Automated Modular Interface for Microfluidic Separations and Fluorescent Detection

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µ/nTAS: Development Sequence

**Proof of Concept**
- Publishable and/or reproducible results
- Operated by inventor(s)

**Prototype**
- Device tested in increasingly realistic conditions
- Operated by trained expert(s)

**Product**
- Operated by customer(s)
Chip-to-World Interfaces

**Fluid Routing**
CapTite™ Interconnect Products

**Electric Fields**
HVS448 8-Channel High Voltage Sequencer

**Detection/Imaging**
LabSmith SVM or Other Detector

**Fluid Pressure**
Programmable Syringe Pump
Types of Interface Controls

- Integrated
- Compression
- Adhesive
Pros and Cons of Integrated Interfaces

- **Advantages**
  - Low losses, dead volume
  - Multi-functional components

- **Disadvantages**
  - Component failure = device failure
  - Material dependent
Integrated Interfaces

Fluidigm Dynamic Array

Pros and Cons of Adhesive Interfaces

• Advantages
  • Low pressure or high pressure
  • Electrokinetic flow
  • Pressure-driven flow
  • Flexible footprint
  • Isolated from component failure

• Disadvantages
  • Material sensitive
  • Requires skill to assemble
CapTite™ Adhesive Interfaces

LabSmith CapTite™ Bonded Port Connectors

LabSmith CapTite™ One-Piece Fittings

On-Chip LabSmith CapTite™ Bonded Port Connectors, with Reservoirs and Electrodes

Some CapTite ™ products shown licensed from Sandia National Laboratories
Fluid and Electrical Connection with Visualization

- Electrode connectors
- Bottom-up viewing and illumination
- Motionless stage for unperturbed microsystems
On-Chip Injection

Pinched Injection of Oregon Green
Imaged on SVM340 with EPI-BLUE Module
Voltage Programmed on HVS448 3000D
On-Chip Injection Equipment

Voltage Programmed on HVS448 3000D

Pinched Injection of Oregon Green
Imaged on SVM340 with EPI-BLUE Module
Pros and Cons of Compression Interfaces

• Advantages
  • Easy assembly
  • Low pressure
  • Electrokinetic flow
  • Pressure-driven flow
  • No adhesives/reusable
  • Material insensitive
  • Component failure somewhat isolated

• Disadvantages
  • High pressure
  • Fixed detection/observation window
  • Fixed via footprint
Integrating Fluid Connections, Pressure and Visualization

- No Glue
- Inter-compatible with LabSmith’s complete line of CapTite™ Microfluidic Components and SVM340
- Low dead volumes
- Positive pressure
Integrating Temperature Control

- Fluid connections
- Heater
- Peltier Cooler
- Imaging
Compression Manifold Dimensions

- Use with any material
- Off the shelf
- Mini-luer connections
- Pressures up to 250 psi
Manifold Chip Dimensions

- Width: 58.5 mm
- Height: 13.5 mm
- Height of each section: 4.5 mm
Integration of Fluid Connections, Pressure and Visualization

• No Glue
• Inter-compatible with LabSmith’s complete line of CapTite™ Microfluidic Components and SVM340
• Low dead volumes
Visualization: Fluid Flow in a Pressure Manifold
Controlling Flow with Pressure

• Breadboard mounted
• Inter-compatible with LabSmith’s complete line of CapTite™ Microfluidic Components.
• Low dead volumes
• 500 PSI max
• Connects directly to 360 µm capillary tubing,
• Volume resolution of 10 nanoliters
• Volume and flow rate accuracy of ~1%.
Controlling Flow with Valves

- Breadboard mounted
- Inter-compatible with LabSmith’s complete line of CapTite™ Microfluidic Components.
- nl and µl valve volumes
- 5000 PSI max
- Connects directly to 360 µm capillary tubing, 1/16” PEEK tubing
Rapid Flow Response
Vacuum Compression Manifold

- Vacuum seal
- Low pressure application

Courtesy of Dr. Blanca Lapizco-Encinas, CINVESTAV

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Vacuum Compression Manifold

Courtesy of
Dr. Blanca Lapizco-Encinas, CINVESTAV
iDEP Set-Up with Vacuum Manifold

• Inter-compatible with LabSmith HVS448 and SVM340

Courtesy of Dr. Blanca Lapizco-Encinas, CINVESTAV
Insulator-Based Dielectrophoresis (iDEP)

Electric field lines being **squeezed** between the insulating posts

**REGION OF LOWER FIELD STRENGTH NEGATIVE DIELECTROPHORESIS**

**REGION OF HIGHER FIELD STRENGTH POSITIVE DIELECTROPHORESIS**
Real-Time iDEP with Vacuum Manifold

SINUSOIDAL SIGNAL

750 V
1000 ms (1 Hz)

Courtesy of
Dr. Blanca Lapizco-Encinas, CINVESTAV
Conclusion

• LabSmith provides practical solutions to control lab-on-a-chip experiments for ideas on the path to products
  – Voltage control
  – Pressure-driven flow control
  – Fluid interconnects
  – Imaging and detection
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