FLUIDIC ARRAYS AND METHOD OF USING

RELATED APPLICATIONS

[0001] This application is a continuation in part application of International Application No. PCT/US02/26459, filed Aug. 20, 2002 and published in English, and claims priority to U.S. patent application Ser. No. 60/313,644, filed Aug. 20, 2001. Both applications are incorporated herein by reference.

FEDERALLY SPONSORED RESEARCH

[0002] This invention was sponsored in part by the National Science Foundation under Grant Nos. ECS-0004030 and ECS-9729405, and by NIH under Grant No. GM65364. The government has certain rights in the invention.

FIELD OF THE INVENTION

[0003] The present invention relates to fluidic systems and, in particular, fluidic arrays and methods for using them to promote interaction of materials.

BACKGROUND OF THE INVENTION

[0004] Performing multiple tests on a material, a single test on multiple materials or multiple tests on multiple materials may be a time consuming and labor intensive process. For example, in a screening test where an indicator is used to detect the presence of a particular substance in a variety of materials, the indicator must be added to each of the materials and the results must be individually observed.

[0005] In some cases, the process of performing multiple tests may be performed in a tray containing multiple wells (multi-well plate). For example, each well may be filled with an indicator and test material may be added to each well. Such an arrangement may facilitate observation of results and processing, such as incubation, required to achieve the results. However, filling each well individually remains time consuming and, as the number of materials to be tested and number of tests increase, the number of wells required to do all of the tests increases geometrically. A system capable of reducing the amount of time and labor required to perform multiple tests is desirable. A small and simple system is particularly desirable.

[0006] Microfluidic systems have received attention recently as creating the possibility of fabricating compact, integrated devices for analytical functions such as sensing, diagnosis and genomic analysis. Microfluidic systems are flow systems miniaturized to dimensions typically as small as a few micrometers (μm). Such systems present challenges in both their design and manufacture. For example, at the level of miniaturization of typical microfluidic systems, fluid flow is predominantly laminar and the effects of diffusion, surface tension and viscosity may be emphasized.

SUMMARY OF THE INVENTION

[0007] In one embodiment, the present invention is directed to a microfluidic system. The microfluidic system includes a first fluid path and a second fluid path segregated from the first fluid path by a first convection controller at a first contact region, wherein at least one of the first fluid path and the second fluid path has a cross-sectional dimension of less than about 1 millimeter.

[0008] In another embodiment, the present invention is directed to a fluidic system including a first fluid path, a second fluid path, a third fluid path segregated from the first fluid path by a convection controller at a first contact region and the second fluid path by a convection controller at a second contact region, and a fourth fluid path segregated from the first fluid path by a convection controller at a third contact region and segregated from the second fluid flow path by a fourth convection controller at a fourth contact region.

[0009] In another embodiment, the present invention is directed to a fluidic array including a first set of fluid paths arranged generally parallel to one another, a second set of fluid paths arranged generally parallel to one another and crossing the first set of fluid paths such that a plurality of contact regions are formed between at least some of the fluid paths in the first set of fluid paths and at least some of the fluid paths in the second set of fluid paths, and a convection controller segregating one of the first set of fluid paths from one of the second set of fluid paths at the contact region.

[0010] In another embodiment, the present invention is directed to a method of promoting interaction. The method of promoting interaction includes introducing a first fluid including a first material into a first fluid path having a cross-sectional dimension of less than 1 millimeter, introducing a second fluid including a second material into a second fluid path segregated from the first fluid path by a convection controller at a contact region, and allowing the first and second materials to interact at the contact region.

[0011] In another embodiment, the present invention is directed to a method of immobilizing a material in a microfluidic system. The method of immobilizing a material in a microfluidic system includes the step of introducing an immobilizer containing the material into a fluid path having a cross-sectional dimension of less than about 1 millimeter.

[0012] In another embodiment, the present invention is directed to a microfluidic system including a fluid path having a cross-sectional dimension of less than about 1 millimeter and an immobilizer positioned within the fluid path.

[0013] In another embodiment, the present invention is directed to a method of patterning a material on a substrate. The method includes placing a first fluid path in fluid contact with the substrate, flowing a fluid comprising the material into the first fluid path, and immobilizing at least a portion of the material within the first fluid path. The method further includes removing the first fluid path from the substrate, leaving at least a portion of the immobilized material in contact with the substrate, and placing a second fluid path in fluid contact with the substrate such that the second fluid path is in fluid contact with at least a portion of the immobilized material.

[0014] In another embodiment, the present invention is directed to fluidic device including a substrate with a material patterned thereon and a fluid path in fluid contact with the substrate such that the fluid path is in fluid contact with at least a portion of the material.

[0015] In another embodiment, the present invention is directed to method of promoting interaction. The method includes providing a fluidic system comprising a fluid path having a cross-sectional dimension of less than one milli-