CLAIMS

What is claimed is:

1. A system for target detection, the system comprising:

a base substrate; and

a set of sample processing regions defined at a broad surface of the base substrate, wherein each sample processing region of the set of sample processing regions comprises:

a set of microwell subarrays arranged in a gradient by dimension of microwells between an upstream end and a downstream end of each respective sample processing region, and

a boundary separating each respective sample processing region from an adjacent sample processing region,

wherein the base substrate is composed of a material having a level of porosity that permits gas exchange between contents of wells of the set of sample processing regions and an environment of the system, while preventing liquid exchange.

2. The system of claim 1, wherein the set of microwell subarrays has an initial microwell subarray with wells having a first characteristic dimension positioned at the upstream end, and a terminal microwell subarray with wells having a second characteristic dimension positioned at the downstream end.

3. The system of claim 2, wherein the first characteristic dimension is smaller than the second characteristic dimension, wherein the initial microwell subarray occupies a first footprint of the base substrate, and wherein the terminal microwell subarray occupies a second footprint of the base substrate larger than the first footprint.

4. The system of claim 2, wherein wells of the initial microwell subarray are arranged in a first packed configuration, and wherein wells of the terminal microwell subarray are arranged in a second packed configuration.

5. The system of claim 1, wherein the base substrate is composed of a PTFE-based material having the level of porosity that permits gas exchange between contents of wells of the set of sample processing regions and an environment of the system, while preventing liquid exchange.

6. The system of claim 1, wherein the set of sample processing regions contains dried sample processing materials comprising at least one of: media, fluorometric substrates, and colorimetric substrates.

7. The system of claim 1, wherein each sample processing region provides an aggregate volumetric capacity from 0.01 to 10 milliliters and wherein each of the set of microwell subarrays comprises between 10 and 100,000 wells, corresponding to a most probable number (MPN) range from 5 to 3,000,000 for a MPN assay.

8. The system of claim 1, wherein the boundary comprises a recessed channel operable to receive sample overflow.

9. The system of claim 1, further comprising a cover substrate configured to mate with the base substrate in a coupled mode, the cover substrate comprising a network of venting channels aligned with the set of sample processing regions upon mating the base substrate with the cover substrate in the coupled mode, the network of venting channels providing gas exchange between the base substrate and an environment surrounding the set of sample processing regions.

10. The system of claim 9, wherein the cover substrate is composed of a material having a level of porosity that permits gas exchange between contents of the system and an environment of the system, while preventing liquid exchange.

11. The system of claim 9, wherein the cover substrate is composed of an elastomeric material.

12. The system of claim 9, wherein the network of venting channels comprises a first subset of channels spanning the cover substrate parallel to a first axis, and a second subset of channels spanning the cover substrate parallel to a second axis, such that the first subset of channels crosses the second subset of channels.

13. The system of claim 9, wherein the network of venting channels are open to an environment of the system at peripheral edges of the cover substrate.

14. The system of claim 9, wherein the cover substrate comprises a first locking portion complementary to a second locking portion of the base substrate.

15. The system of claim 9, wherein the cover substrate is separated from the base substrate by one or more functional layers.

16. The system of claim 15, wherein the one or more functional layers comprises a porous adhesive film layer positioned between the cover substrate and the base substrate and providing gas exchange from wells of the set of sample processing regions.

17. A system for target detection, the system comprising:

a base substrate;

a set of sample processing regions defined at a broad surface of the base substrate, wherein sample processing region each of the set of sample processing regions includes:

a set of microwell subarrays arranged in a volumetric gradient between an upstream end and a downstream end of each respective sample processing region, and

a boundary separating each respective sample processing region from an adjacent sample processing regions; and

a cover substrate configured to mate with the base substrate in a coupled mode,, wherein at least one of the base substrate and the cover substrate is composed of a material having a level of porosity that permits gas exchange while preventing liquid exchange between contents of wells of the set of sample processing regions and an environment of the system.

18. The system of claim 17, wherein the set of microwell subarrays has an initial microwell subarray with wells having a first characteristic dimension positioned at the upstream end, and a terminal microwell subarray with wells having a second characteristic dimension positioned at the downstream end, wherein the first characteristic dimension is smaller than the second characteristic dimension.

19. The system of claim 17, wherein the cover substrate comprises a network of venting channels aligned with the set of sample processing regions upon mating the base substrate with the cover substrate in the coupled mode, the network of venting channels providing gas exchange between the base substrate and an environment surrounding the set of sample processing regions.

20. The system of claim 17, wherein the cover substrate is composed of an elastomeric material.