Systems and Methods for Biological Analysis

CROSS-REFERNCE TO RELATED APPLICATIONS

~~[0001]~~ This application claims the benefit of priority of U.S. provisional application Serial No. 61/541,366, filed September 30, 201 1, which is incorporated herein by reference in its entirety.

Background of the Invention

Field of the Invention

The present invention relates generally to systems, devices, and methods for observing, testing, and/or analyzing one or more biological samples, and more specifically to systems, devices, and methods for observing, testing, and/or analyzing an array of biological samples.

Description of the Related Art

Optical systems for biological and biochemical reactions have been used to monitor, measure, and/or analyze such reactions in real time. Such systems are commonly used in sequencing, genotyping, polymerase chain reaction (PCR), and other biochemical reactions to monitor the progress and provide quantitative data. For example, an optical excitation beam may be used in real-time PCR (qPCR) reactions to illuminate hybridization probes or molecular beacons to provide fluorescent signals indicative of the amount of a target gene or other nucleotide sequence. Increasing demands to provide greater numbers of reactions per test or experiment have resulted in instruments that are able to conduct ever higher numbers of reactions simultaneously.

The increase in the number sample sites in a test or experiment has led to microtiter plates and other sample formats that provide ever smaller sample volumes. In addition, techniques such as digital PCR (dPCR) have increased the demand for smaller sample volumes that contain either zero or one target nucleotide sequence in all or the majority of a large number of test samples. There is a need for systems and sample format that will provide reliable data in a high-density sample format.

Summary:

According to a first aspect of the present invention, there is provided a case for containing a plurality of biological samples, the case comprising:

a base;

a substrate attached to the base, the substrate comprising a plurality of reaction regions configured to receive one or more biological samples; and

a cover comprising an inner surface, the cover configured to be attached to the base such that the base and cover together provide a cavity containing the substrate; and

wherein the inner surface includes a central area and a recessed area disposed about the central area, the central area configured to cover the reaction regions, the recessed area being offset from the central area in a direction normal to the inner surface.

According to a second aspect of the present invention, there is provided an instrument for biological analysis, comprising:

a base configured to receive a sample carrier as defined in the first aspect;

an electromagnetic radiation source configured to produce one or more excitation beams;

an excitation optical system configured to direct the one or more excitation beams to the biological samples;

an optical sensor configured to receive an emission from the biological samples in response to the one or more excitation beams;

an emission optical system configured to direct the emission from at least some of the biological samples to the optical sensor;

According to third aspect of the present invention, there is provided a method comprising:

providing a base and a substrate comprising a plurality of reaction regions, wherein the substrate is attached to the base;

loading one or more biological samples into at least some of the reaction regions;

enclosing substrate within a cavity by locating a cover over base;

filling the cavity with a fluid via the fill port;

providing a plug assembly comprising a plug and a plug driver;

attaching the plug assembly to the fill port by applying a first force or torque; and

applying a second force or torque to fracture plug assembly and detach the plug driver from plug.

According to a fourth aspect of the present invention, there is provided a case for containing a plurality of biological samples, the case comprising:

a base comprising a fill port;

a substrate attached to the base, the substrate comprising a plurality of reaction regions configured to receive one or more biological samples; and

a plug assembly comprising a plug and a plug driver, the plug assembly configured to close the fill port during use;

wherein the plug assembly is configured to close the fill port using a first force or torque and to separate the plug driver from the plug using a second force or torque that is higher than the first force and/or that is in a different direction than the first force or torque.

Brief Description of the Drawings

Embodiments of the present invention may be better understood from the following detailed description when read in conjunction with the accompanying drawings. Such embodiments, which are for illustrative purposes only, depict novel and non-obvious aspects of the invention. The drawings include the following figures: