

number of components, complicates the temperature control scheme, and increases the risk of component failure.

[0004] Moreover, using an electrophoresis apparatus with multiple interconnected structures can be relatively complex. For example, attaching the separation medium (hereinafter referred to as "polymer") source to the capillary array can be complicated and runs the risk of introducing bubbles or other artifacts each time the array is detached and attached to the polymer source. Moreover, the user, rather than the manufacturer, generally must attach the buffer source to the array, and must do it multiple times through the life of the capillary array.

[0005] It is therefore desirable to provide a capillary electrophoresis apparatus with a reduced number of interconnected structures to reduce the number of necessary heating/temperature control zones, reduce user handling of the structures, reduce likelihood of component failure, reduce introduction of bubbles and other artifacts into the apparatus, and facilitate overall usage of the apparatus.

SUMMARY

[0006] In one aspect, a biological analysis device for performing capillary electrophoresis includes a voltage section configured to generate a voltage differential across a cathode connector and an anode connector, an optical detector system configured to detect light emission from a sample, and a cartridge holding portion configured to receive at least a portion of a removable cartridge, the cartridge comprising one or more capillaries and a separation medium container. The biological analysis device further includes an actuation section comprising one or more actuators configured to actuate

components of the removable cartridge when the removable cartridge is received in the cartridge holding portion, a temperature regulation section configured to maintain the one or more capillaries at a temperature higher than ambient temperature; and a refrigeration section configured to refrigerate a separation medium stored in the separation medium container at a temperature lower than ambient temperature. The actuation section further includes alignment features configured to interface with complementary alignment features of a fluidics section of the removable cartridge. The one or more actuators are configured to actuate one or more fluid control devices of the removable cartridge.

[0007] There is also disclosed a replaceable cartridge for a biological analysis device that includes a fluid delivery manifold and one or more capillaries each having a first end and a second end, the first end being fluidically coupled with the fluid delivery manifold. A buffer reservoir is fluidically coupled with the fluid delivery manifold, and an electrophoresis separation medium container is fluidically coupled with the fluid delivery manifold. A fluid transfer device is configured to transfer the separation medium from the separation medium storage container through the fluid delivery manifold into the one or more capillaries.

[0008] In another aspect, a method for performing capillary electrophoresis using a biological analysis device comprises inserting a removable cartridge comprising one or more capillaries in the biological analysis device, interfacing alignment features of an actuation section of the biological analysis device with complementary alignment features of a fluidics section of the removable cartridge, actuating a fluid transfer device of the fluidics section of the removable cartridge using an actuator of the actuation section of the biological analysis device, the actuating the fluid transfer device causing a separation medium to be transferred from a separation medium storage container of the removable

cartridge into the one or more capillaries, actuating a buffer valve of the fluidics section of the removable cartridge using an actuator of the actuation section of the biological analysis device, the actuating the buffer valve causing ends of the capillaries to be exposed to an electrically conductive buffer, maintaining the one or more capillaries at a temperature higher than ambient temperature using a temperature regulation section of the biological analysis device, and refrigerating the separation medium stored in the separation medium storage container at a temperature lower than ambient temperature using a refrigeration section of the biological analysis device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a schematic representation of a biological analysis device according to an exemplary embodiment of the disclosure.

WHAT IS CLAIMED IS:

1. A biological analysis device for performing capillary electrophoresis, comprising:

a voltage section configured to generate a voltage differential across a cathode connector and an anode connector;

an optical detector system configured to detect light emission from a sample;

a cartridge holding portion configured to receive at least a portion of a removable cartridge, the cartridge comprising one or more capillaries and a separation medium container;

an actuation section comprising one or more actuators configured to actuate components of the removable cartridge when the removable cartridge is received in the cartridge holding portion, the actuation section further comprising alignment features configured to interface with complementary alignment features of a fluidics section of the removable cartridge;

a temperature regulation section configured to maintain the one or more capillaries at a temperature higher than ambient temperature; and

a refrigeration section configured to refrigerate a separation medium stored in the separation medium container at a temperature lower than ambient temperature.

wherein the one or more actuators are configured to actuate one or more fluid control devices of the removable cartridge.

~~2. The biological analysis device of claim 1, wherein the one or more actuators are configured to actuate one or more fluid control devices of the removable cartridge.~~

3.2. The biological analysis device of claim 1, further comprising a controller programmed to control actuation of the one or more actuators.

4.3. The biological analysis device of claim 1, wherein the cartridge holding portion comprises a cartridge alignment structure configured to engage with a feature of the cartridge to position the cartridge in a predetermined alignment with components of the biological analysis device.

5.4. The biological analysis device of claim 4.3, wherein the cartridge alignment structure is configured to align the cartridge with respect to the optical detector system.

6.5. The biological analysis device of claim 4.3, wherein the cartridge alignment structure is configured to move the cartridge from a first position to a second position within the biological analysis device.

7.6. The biological analysis device of claim 1, wherein the temperature regulation section comprises a heating element and an air movement element.

8.7. The biological analysis device of claim 76, wherein the temperature regulation section comprises a plurality of ports configured to correspond to a plurality of ports in the removable cartridge.

9.8. A method for performing capillary electrophoresis using a biological analysis device, comprising:

inserting a removable cartridge comprising one or more capillaries in the biological analysis device;

interfacing alignment features of an actuation section of the biological analysis device with complementary alignment features of a fluidics section of the removable cartridge;

actuating a fluid transfer device of the fluidics section of the removable cartridge using an actuator the actuation section of the biological analysis device, the actuating the fluid transfer device causing a separation medium to be transferred from a separation medium storage container of the removable cartridge into the one or more capillaries;

actuating a buffer valve of the fluidics section of the removable cartridge using an actuator of the actuation section of the biological analysis device, the actuating the buffer valve causing ends of the capillaries to be exposed to an electrically conductive buffer;

maintaining the one or more capillaries at a temperature higher than ambient temperature using a temperature regulation section of the biological analysis device;
and

refrigerating the separation medium stored in the separation medium storage container at a temperature lower than ambient temperature using a refrigeration section of the biological analysis device.

~~10.9.~~ The method of claim 98, further comprising actuating a separation medium valve actuator to close a separation medium valve between the one or more capillaries and the separation medium storage container before the actuating the fluid transfer device.

~~11.10.~~ The method of claim 98, further comprising applying a voltage differential between an anode and a cathode of the biological analysis device, the anode being electrically coupled with a first end of the one or more capillaries and the cathode being electrically coupled with a second end of the one or more capillaries.

~~12.11.~~ The method of claim 98, further comprising detecting an analyte within the one or more capillaries with an optical detector of the biological analysis device.