Microfluidic cells and micropumps for quartz crystal microbalance applications

As member of the EU project consortium **CATCH-U-DNA** (https://catch-u-dna.com), JOBST TECHNOLOGIES developed advanced microfluidics cells in combination with micropumps for quartz crystal microbalance applications.

The aim of the EU project is to catch and detect free cancer DNA in the bloodstream of patients (circulating-tumor DNA). For early diagnosis and treatment, a quantitative detection is important for the patients. The available techniques to detect such DNA in human samples are still expensive and involve laborious multi-step methods. Therefore, the project consortium developed a new detection approach based on an acoustic technique employing a quartz crystal microbalance (QCM-D) device. In this innovative method, we monitor changes in the acoustic energy and correlate them to the presence of “soft” nanoparticles. The developed acoustic biochip array, incorporating 24 QCM-sensors, is combined with highly specific amplification of the target DNA.

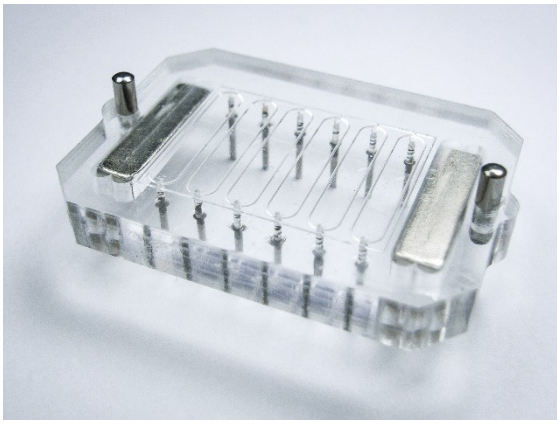

Figure 1: The developed flow cell

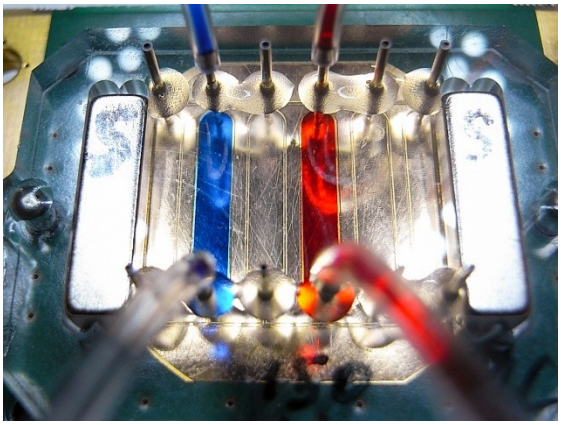

Figure 2: The call in action – two of the six crystal areas are fed with colored liquid.

Within the developed concept, amplified double stranded DNA carrying a cancer-specific mutation[1] was immobilized to the device surface followed by addition of liposomes. The latter can bind to previously specially modified DNA parts. The liposomes act as significant acoustic-signal enhancers due to their “soft” highly dissipative spherical shape.[2] The combined amplification of the DNA target with the acoustic detection is demonstrated to be able to detect down to one single copy of the DNA target in the initial sample.

To deliver the fluids to the crystal surface, Jobst developed a multi-channel flow cell that is pressed directly at the crystal. Multiple of the Jobst CPP1 micropumps (https://tinyurl.com/CPP1-PressRelease) are connected to the flow cells to deliver the analyte stream.

The developed cell consists of a stiff polymer plate with customized silicone micro-seals creating a well-defined surface area of the crystal.
In the depicted cell six crystal areas (channels) can either be accessed in a parallel or serial manner. Rapid prototyping options allow for other seal layouts on the crystals surface demanded by different sensing application To keep a constant and defined sealing pressure between the crystal and the flow cell two magnets deliver constant clamping forces. This method has the advantage that the ac-

[1] *BRAF* V600E

[2] https://doi.org/10.1021/acs.analchem.0c00366 and https://doi.org/10.1103/PhysRevApplied.13.064059

tuation of the crystal is not interfered the flow cells can later easily be removed and cleaned to be reused for the next measurement.
The feature of addressing every cell channel separately is provided by the low footprint area of the CPP1 micropumps. The pumps can directly be connected to the fluidics system making it possible to pump a low analyte volume of only 30 ul directly through the cell. Our CCP1 micropumps are available for different pump rate ranges and can easily be integrated in custom microfluidics circuits.

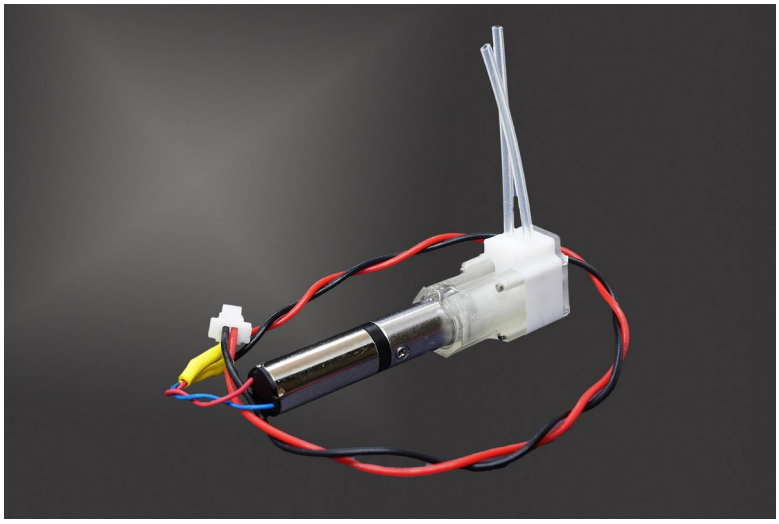

Figure 3: CPP1-180-ZM micropump, designed for pump rates from 150 nl/min – 180 ul/min.

As an expert in developing and manufacturing of custom microfluidic solutions, Jobst Technologies is a reliable partner for your custom microfluidic systems and pumping solution.

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