and ultimately microstructures. FIG. **28** shows the results of various experiments that have been conducted to determine homogeneous/discrete patterns and their relation with the size and number of transparent pixels. Note that here first level swatches are used to pattern **32** pattern intensities ('tonalities'). Further, an array of grayscale binary masks of 2 mm circles are shown patterned with several grayscale tones. Swatches are also shown in the panels at different pixel sizes and densities, e.g., pixels per inch or ppi. The examples of thiolene polymerized patterns created with such masks are also shown.

[0088] FIG. **29** shows examples of the determination of a discrete pattern **4***a*, a transition case **4***b*, and a homogeneous pattern **4***c* in the case of 75% grayscale with varying ppi. It should be noted that n is the number of pixels per millimeter squared of pattern and a is the pixel size in micrometers.

[0089] FIGS. **30-33**, show yet another embodiment of a microfluidic device **111** of the present invention including various microstructures **281**. FIGS. **30** and **31** show a master template of a microstructure and FIGS. **32-33** show replicas created from the template shown in FIGS. **30** and **31**. The insert view in FIG. **31** shows a grayscale pattern **283** used to produce the microstructure **281**. FIG. **30** shows a detail of the thiolene master pattern **285** showing the array of side microchannels **281**. FIG. **31** shows a detail of an end of a side microchannel **281**. The post **291** at the end of the micro channel **281** is used to create a cavity **293** on the PDMS replica **295**. FIG. **32** shows a bottom view of a PDMS replica **295** created using the master **285**. FIG. **33** shows that the previously discussed cavity may be used as a guide to introduce a thin metal tubing **297** and punch a small hole all the way through the PDMS and out to the exterior.

[0090] There are virtually innumerable uses for the present invention, all of which need not be detailed here. Additionally, all the disclosed embodiments can be practiced without undue experimentation. Further, although the best mode contemplated by the inventors of carrying out the present invention is disclosed above, practice of the present invention is not limited thereto. It will be manifest that various additions, modifications, and rearrangements of the features of the present invention may be made without deviating from the spirit and scope of the underlying inventive concept.

[0091] In addition, the individual components of the present invention discussed herein need not be fabricated from the disclosed materials, but could be fabricated from virtually any suitable materials. Moreover, the individual components need not be formed in the disclosed shapes, or assembled in the disclosed configuration, but could be provided in virtually any shape, and assembled in virtually any configuration. Furthermore, all the disclosed features of each disclosed embodiment can be combined with, or substituted for, the disclosed features of every other disclosed embodiment except where such features are mutually exclusive.

[0092] Further, although the concept of pattern homogenization for the fabrication of 3D structures is shown and described here using masking opaque/transparent motifs and UV light, the same concept could easily be accomplished using infrared light (thermal radiation) and a thermal-resist instead of UV light and a photoresist. Another additional possibility would be to use conventional lithography to create the motifs on a photoresist covering a silicon or glass wafer. The photoresist with the motifs would work as a mechanical mask for the fabrication of 3D structures on the wafers using wet or dry etching.

[0093] It is intended that the appended claims cover all such additions, modifications, and rearrangements. Expedient embodiments of the present invention are differentiated by the appended claims.

What is claimed is:

1. A three dimensional microfluidic device comprising:

a plurality of inlets;

a main microchannel having topographic constrictions and having fluid communication with the inlets; and

dead-end side channels with small orifices to allow gas to escape in fluid communication with the main microchannel.

2. The device of claim **1**, further comprising at least one outlet in communication with the microchannel.

3. The device of claim **1**, wherein each constriction is designed to stop priming flow through the main microchannel.

4. The device of claim **1**, wherein the constrictions use capillary forces to move a liquid until a dead-end side channel is completely filled and a plug of liquid is stored therein.

5. The device of claim **1**, wherein the device is used to create libraries of liquid plugs with arbitrary concentrations of chemicals.

6. The device of claim **1**, wherein a liquid to be stored in the device is stored sequentially in the dead-end side channels.

7. The device of claim **1**, wherein the device allows for complex chemical mixtures to be: generated and stored for applications such as chemotaxis experiments under zero-flow conditions; dispersed in immiscible liquid forming droplets for combinatorial experiments; or stored deterministically for subsequent analysis.

8. The device of claim **1**, wherein the device is used in a remote location to sample water from a source.

9. The device of claim **1**, wherein the device is designed to be primed passively with capillary forces.

10. The device of claim **1**, wherein liquid in the different dead-end side channels corresponds to samples acquired sequentially with a time lag between them.

11. The device of claim **1**, wherein biological cells are introduced in different side channels according to a distinct property.

12. A microfluidic device without any actuator that is capable of sorting liquid plugs chronologically and storing them comprising:

a main microchannel with a multitude of topographic constrictions;

at least two inlets that merge into the main microchannel;

side channels that are associated with the topographic constrictions and alternate with the inlets; and

one outlet in communication with the main microchannel.

13. The device of claim **12**, wherein the device provides for a gradient of proteins across a direction perpendicular to at least two of the side channels.

14. The device of claim **12**, wherein the device is used under zero gravity to handle liquid samples in space.

15. A microfluidic device for sorting and storing liquid plugs comprising:

a photoresist exposed to UV light through a binary transparency mask including an optical adhesive with low contrast $\gamma \approx 0.55$ to promote partial polymerization in areas subject to diffracted light and to facilitate the transfer of discrete patterns from the mask as homogeneous patterns (smooth surfaces) to the photoresist.