to ammonia (NH_3) gas;

a third member coupled to the second member, wherein the third member is configured to prevent liquid permeation produced by the shift in the phase equilibrium of the ammonium to the ammonia gas; and

a fourth member coupled to the third member, wherein the fourth member is configured to act on the ammonia gas;

an optoelectronic reader that includes:

a light emitting diode (LED) configured to emit a light towards the sensing cartridge; and

a photodiode configured to sense reflected light from the sensing cartridge and to provide a measurement based on the reflected light; and

a processor configured to quantify the ammonia gas based on the measurement.

11. A sensing cartridge comprising:

a first member configured to separate a plurality of components including a permeate from a feed solution, wherein the first member is an asymmetric membrane having a first surface having a first average pore size that accepts the plurality of components of the feed solution and a second surface opposite the first surface having a second average pore size that accepts a subset of the plurality of components, which subset includes the permeate, wherein the first average pore size is greater than the second average pore size; and

a second member having a surface in interfacial contact with the second surface of the first member, wherein the interfacial contact produces a tension at the surface of the second member, which tension results in a wicking of the permeate from the first member via capillary action.

12. The sensing cartridge of claim 11, wherein the second member is configured to act on a constituent in the permeate to shift a phase equilibrium of the constituent to a gaseous state.

13. The sensing cartridge of claim 11, wherein the second member is configured to transport the permeate to another member that is configured to act on a constituent in the permeate to shift a phase equilibrium of the constituent to a gaseous state.

14. The sensing cartridge of claim 11, wherein:

the average pore size of the first surface of the asymmetric membrane is between 75 micrometers (μm) and 125 μm; and

the average pore size of the second surface of the asymmetric membrane is between 500 nanometers (nm) and 1 μm.

15. The sensing cartridge of claim 11, wherein the second member includes at least one of a process, an additive, and a catalyst to act on a constituent in the permeate to shift a phase equilibrium of the constituent to a gaseous state.

16. The sensing cartridge of claim 11, wherein the second member induces a shift in a phase equilibrium of the permeate by changing a temperature of the permeate to affect solubility of a gas in the permeate,

wherein the temperature of the permeate is changed via at least one of:

nanophotonic materials included in the second member, wherein the nanophotonic materials heat when irradiated with light in a visible spectrum; and

a conductive member included in the second member, wherein the conductive member is heated resistively with an applied electrical current.

17. The sensing cartridge of claim 11, wherein:

a third member is coupled to the second member, wherein the third member is configured to prevent further permeation of liquid permeate from the second member; and

a fourth member is coupled to the third member, wherein the fourth member is configured to respond to a diffused gas of a constituent in the permeate.

18. The sensing cartridge of claim 17, wherein the fourth member includes a gas responsive layer that has a proportional change in frequency in response to a quantity of gas present.

19. The sensing cartridge of claim 11, wherein:

the second member is configured to act on a constituent in the permeate to shift a phase equilibrium of the constituent to a gaseous state.

20. A system comprising:

a sensing cartridge that includes:

a first member configured to separate a plurality of components including a permeate from a feed solution, wherein the first member is an asymmetric membrane having a first surface having a first average pore size that accepts the plurality of components of the feed solution and a second surface opposite the first surface having a second average pore size that accepts a subset of the plurality of components, which subset includes the permeate, wherein the first average pore size is greater than the second average pore size;

a second member having a surface in interfacial contact with the second surface of the first member, wherein the interfacial contact produces a tension at the surface of the second member, which tension results in a wicking of the permeate from the first member via capillary action, wherein the second member acts on a constituent in the permeate to shift a phase equilibrium of the constituent to a gaseous state;

a third member coupled to the second member, wherein the third member is configured to prevent liquid permeation produced by the shift in the phase equilibrium of the constituent to the gaseous state; and

a fourth member coupled to the third member, wherein the fourth member is configured to respond to diffused gas of the constituent; and

an optoelectronic reader that includes:

a sensing light emitting diode (LED) configured to emit a light towards the sensing cartridge; and

a sensing photodiode configured to sense reflected light from the sensing cartridge and to provide a measurement based on the reflected light; and

a processor configured to quantify the constituent based on the measurement.