**Innovative Electronics for Experimental Research** 

#### Automated Modular Interface for Microfluidic Separations and Fluorescent Detection

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# µ/nTAS: Development Sequence



#### Product



#### Prototype

- Device tested in increasingly realistic conditions
- Operated by trained expert(s)
- Publishable and/or reproducible results

Proof of

Concept

Operated by inventor(s)

 Operated by customer(s)

#### **Chip-to-World Interfaces**



Syringe Pump

LabSmith



#### **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



Zeng, Y. et al. Anal. Chem. 2010, 82 (8), pp 3183–3190.



## 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**



On-Chip LabSmith CapTite<sup>™</sup> Bonded Port Connectors, with Reservoirs and Electrodes



# Fluid and Electrical Connection with Visualization



Synchronized Video Microscope



Synchronized Video Microscope with integrated BreadBoard (iBB) and CapTite<sup>™</sup> Reservoirs

- 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 <u>CapTite™</u>
 <u>Microfluidic Components</u> and SVM340
 Low dead volumes
 Positive pressure

# **Integrating Temperature Control**

microfluidic ChipShop Fluid connection • 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**



## Integration of Fluid Connections, Pressure and Visualization



#### •No Glue

 Inter-compatible with LabSmith's complete line of <u>CapTite™</u> <u>Microfluidic Components</u> and SVM340

Low dead volumes





## Visualization: Fluid Flow in a Pressure Manifold







#### **Controlling Flow with Pressure**



Programmable Syringe Pump



#### Integrated Bread Board (iBB)

- Breadboard mounted
- Inter-compatible with LabSmith's complete line
- of <u>CapTite<sup>™</sup> Microfluidic Components</u>.
- 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**



Manual Valve

**Automated Valve**  Breadboard mounted Inter-compatible with LabSmith's complete line of <u>CapTite<sup>™</sup> Microfluidic Components</u>. •nl and μl valve volumes •5000 PSI max •Connects directly to 360 µm capillary tubing, iBB

1/16" PEEK tubing

#### **Rapid Flow Response**





#### **Vacuum Compression Manifold**



# Vacuum sealLow pressure application



#### **Vacuum Compression Manifold**





#### iDEP Set-Up with Vacuum Manifold



•Inter-compatible with LabSmith HVS448 and SVM340



## Insulator-Based Dielectrophoresis (iDEP)



# 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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- microfluidicChipShop
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  - Expertise
  - iBB Manifold



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