Microfluidics InnovationHub

NGM Open Call Reference Case

MICROFLUIDICS-ENHANCED CIRCULATING TUMOR CELL (CTC) SEPARATION TOWARDS LIQUID BIOPSY CANCER DIAGNOSTICS

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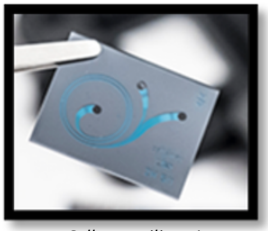
Cellsway

OVERVIEW

The current standard of cancer care is driven by the analysis of tumor cells obtained via solid tissue biopsy. The major limitation of this method is that it is an invasive procedure with limited repeatability. Cellsway, a deep-tech start-up, offers a non-invasive and repeatable alternative to solid tissue biopsy with its liquid biopsy platform, enabling the enrichment of circulating tumor cells (CTCs) from the blood of cancer patients for effective cancer monitoring and therapy guidance.

The platform comprises an IP-protected microfluidic disposable chip coupled with a benchtop instrument to process the blood sample for CTCs isolation, and a portfolio of downstream assays for CTCs identification and characterization. This approach has great potential in improving cancer diagnostics as liquid biopsy enables frequent monitoring of the patient, and molecular analyses of CTCs enable clinicians to gather real-time information about the cancer of the patient and make personalised therapy decisions and thus improve patient outcomes.



Cellsway silicon/ glass microfluidic chip

Starting Point Cellsway

- Disposable microfluidic chip: Cellsway currently manufactures their chip using silicon etching and glass bonding. Channel surface modification is performed by the user during chip operation.
- Chip Mounting: The chip is mounted to the instrument through a 3D-printed interface

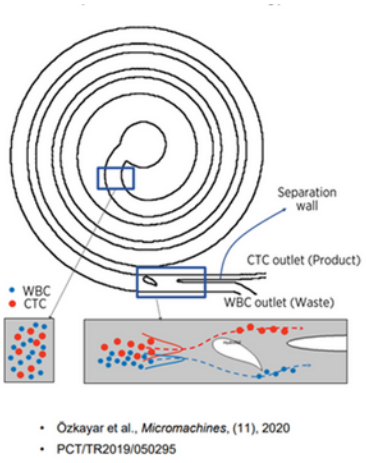
Cellsway chip mounting interface within the benchtop control instrument

Inquiries to MIH

- Manufacture transfer of disposable microfluidic chip:
  - From silicon etching to high-volume, low-cost, polymer-based manufacture.
  - Integration of surface modification into manufacture process to facilitate user operation.
  - Supply of individually packaged chips under ISO13485 compliance
- Re-design, optimisation, and manufacture of chip mounting interface

WORKING PRINCIPLE

Cellsway's patented core technology lies in the microfluidic structures that allow for highly efficient CTC separation and enrichment. This comprises a spiral microfluidic channel embedded with a hydrofoil structure downstream. The spiral channel spatially distribute cells based on size, with the hydrofoil structures further increasing the distance between the CTC and white blood cell (WBC) populations, thereby improving the separation resolution. This method not only ensures high separation efficiency, but also preserves cell viability allowing for functional downstream analyses of enriched CTC solutions.



- Özkayar et al., *Micromachines*, (11), 2020
- PCT/TR2019/050295

Label free
(epitope independent)

High throughput
(<20 min/7.5 ml blood)

High CTC recovery
(60-83%)

Preserved cell viability
(upto 100%)

Simple operation
(<10 min hands-on)

Small footprint
(40x30x30 cm)

PROJECT

Scope:

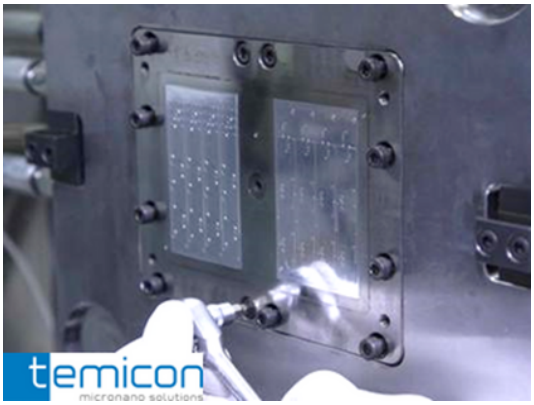
- Budget: 99,589€
- Funding Rate: 85%
- Duration: 12 months
- NGM Partners: Micronit b.v., Temicon GmbH, Ibidi GmbH

TECHNICAL IMPLEMENTATION

Summary

NGM partners have come together to develop the manufacture of Cellsway's disposable microfluidic chip using insert injection moulding, towards production ramp-up and achieving competitive cost-per-chip. This involves the mastering of challenging microstructures, as well as implementing a hydrophilic and anti-biofouling channel surface coating strategy that can be applied prior to bonding to ensure efficient batch production. Furthermore, the microfluidic chip mounting interface used to interface the chip with Cellsway's benchtop device is being redesigned towards robust manufacture and user-friendly device operation.

The customer benefits from maintaining the performance of their silicon-based chips whilst enjoying the volume and cost benefits of polymer-based manufacture, as well as product improvements such as the implementation of a durable surface coating and a user-oriented redesign of the chip mounting interface.



Insert injection moulding employed for high-volume and low-cost microfluidic chip manufacture.

Implementation

Materials:

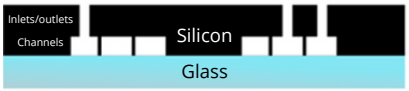
- PMMA

Manufacture method:

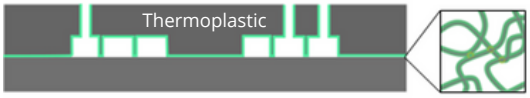
- Injection-moulding

Requirements:

- Maintenance of high-performance CTC separation
- High-volume / low-cost manufacture
- Implementation of scalable surface modification compatible with bonding methods

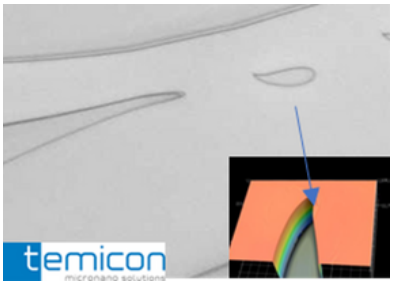


Surface modifications performed by user via flow-through prior to device operation

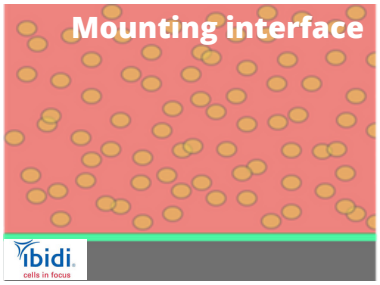


"Coat and bond" Simultaneous surface modification and bonding

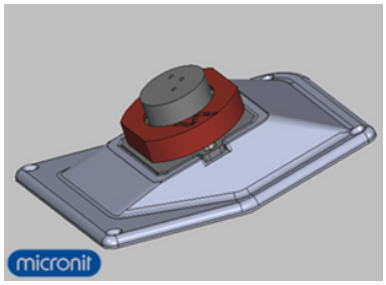
Features/ Benefits



Proprietary mastering techniques for the injection moulding of the microfluidic chip ensures high quality chip replication of critical features with low structure dimension variability and low channel draft angles.

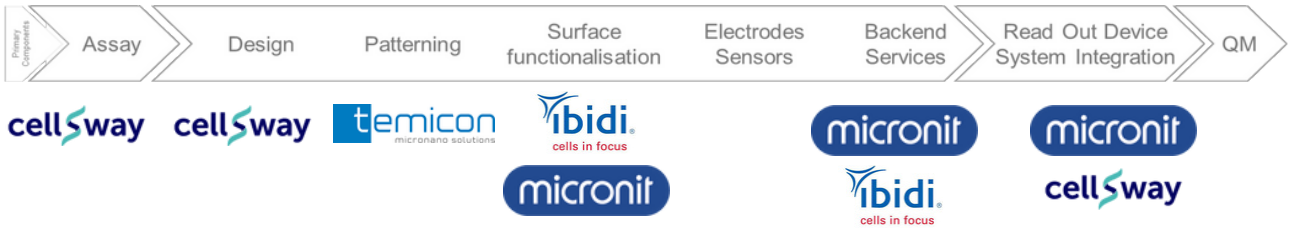


Proprietary surface modification techniques are used to achieve long-lasting hydrophilic and anti-biofouling channel coatings.



Redesign, optimisation, and manufacture of chip mounting interface towards facile and robust operation.

Value Chain



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