

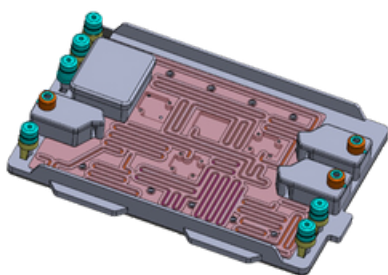
Revolutionary Microfluidic Platform for NGS Sample Prep

Summary

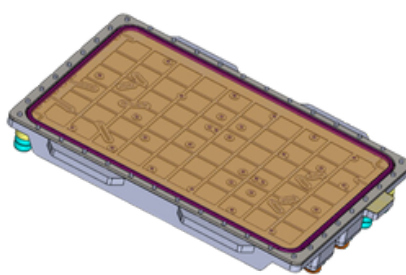
A biotech startup customer specializing in hands-free sample-to-answer solutions that automate and miniaturize genomic protocols, approached Gener8 for the development of a novel disposable, low-cost, digital microfluidic electrowetting on diode (EWOD) platform for molecular sample prep protocols. The platform automates sample preparation protocols used for NGS library prep, synthetic biology, cell editing, and combinatorial chemistry.

Methods Employed

A considerable amount of CAD work and volume calculations were performed before arriving at the final design. The membrane was stretch over the rib of polycarbonate and an adhesive layer of PSA and then heat staked to the cartridge to provide tension. The channels were sealed using laser. The chambers were sealed using sonic welding. A total of nine pneumatic connections were designed on the manifold that were used to move fluid. COC was selected for the cartridge due to its inherent hydrophobic nature. The cartridge was connected to the manifold using elastomer gaskets which were compressed to form a seal. A custom motorized pipette was designed to provide precise volumetric fluid control via a bank of solenoid valves on the manifold.



Top view of cartridge shows pneumatic interface ports, reagent storage wells, a waste chamber, and serpentine channels capped with a laser welded film designed to stage certain volumes of fluids with little to no loss



Bottom view of the cartridges shows the EWOD space enclosed by a tensioned film, entry and exit vias to the EWOD space, and an electrode contact tab to the right.

At A Glance

Customer

Biotech company

Product

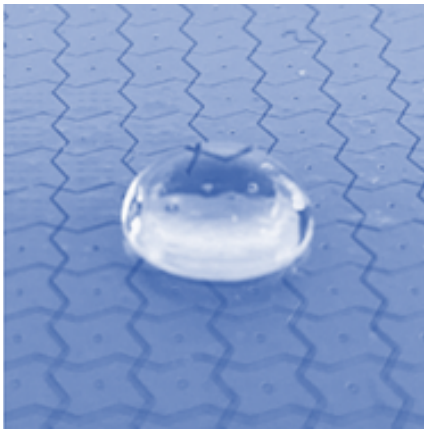
Microfluidic Platform for NGS Sample Prep

Services/ Market

Healthcare, Life Sciences

Challenge

The biggest challenge was in the design layout of the cartridge. For example, certain areas of the cartridge were designated for a variety of reactions or for mixing of different reagents with the samples. The cartridge was responsible for delivering a certain volume of a reaction in a defined location over a complex electro-array for thermal cycling, for performing a variety of reactions or for mixing of different reagents with the samples. Channels had to accommodate sufficient volume in order to meter the reagents. On cartridge storage was also included in the design. Waste was to be stored on cartridge. In order to reuse the EWOD, it had to be protected by a very thin, hydrophobic membrane, maintained under tension. To move fluids around, pneumatic connections had to be designed on a manifold that would interface with the cartridge.

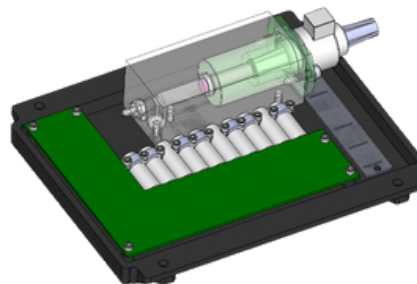


The customer's electrowetting technology utilizes electromechanical forces to move fluids across a surface of patterned electrodes, allowing a full range of processes including dispensing reagents, merging or splitting droplets, mixing gently or vigorously, isothermal and thermocycle control, and magnetic control.

This technology is distinct from microchannel-based fluidics as it enables precise control of reagents without the need for complex channels, microvalves, or pumps.



The bottom of the manifold contains pneumatic interfaces to the cartridge and a laser welded top plate to complete the air channels.



The manifold consists of a custom designed motorized pipette and a bank of valves for fluidic control.

Solution

Gener8 met the customer's requirements in designing and developing a simple, easy to use, cartridge enabling walkaway automation of a complex NGS library prep cartridge which delivered precise volumes of reagents and accommodated multiple sample prep protocols, including those for target enrichment, on-demand sample processing, and long read sequencing.

Expertise Employed

- Microfluidics design and testing
- Injection molding & design for manufacture
- Laser welding
- Sonic welding
- Over-molding
- Heat staking
- Project Management



Image of the commercially available cartridge