

In FIG. 4A, this layer is shown in two separate pieces, **428**, **430**, though it would be understood by one of ordinary skill in the art that a single piece layer would be appropriate.

**[0129]** In various embodiments, the label is a computer-readable label. For example, the label can include a bar code, a radio frequency tag or one or more computer-readable characters. The label can be formed of a mechanically compliant material. For example, the mechanically compliant material of the label can have a thickness of between about 0.05 and about 2 millimeters and a Shore hardness of between about 25 and about 100. The label can be positioned such that it can be read by a sample identification verifier as further described herein.

**[0130]** The cartridge can further include a heat sealable laminate layer **422** (typically between about 100 and about 125 microns thick) attached to the bottom surface of the microfluidic substrate **424** using, for example, heat bonding. This layer serves to seal the PCR channels and vent channels in substrate **424**. The cartridge can further include a thermal interface material layer **420** (typically about 125 microns thick), attached to the bottom of the heat sealable laminate layer using, for example, pressure sensitive adhesive. The layer **420** can be compressible and have a higher thermal conductivity than common plastics, thereby serving to transfer heat across the laminate more efficiently. Typically, however, layer **420** is not present.

**[0131]** The application of pressure to contact the cartridge to the heater of an instrument that receives the cartridge generally assists in achieving better thermal contact between the heater and the heat-receivable parts of the cartridge, and also prevents the bottom laminate structure from expanding, as would happen if the PCR channel was only partially filled with liquid and the air entrapped therein would be thermally expanded during thermocycling.

**[0132]** In use, cartridge **400** is typically thermally associated with an array of heat sources configured to operate the components (e.g., valves, gates, actuators, and processing region **410**) of the device. Exemplary such heater arrays are further described herein. Additional embodiments of heater arrays are described in U.S. patent application Ser. No. \_\_\_\_\_, entitled "Heater Unit for Microfluidic Diagnostic System" and filed on even date herewith, the specification of which is incorporated herein by reference in its entirety. In some embodiments, the heat sources are controlled by a computer processor and actuated according to a desired protocol. Processors configured to operate microfluidic devices are described in, e.g., U.S. application Ser. No. 09/819,105, filed Mar. 28, 2001, which application is incorporated herein by reference.

**[0133]** In various embodiments, during transport and storage, the microfluidic cartridge can be further surrounded by a sealed pouch. The microfluidic cartridge can be sealed in the pouch with an inert gas. The microfluidic cartridge can be disposable for example after one or more of its sample lanes have been used.

#### HIGHLY MULTIPLEXED EMBODIMENTS

**[0134]** Embodiments of the cartridge described herein may be constructed that have high-density microfluidic circuitry on a single cartridge that thereby permit processing of multiple samples in parallel, or in sequence, on a single cartridge. Preferred numbers of such multiple samples include 20, 24, 36, 40, 48, 50, 60, 64, 72, 80, 84, 96, and 100, but it would be

understood that still other numbers are consistent with the apparatus and cartridge herein, where deemed convenient and practical.

**[0135]** Accordingly, different configurations of lanes, sample inlets, and associated heater networks than those explicitly depicted in the FIGs and examples that can facilitate processing such numbers of samples on a single cartridge are within the scope of the instant disclosure. Similarly, alternative configurations of detectors and heating elements for use in conjunction with such a highly multiplexed cartridge are also within the scope of the description herein.

**[0136]** It is also to be understood that the microfluidic cartridges described herein are not to be limited to rectangular shapes, but can include cartridges having circular, elliptical, triangular, rhombohedral, square, and other shapes. Such shapes may also be adapted to include some irregularity, such as a cut-out, to facilitate placement in a complementary apparatus as further described herein.

**[0137]** In an exemplary embodiment, a highly multiplexed cartridge has 48 sample lanes, and permits independent control of each valve in each lane by suitably configured heater circuitry, with 2 banks of thermocycling protocols per lane, as shown in FIG. 12. In the embodiment in FIG. 12, the heaters (shown superimposed on the lanes) are arranged in three arrays **502**, **504**, with **506**, and **508**. The heaters are themselves disposed within one or more substrates. Heater arrays **502**, **508** in two separate glass regions only apply heat to valves in the microfluidic networks in each lane. Because of the low thermal conductivity of glass, the individual valves may be heated separately from one another. This permits samples to be loaded into the cartridge at different times, and passed to the PCR reaction chambers independently of one another. The PCR heaters **504**, **506** are mounted on a silicon substrate—and are not readily heated individually, but thereby permit batch processing of PCR samples, where multiple samples from different lanes are amplified by the same set of heating/cooling cycles. It is preferable for the PCR heaters to be arranged in 2 banks (the heater arrays **506** on the left and right **508** are not in electrical communication with one another), thereby permitting a separate degree of sample control.

**[0138]** FIG. 13 shows a representative 48-sample cartridge **600** compatible with the heater arrays of FIG. 12, and having a configuration of inlets **602** different to that depicted on other cartridges herein. The inlet configuration is exemplary and has been designed to maximize efficiency of space usage on the cartridge. The inlet configuration can be compatible with an automatic pipetting machine that has dispensing heads situated at a 9 mm spacing. For example, such a machine having 4 heads can load 4 inlets at once, in 12 discrete steps, for the cartridge of FIG. 13. Other configurations of inlets though not explicitly described or depicted are compatible with the technology described herein.

**[0139]** FIG. 14 shows, in close up, an exemplary spacing of valves **702**, channels **704**, and vents **796**, in adjacent lanes **708** of a multi-sample microfluidic cartridge for example as shown in FIG. 13.

**[0140]** FIGS. 15 and 16 show close-ups of, respectively, heater arrays **804** compatible with, and inlets **902** on, the exemplary cartridge shown in FIG. 14.

**[0141]** FIGS. 17A and 17B show various views of an embodiment of a radially-configured highly-multiplexed cartridge, having a number of inlets **1002**, microfluidic lanes **1004**, valves **1005**, and PCR reaction chambers **1006**. FIG.