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Microfluidic cartridge for liquid biopsy from whole blood with embedded reagents

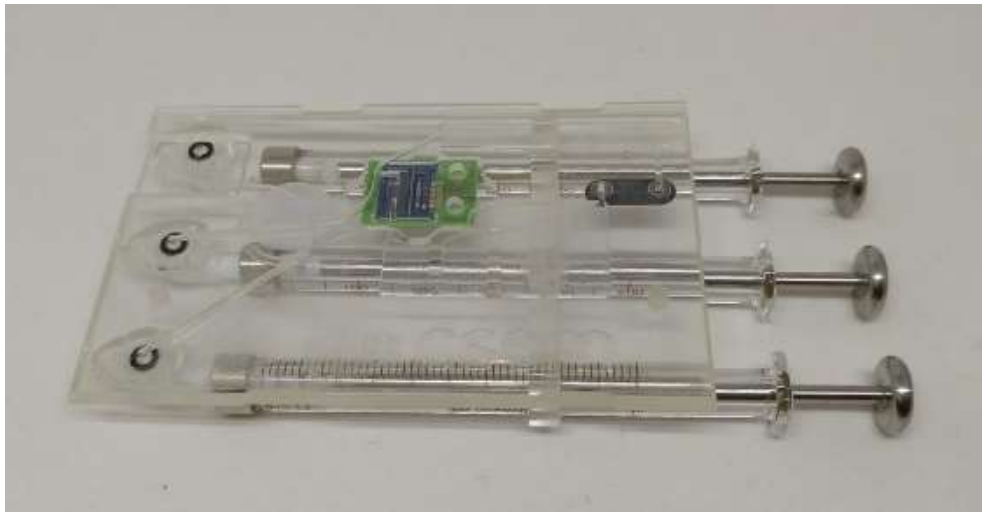
T. Volden, S. Berchtold, S. Graf, V. Revol

Tools and Instruments for Life Sciences

CSEM SA, Switzerland

Outline

- Overview and motivation
- Process requirements
- Cartridge design
- Video of prototype



Motivation & overview of technical solution

- Personalized medicine -> companion diagnostics
- Monitoring of cancer treatment

BIOCDx

- Biomarker detection from blood sample
- Biophotonic sensor platform (Mach-Zehnder interferometer)
- Compact instrument with disposable cartridge

- Developed in “BIOCDx” EU project (H2020-ICT-2016-1)
  http://biocdx.eu/

European Commission

HORIZON 2020

Esterline CMC Medical

LIONIX INTERNATIONAL

future diagnostics

surfix

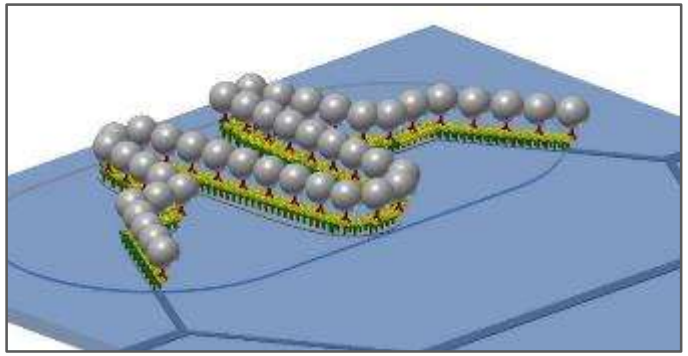
National Technical University of Athens

BRFAA

LEAD PHARMA

Implementing bioassay in microfluidic device

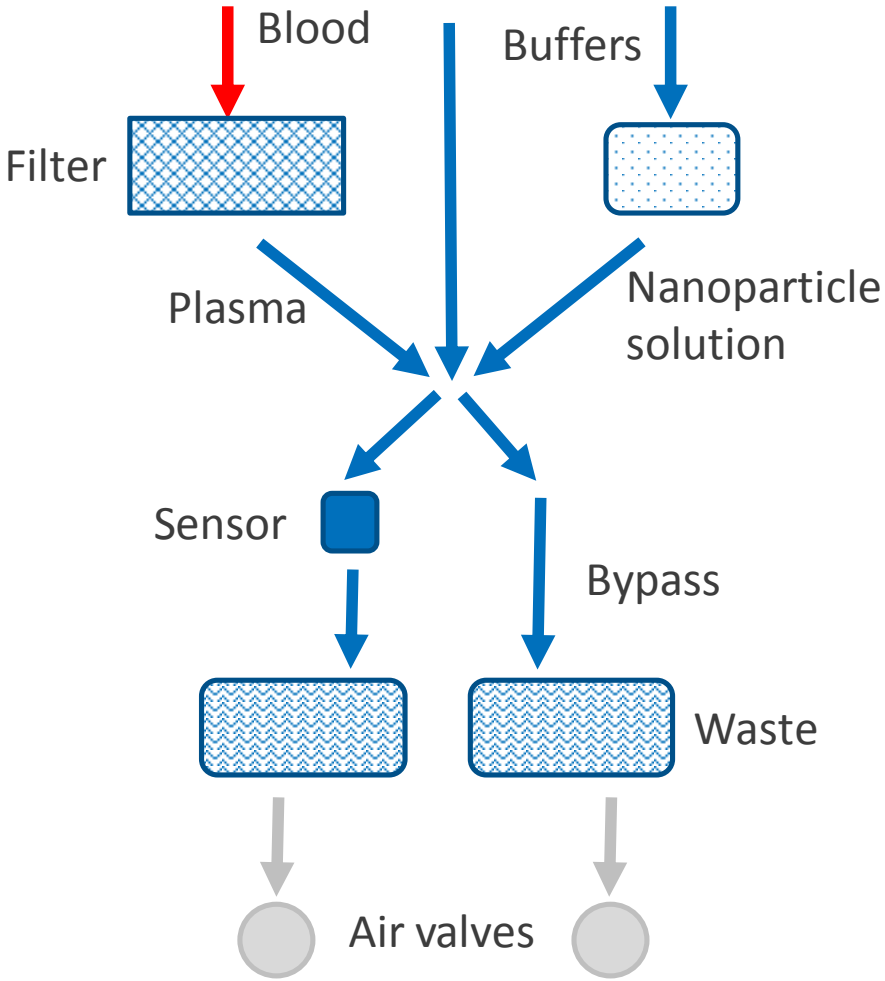
- From laboratory protocol to automated microfluidic workflow
  - Sandwich immunoassay
  - Amplification through nanoparticles
  - Blood sample preparation
- Challenges
  - Blood filtering and plasma volumes
  - Diffusion, bubbles
  - Contamination



Cartridge main functions

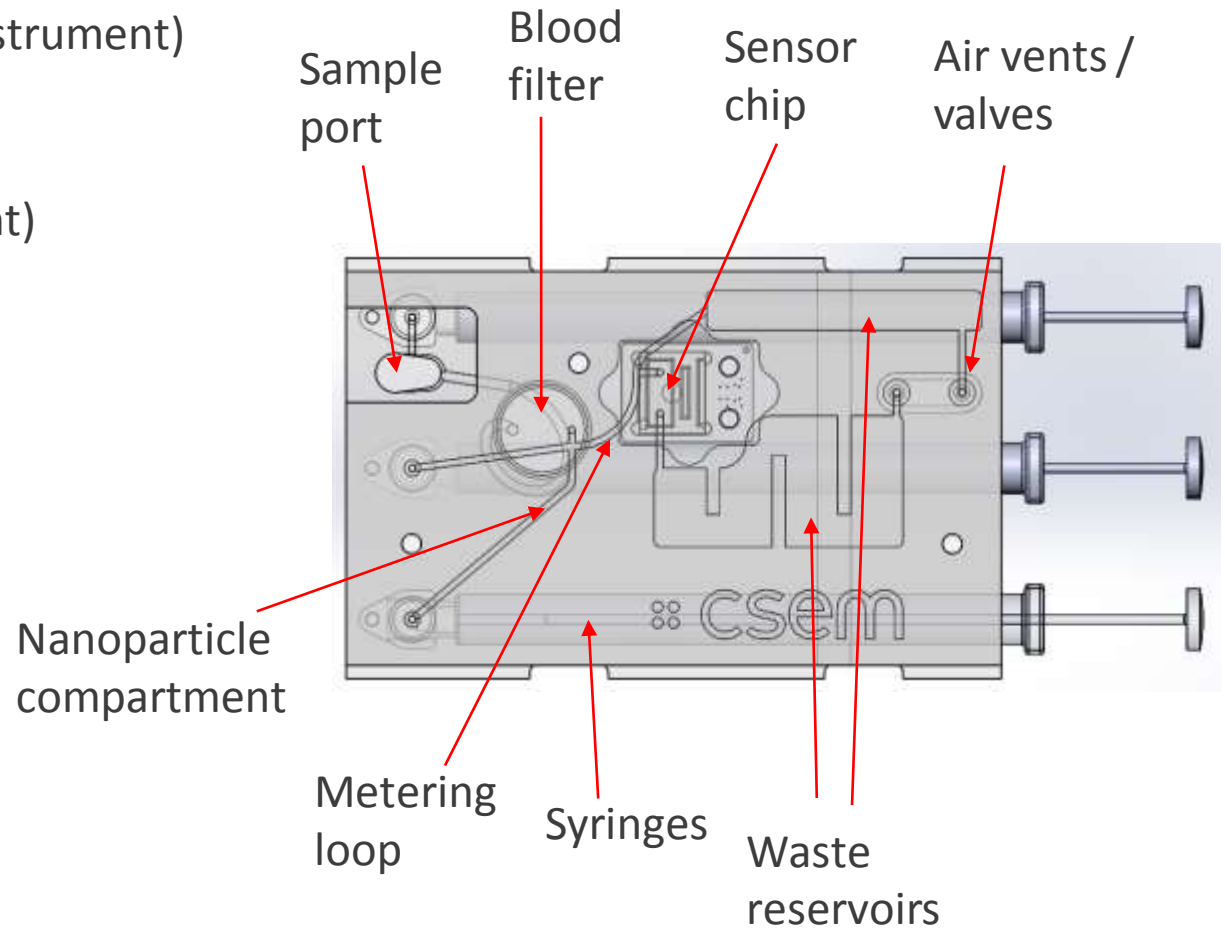
- Blood plasma extraction through polymer filter membrane
- Nanoparticle dissolution
- Priming / washing of sensor channels

- -> Multiplexing of three flows into sensor and bypass channel



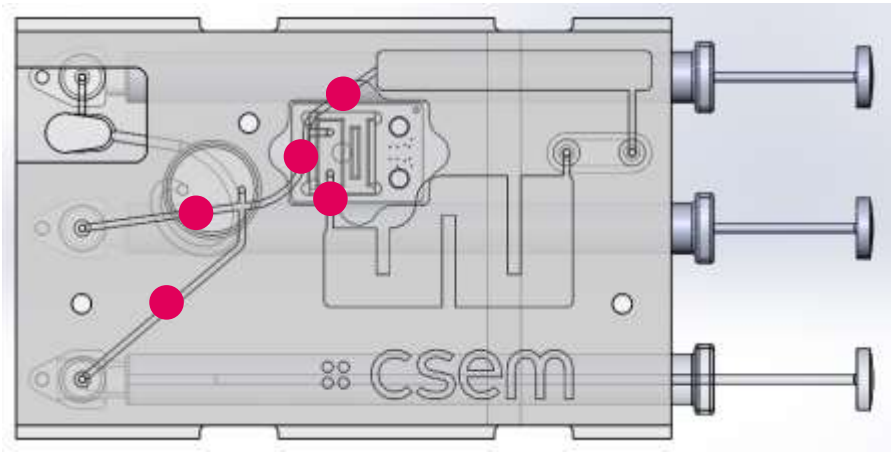
Cartridge building blocks

- Three buffer/air syringes (linear actuators on instrument)
- Metering loop of 15 uL for blood plasma
- Elastomeric valves (servo actuator on instrument)



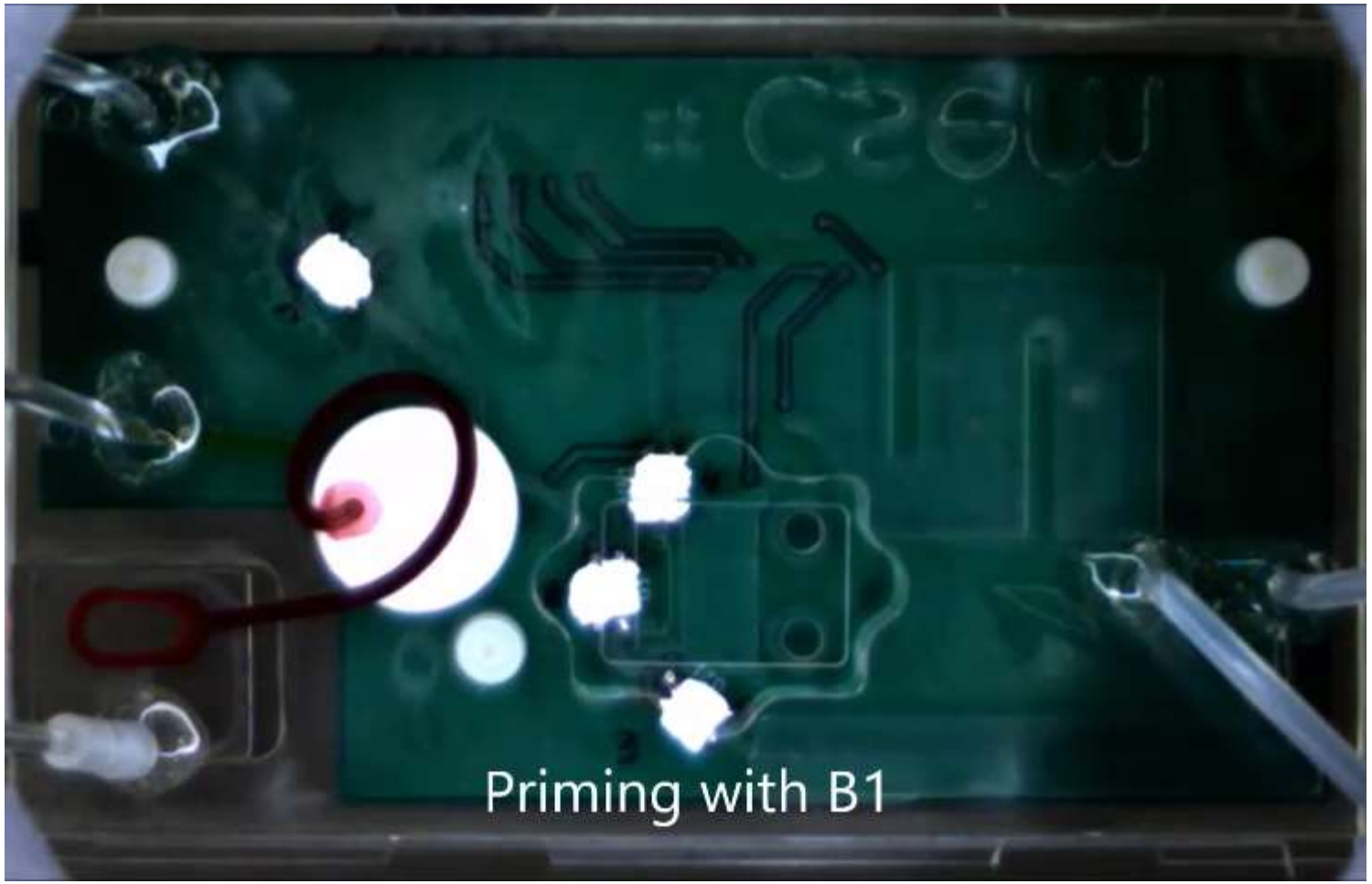
Flow front sensors

- Closed-loop control of liquid actuation
  - Blood filtration duration
  - Air-gap elimination
  - Bubble detection
- IR light barrier devices



Video of automated fluidic workflow

- 80 uL human blood with EDTA
- BSA buffers



Fabrication

- Injection molded PMMA plates
- First iterations CNC milled PMMA plates
- Medical grade adhesive foils for assembly

Continued work

- Integration of final design iterations (instrument, cartridge, sensor chip)
- Full system testing and characterization

- Thomson's Rule for First-Time Telescope Makers: *"It is faster to make a four-inch mirror then a six-inch mirror than to make a six-inch mirror."*

Thank you for your attention!

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