Meta Title: Digital Microfluidic Methods for SARS-CoV-2RT-PCR Testing

Meta Description: Read on to discover how digital microfluidic methods can help labs become more efficient at SARS-CoV-2 RT-PCR Testing.

Keywords: Digital Microfluidic, COVID-19 testing

Making SARS-CoV-2 RT-PCR Testing More Effective through Digital Microfluidics

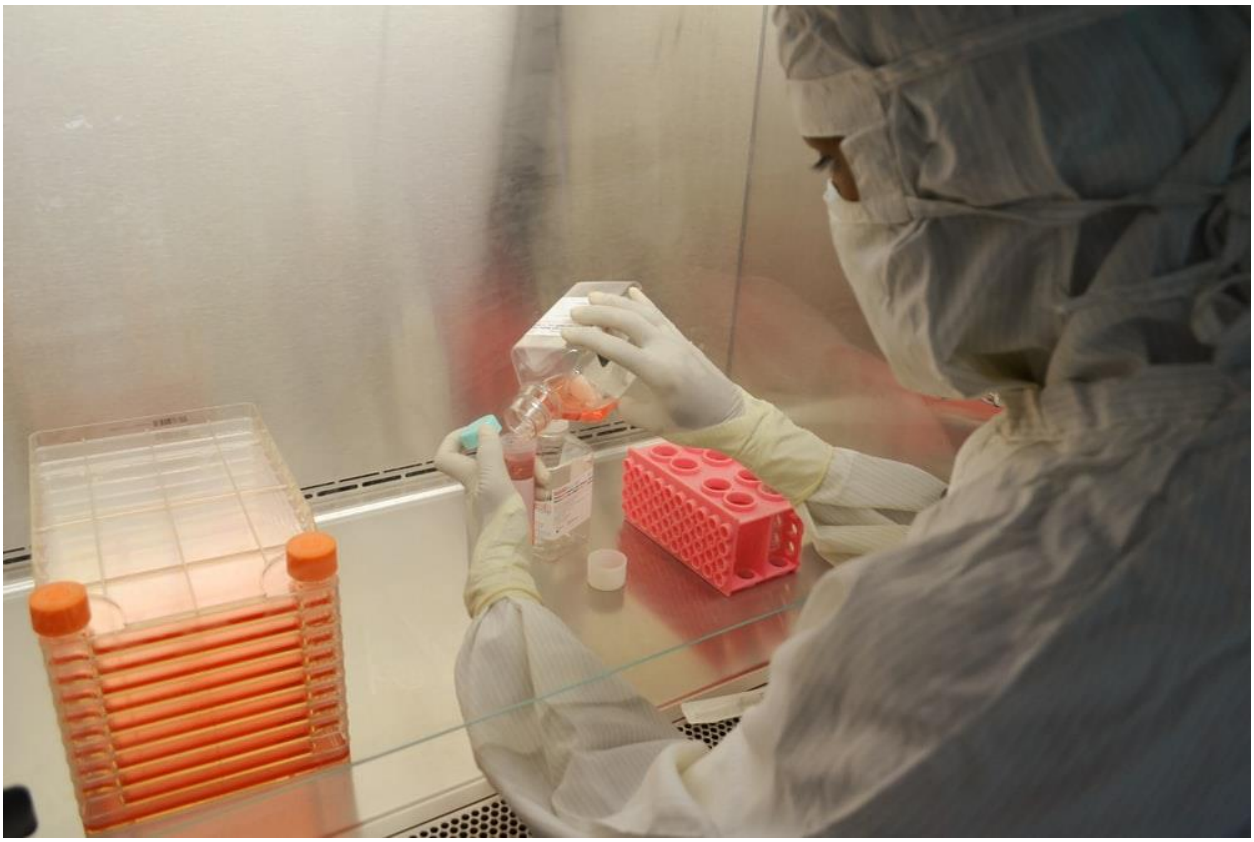

Image text: COVID-19 testing

Alt-text: Digital Microfluidic methods for COVID-19 testing

Image description: A woman working at the laboratory

While the latest news regarding the development of the COVID-19 vaccine seems quite promising, our efforts to improve the testing models must continue.

The latest approach to COVID-19 testing relies on Polymerase Chain Reaction (PCR) and Real-Time Polymerase Chain Reaction (RT-PCR). The Centers for Disease Control and Prevention consider RT-PCR a

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confirmatory coronavirus test, so it is more of a method of choice. This testing method is accredited worldwide as a gold standard for the identification of SARS-CoV2.

One of the latest progress in this department has been the use of a digital microfluidic platform. Baebies has been using this technology for some time for newborn screening in many state departments of health. This article will discuss how this platform can increase the efficiency of COVID-19 testing.

PCR has been used as a standard technique for amplifying DNA traces in the diagnostic, forensic, and biological research fields for a long time. Modern-day scientists have long been interested in utilizing microfabrication and microfluidic techniques for the miniaturization and increased speed of PCR systems.

This article will talk about the Baebies FINDER 1.5 platform, which is designed for RT-PCR involving multiple digital signals.

Electrowetting for the Manipulation of Discrete Liquid Droplets

Electrowetting is known to be a convenient technique for the manipulation of droplets of water as well as human physiological fluids. Generally, an electrowetting device has a top and bottom plate with electrodes, in between which the droplets are sandwiched.

The plates' interior features a coating of a hydrophobic material and a non-conductive fluid that fills the space in between. This fluid supports the transport of droplets across the surfaces of the chip, ensuring that they don't evaporate.

When an electrode is activated, we see a reduction in the tension between the surface and droplets. As a result, the droplet feels wetter on the hydrophobic surface. If we apply a voltage to an electrode close to the droplet, an energy gradient is created on the surface and the droplet quickly aligns itself with the energized electrode.

By repeating the process while switching voltages, a series of microfluidic operations can be created for independent droplet manipulation. This approach is known as digital microfluidics. It lends itself to the precise execution of many required or desired test steps, such as washing, movement, mixing, etc.

Introducing Baebies FINDER 1.5: A Digital Microfluidic Platform for RT-PCR

The Baebies FINDER 1.5 platform uses the electrowetting technique for DNA amplification. The method also involves cyclically shuttling individual droplets between fixed temperature zones. The single-use, disposable cartridge completes the system.

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System Details

This system features an instrument about the size of a toaster with no need for pumps, tubes, or valves due to a self-contained disposable cartridge, where sample processing and PCR occur.

Upon inserting the cartridge into the instrument deck amidst magnets and heaters, electrical interface-based communication takes place.

Microfluidic Control

An electrical controller is used to enable microfluidic control on the cartridge. The controller has a microprocessor and a switch to deliver different electrowetting voltages to different channels. The microprocessor is used for storing and executing programs and for operating detectors and heaters in the system. Connector pins are aligned with the copper contact pads on the cartridge to create the instrument-cartridge electrical interface.

Detection of RT-PCR

A customized miniature fluorimeter module is used for optical detection of RT-PCR. This module has four independent channels. Each channel contains:

- A photodiode
- A light-emitting diode
- A FITC filter set
- A dichroic mirror

The module lies directly above the cartridge deck facing the cartridge's extension area. The peak wavelength of 475 nm produces an illumination spot focused on the chip's detection electrodes. All background signals are rejected by a lock-in amplifier.

Digital Microfluidic Process

Before PCR, a filler fluid is poured into the cartridge such that there is no bubble formation during the process. Samples and reagents then enter the cartridge and are stored in the cartridge reservoirs.

The droplets are then divided by switching electrodes. For a typical chain reaction, an individual droplet of the DNA sample and one of the PCR mix are mixed together. The resulting droplet is then thermocycled between two temperature zones.

At the end of the process, the droplet is taken to the detection electrode, where its fluorescence is measured.

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PCR Performance

The multi-channel PCR system seems promising for the detection of DNA traces. The resulting amplified products are of the expected length. Moreover, there are no traces of by-products. The PCR amplification is deemed highly reproducible.

From all of this information, it can be deduced that a digital microfluidic platform can be used to optimize RT-PCR.

Another important thing is that the microfluidic platform can perform sample concentration and solution exchange using magnetic beads to detect the DNA of pathogens in realistic clinical specimens.

The bottom line is that digital microfluidics is a flexible approach that allows us to change the parameters in real-time, unlike most other formats.

Baebies Embraces the Revolutionary Digital Microfluidic Platform for COVID-19 Testing

At Baebies, we are committed to utilizing the latest technology and innovative healthcare approaches to save and improve lives. We hold over 300 patents for Digital Microfluidics. We were named the winner of the 2020 AACC Clinical Lab Expo and were given the Disruptive Technology Award for this technology.

We take pride in using our digital microfluidic platform to enhance the reliability and effectiveness of the RT-PCR SARS-CoV-2 test. Our technology allows efficient RT-PCR testing, providing results in less than 17 minutes on a platform the size of a toaster with no fluid requirements, maintenance, or waste collection.

Baebies invites healthcare laboratories to leverage the power of digital microfluidic methods to become more effective in their testing and diagnosis. By embracing the new technology, we can do more with less and obtain the COVID-19 testing results faster than usual!

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