SYSTEM AND METHOD FOR RAPID MULTIPLEXED SAMPLE PROCESSING WITH APPLICATIONS FOR NUCLEIC ACID AMPLIFICATION ASSAYS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application number 63/093,727 filed on 19-0CT-2020, which is incorporated in its entirety herein by this reference.

TECHNICAL FIELD

[0002] This invention relates generally to the sample processing field, and more specifically to new and useful systems and methods for rapid and multiplexed sample processing, with applications in characterizing in performing nucleic acid amplification assays.

BACKGROUND

[0003] Detecting and characterizing targets from biological samples is relevant to many fields. However, sample processing involving partitioned sample volumes is typically time consuming, workflow-intensive, manual, and subject to cost constraints, motivating development of new technologies to address these and other deficiencies.

[0004] In particular, in the context of polymerase chain reaction (PCR) processes involving partitioned volumes (e.g., for digital PCR, for qPCR, etc.), partitioning of samples in an efficient manner that is not cost prohibitive, while increasing dynamic range of detection and multiplexing capability, is of interest. Current partitioning devices and systems, however, are typically expensive, require large device footprints, are limited in dynamic range, are limited in ability to perform multiplexed analysis, and require long processing times to produce results.

SUMMARY

[0004a] In one aspect, the present disclosure refers to a system for target detection, the system comprising:

a base substrate; and

an array of sample processing regions defined at a broad surface of the base substrate, wherein each of the array of sample processing regions comprises:

a set of microwell subarrays arranged in a gradient by volumetric capacity between an upstream end and a downstream end of each respective sample processing region, and

a boundary separating each respective sample processing region from adjacent sample processing regions,

wherein the system comprises an operation mode in which, upon distribution of a sample across the set of microwell subarrays and processing of the sample within the set of microwell subarrays in parallel, preliminary representative results are produced from averaged signals of a microwell subarray of the set of microwell subarrays.

[0004b] In another aspect, the present disclosure refers to a method for target detection, the method comprising:

transmitting a set of samples, comprising one or more targets, to an array of sample processing regions of a substrate, wherein each of the set of sample processing regions includes: a set of microwell subarrays arranged in a gradient by volumetric capacity between an upstream end and a downstream end of each respective sample processing region, and wherein transmitting comprises automatically distributing the set of samples across the gradients of the set of sample processing regions in parallel; applying a cover layer to the microwell assembly; transitioning the microwell assembly into alignment between a heating body and an imaging subsystem; biasing the heating body against the microwell assembly, thereby pressing the cover layer against the set of sample processing regions and isolating partitions of the samples at the sample processing regions; processing the set of samples with the heating body at the set of sample processing region in parallel, in coordination with target detection by the imaging subsystem; and for each of the set of samples, returning preliminary representative results produced from averaged signals of a respective microwell subarray of the set of microwell subarrays, wherein said preliminary representative results characterize aspects of target material of the set of samples.

BRIEF DESCRIPTION OF THE FIGURES

[0005] FIGURES IA-IB depict schematic representations of embodiments of a microwell assembly for target detection and sample processing;