mm to about 10 mm), or a distinct location having a surface area of between about 1 mm^2 about 225 mm^2 (typically between about 1 mm^2 and about 100 mm^2, or in some embodiments between about 5 mm^2 and about 50 mm^2).

[0073] In various embodiments, the heat source can be situated in an assembly that is removable from the apparatus, for example, to permit cleaning or to replace the heater configuration.

[0074] In various embodiments, the apparatus can include a compliant layer at the contact heat source configured to thermally couple the contact heat source with at least a portion of a microfluidic cartridge received in the receiving bay. The compliant layer at can have a thickness of between about 0.05 and about 2 millimeters and a Shore hardness of between about 25 and about 100.

[0075] In various embodiments, the apparatus can further include one or more force members (not shown in FIG. **3**) configured to apply force to thermally couple the at least one heat source at least a portion of a microfluidic cartridge received in the receiving bay.

[0076] In various embodiments, the one or more force members are configured to apply force to a plurality of locations in the microfluidic cartridge. The force applied by the one or more force members can result in an average pressure at an interface between a portion of the receiving bay and a portion of the microfluidic cartridge of between about 5 kilopascals and about 50 kilopascals, for example, the average pressure can be at least about 7 kilopascals, and still more preferably at least about 14 kilopascals. At least one force member can be manually operated. At least one force member can be mechanically coupled to a lid at the receiving bay, whereby operation of the lid operates the force member. The application of force is important to ensure consistent thermal contact between the heater wafer and the PCR reactor and microvalves in the microfluidic cartridge.

[0077] In various embodiments, the apparatus can further include a lid at the receiving bay, the lid being operable to at least partially exclude ambient light from the receiving bay. The lid can be, for example, a sliding lid. The lid can include the optical detector. A major face of the lid at the optical detector or at the receiving bay can vary from planarity by less than about 100 micrometers, for example, less than about 25 micrometers. The lid can be configured to be removable from the apparatus. The lid can include a latching member that ensures that the lid is securely closed before amplification reactions are applied to the samples in the cartridge.

[0078] The processor is also configured to receive signals from and control a detector **999** configured to detect a polynucleotide in a sample in one or more of the individual sample lanes, separately or simultaneously. The processor thereby provides an indication of a diagnosis from the cartridge **994**. Diagnosis can be predicated on the presence or absence of a specific polynucleotide in a particular sample. The diagnosis can be transmitted to the output device **986** and/or the display **982**, as described hereinabove.

[0079] The detector can be, for example, an optical detector that includes a light source that selectively emits light in an absorption band of a fluorescent dye, and a light detector that selectively detects light in an emission band of the fluorescent dye, wherein the fluorescent dye corresponds to a fluorescent polynucleotide probe or a fragment thereof. Alternatively, for example, the optical detector can include a bandpass-filtered diode that selectively emits light in the absorption band of the fluorescent dye and a bandpass filtered photodiode that selectively detects light in the emission band of the fluorescent dye; or for example, the optical detector can be configured to independently detect a plurality of fluorescent dyes having different fluorescent emission spectra, wherein each fluorescent dye corresponds to a fluorescent polynucleotide probe or a fragment thereof; or for example, the optical detector can be configured to independently detect a plurality of fluorescent dyes at a plurality of different locations on a microfluidic cartridge, wherein each fluorescent dye corresponds to a fluorescent polynucleotide probe or a fragment thereof in a different sample.

[0080] A suitable processor **980** can be designed and manufactured according to, respectively, design principles and semiconductor processing methods known in the art.

[0081] The system in FIG. **3** is configured so that a cartridge with capacity to receive multiple samples can be acted upon by the system to analyze multiple samples—or subsets thereof—simultaneously, or to analyze the samples consecutively. It is also consistent that additional samples can be added to a cartridge, while previously added samples are being amplified and analyzed.

[0082] The system shown in outline in FIG. **3**, as with other exemplary embodiments described herein, is advantageous at least because it does not require locations within the system suitably configured for storage of reagents. Neither does the system, or other exemplary embodiments herein, require inlet or outlet ports that are configured to receive reagents from, e.g., externally stored containers such as bottles, canisters, or reservoirs. Therefore, the system in FIG. **3** is self-contained and operates in conjunction with a microfluidic cartridge, wherein the cartridge has locations within it configured to receive mixtures of sample and PCR reagents.

[0083] The system of FIG. **3** may be configured to carry out operation in a single location, such as a laboratory setting, or may be portable so that it can accompany, e.g., a physician, or other healthcare professional, who may visit patients at different locations. The system is typically provided with a power-cord so that it can accept AC power from a mains supply or generator. An optional transformer (not shown) built into the system, or situated externally between a power socket and the system, transforms AC input power into a DC output for use by the system. The system may also be configured to operate by using one or more batteries and therefore is also typically equipped with a battery recharging system, and various warning devices that alert a user if battery power is becoming too low to reliably initiate or complete a diagnostic analysis.

[0084] The system of FIG. **3** may further be configured, for multiplexed cartridge analysis. In one such configuration, multiple instances of a system, as outlined in FIG. **3**, are operated in conjunction with one another to accept and to process multiple cartridges, where each cartridge has been loaded with a different sample. Each component shown in FIG. **3** may therefore be present as many times as there are cartridges, though the various components may be configured in a common housing.

[0085] In still another configuration, a system is configured to accept and to process multiple cartridges, but one or more components in FIG. **3** is common to multiple cartridges. For example, a single device may be configured with multiple cartridge receiving bays, but a common processor and user interface suitably configured to permit concurrent, consecutive, or simultaneous, control of the various cartridges. In such an embodiment a single detector, for example, can scan