

# More Than Lab-on-a-Chip: Everything You Need to Run Micro/Nano-Fluidics Experiments

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# Micro/nano Total Analysis Systems

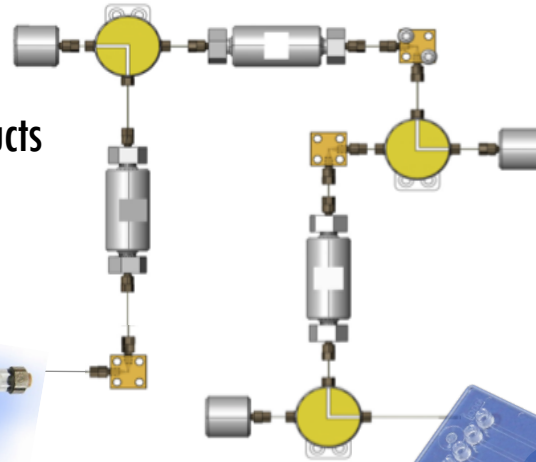
- Goal is often to combine all of workflow into monolithic device (e.g. for *in vitro* diagnostics applications)
- In prototyping stage, sample prep and downstream analysis/detection often must be decoupled due to complexity
- Monolithic devices need to be connected to the rest of the world fluidically and electrically

# Ensuring Experimental Parameter Control

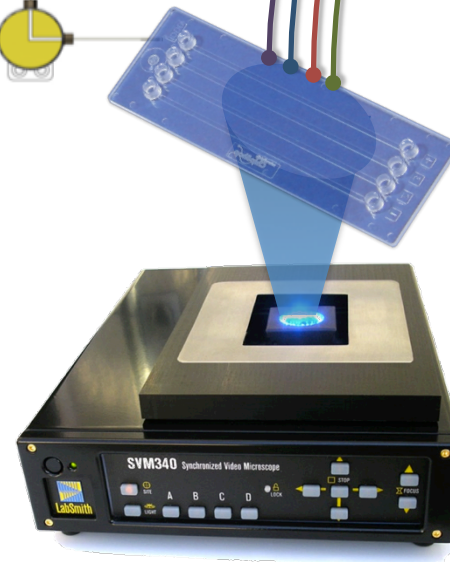
**Fluid Routing**  
CapTite™ Micro-  
Nano-fluidics Products



**Pressure-Driven Flow**  
SPS01 Programmable  
Syringe Pump



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



**Detection & Imaging**  
SVM340 Inverted  
Fluorescence Microscope

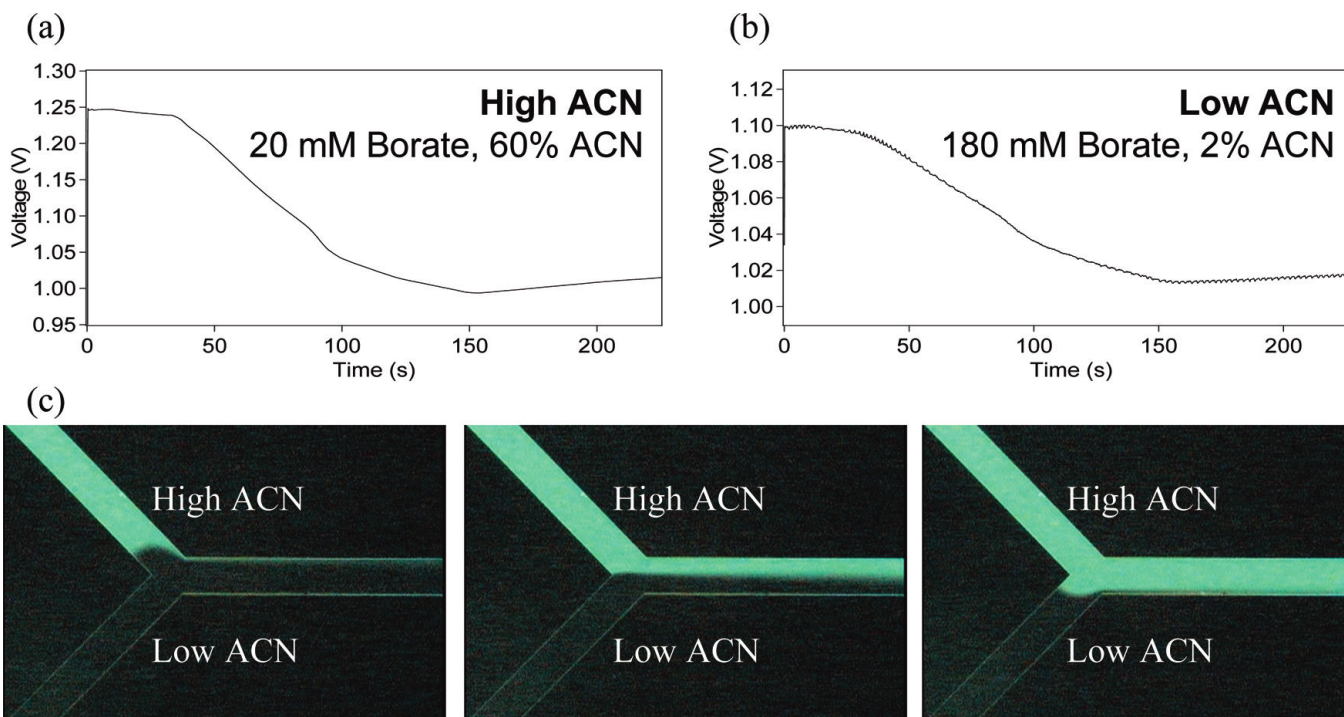
Chip courtesy of ChipShop

# The LabSmith High Voltage Sequencer (HVS)



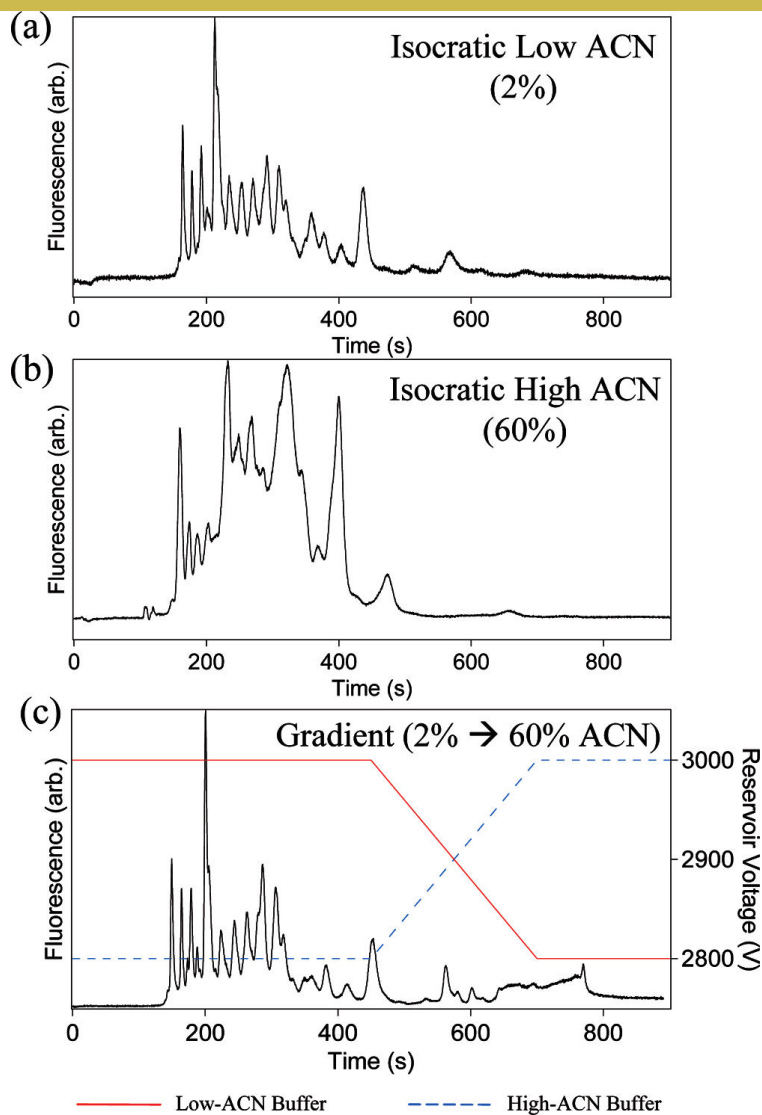
- Eight channels supplying/sensing up to  $\pm 3.0\text{kV}/\pm 6\text{mA}$
- 1 kHz sequencing for microfluidics and MEMS
- 16-bit current sensing resolution
- Complete experiment control for microsystem analysis

# Aqueous/Organic Gradient Control Using HVS



Wheeler, *et al. Anal. Chem.*, Gradient Elution in  
Microchannel Electrochromatography, 2009, 81, 3851–  
3857.

# Gradient Elution of Tryptic Digest of FITC-Casein using HVS

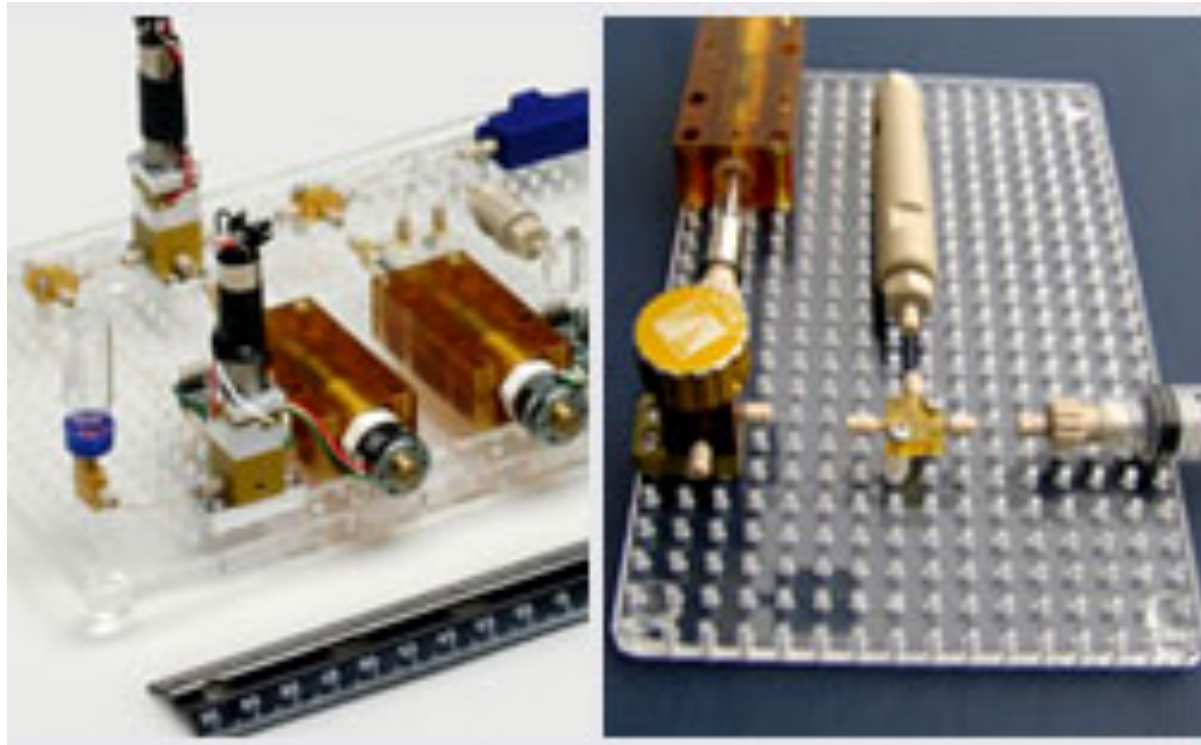


Wheeler, A.R. *et al.*, *Anal. Chem.*, Gradient Elution in Microchannel Electrochromatography, 2009, 81, 3851–3857.

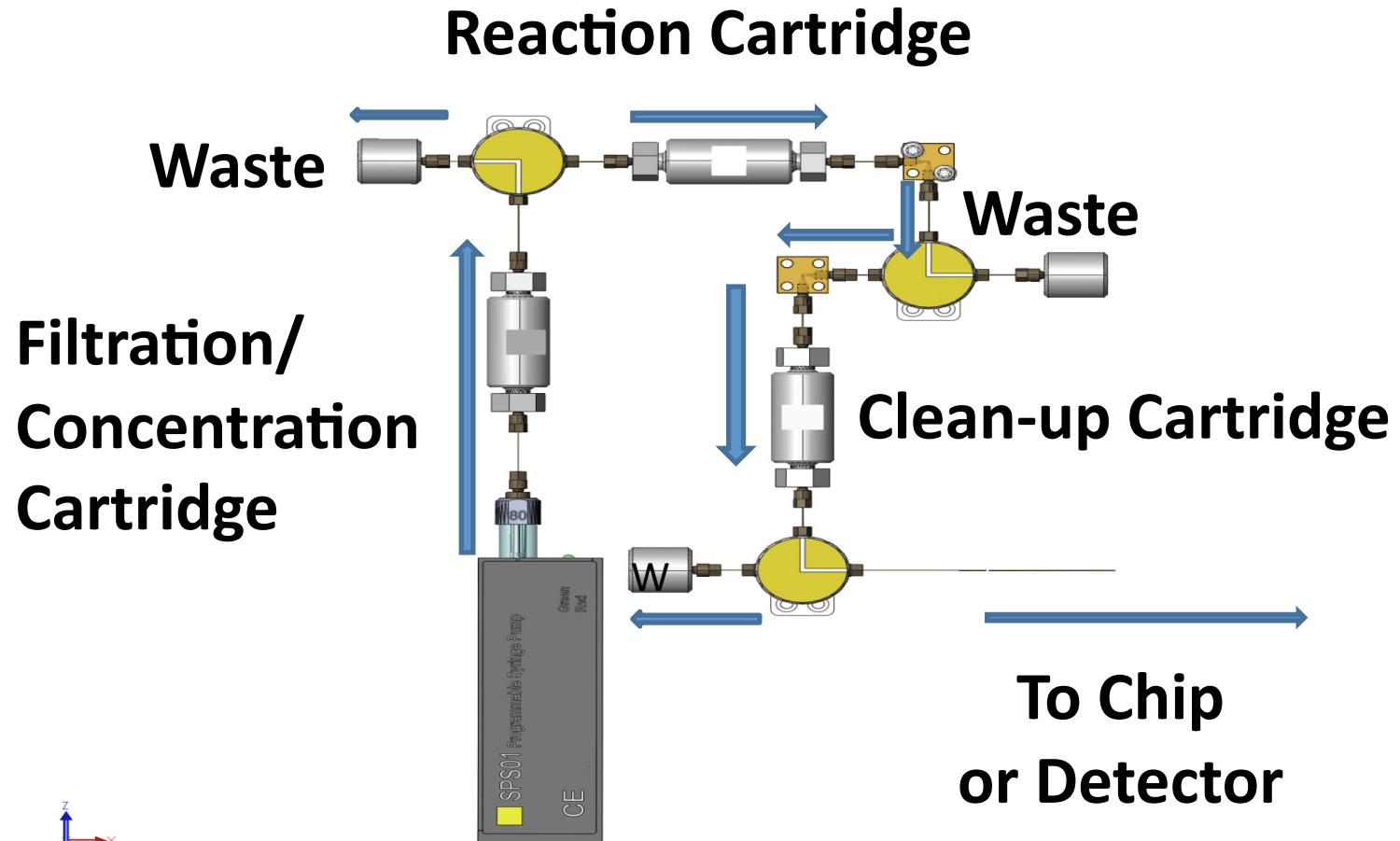
# HVS Product Line and Specs

Model	Max voltage differential	Output voltage	Max current	Measurement resolution	Input resistance
6000D	±6000 V	-3000 V to +3000 V	±3 mA	100 nA/100 mV	200 MΩ
3000D	±3000 V	-1500 V to +1500 V	±6 mA	200 nA/50 mV	100 MΩ
3000	±3000 V	-3000 V to 0 V, -1500 V to +1500 V, or 0 V to 3000 V	±6 mA	100 nA/100 mV	<200 MΩ
1500	±1500 V	-1500 V to 0 V, -750 V to +750 V, or 0 V to 1500 V	±12 mA	200 nA/50 mV	100 MΩ
800	±800 V	-800 V to 0V, -400 V to +400 V, or 0 V to 800 V	±25 mA	500 nA/25 mV	100 MΩ
400	±400 V	-400 V to 0 V, -200 V to +200 V, or 0 V to 400 V	±50 mA	1 μA /12 mV	100 MΩ
200	±200 V	-200 V to 0 V, -100 V to +100 V, or 0 V to 200 V	±100 mA	2 μA /6 mV	100 MΩ

# Fluid Connections and Sample Preparation - Breadboarded System

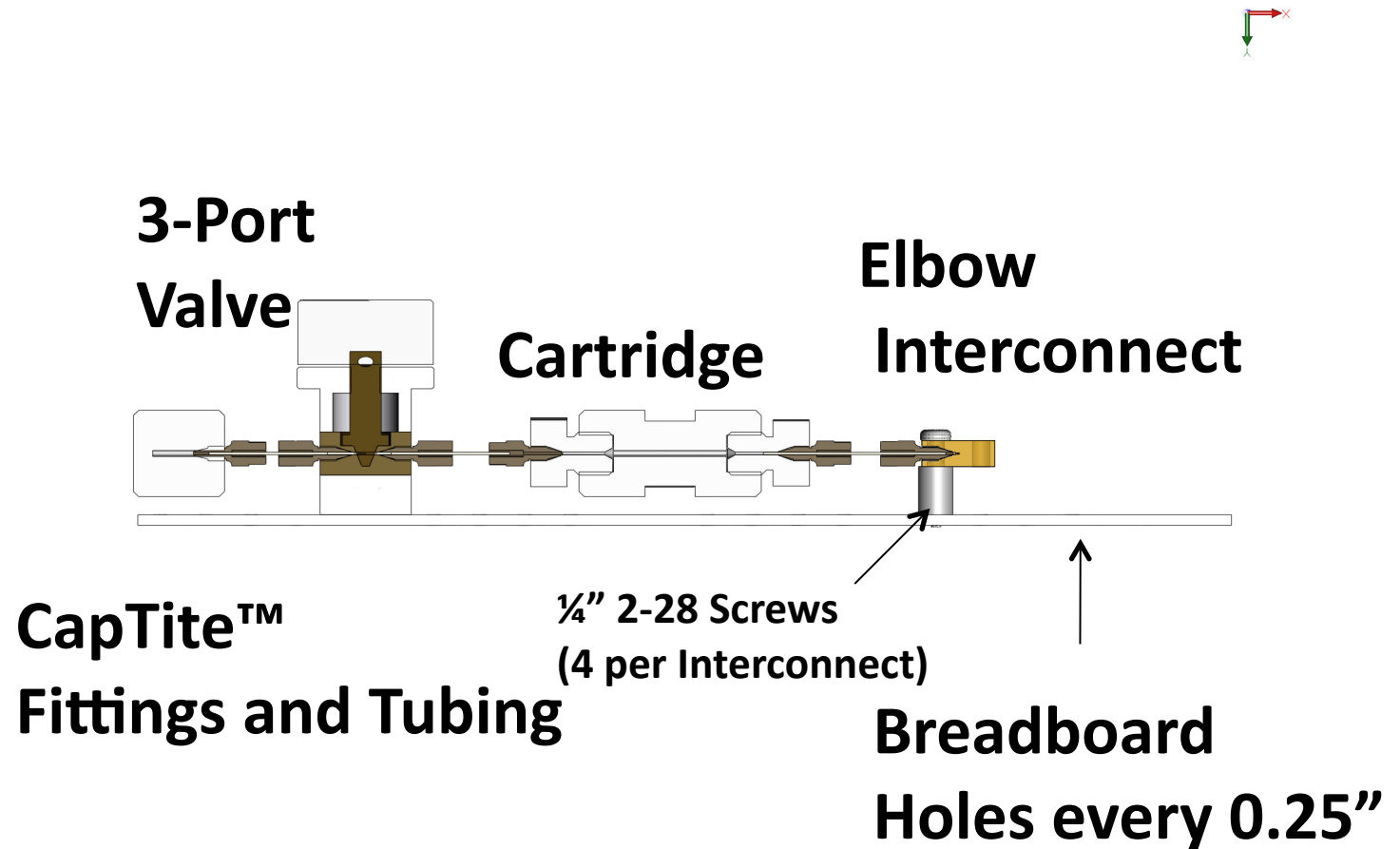


# Breadboard for Sample Prep Fluid Circuit – Top Down View



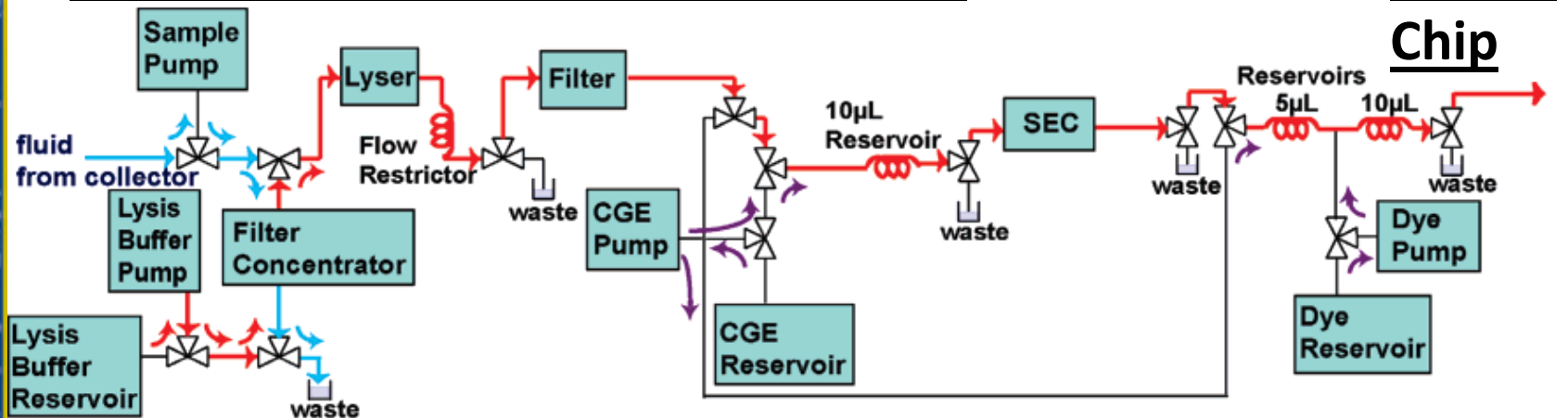
**Sample / Buffer  
Syringe Pump**

# Assay Breadboard – Cross Sectional View



# Automated Pathogen Detection

## Breadboarded System – Sample Prep



To CGE  
Chip

The automated sample preparation (ASP) system had a total cycle time (included sample prep and on-chip analysis) of 15 minutes for *Bacillus subtilis*.

Vandernoot *et al*, Anal. Chem. 2007, 79, 5763-5770

# Single User Microfluidic Construction Kit

**PY2 72-0426 C360-KIT1**

**\$2,550.00**

QTY	Part Number	Description
75	PY2 72-0431	One Piece Fitting
10	PY2 72-0433	Plug
5	PY2 72-0438	Tee Interconnect
5	PY2 72-0443	Cross Interconnect
10	PY2 72-0449	Luer-Lock Adapter
25	PY2 72-0448	Bonded Port Connector
2	PY2 72-0445	Selector Valve
2	PY2 72-0430	Breadboard

Includes Tools and Capillary

# NEW! Pressure-Driven Flow Control - SPSO1 Programmable Syringe Pump

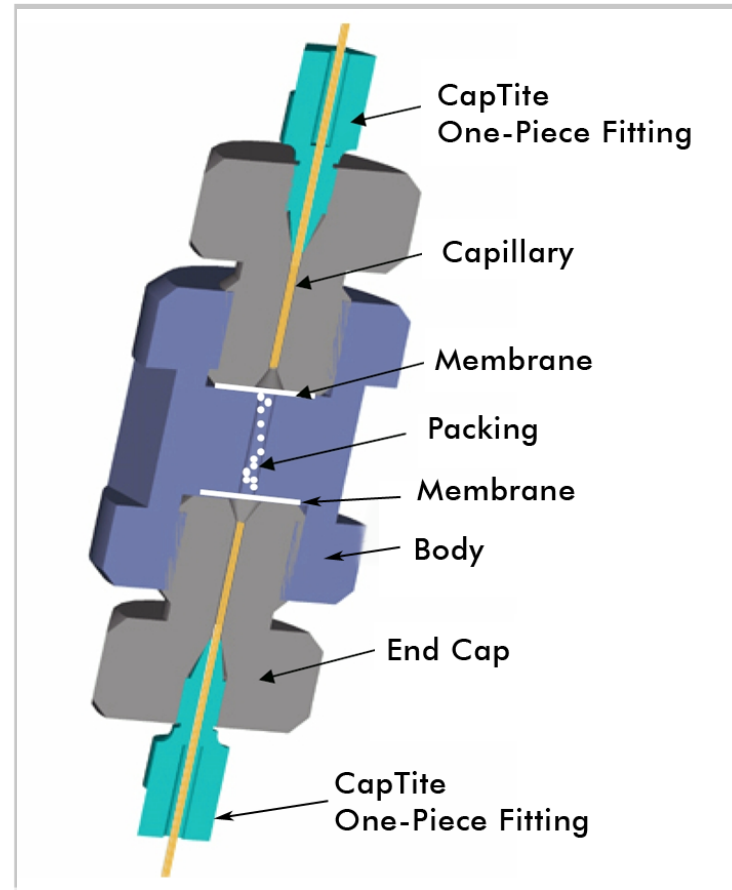


- Breadboard mounted
- Inter-compatible with LabSmith's complete line of [CapTite Microfluidic Components](#).
- Low dead volumes
- Connects directly to 360  $\mu\text{m}$  capillary tubing, Delivers 4 to 80 microliters,
- Volume resolution of 10 nanoliters
- Volume and flow rate accuracy of  $\sim 1\%$ .

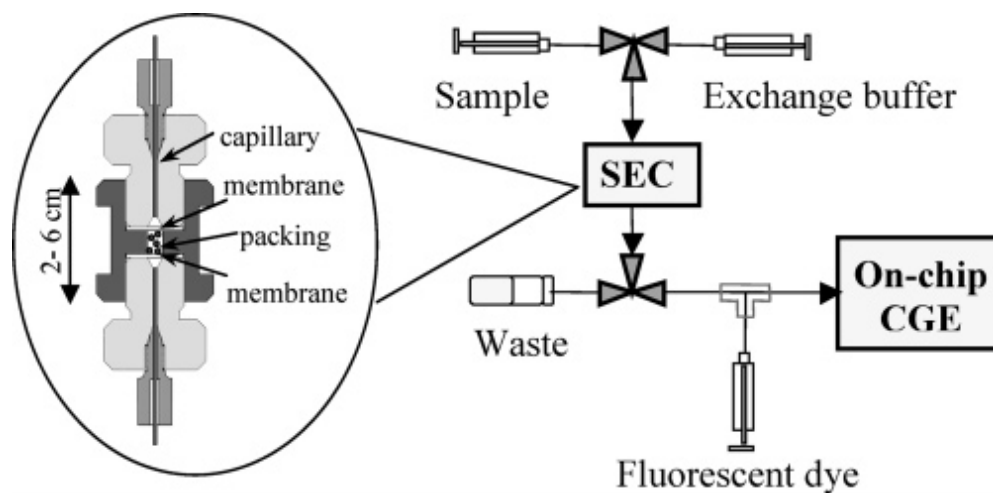
# SPS01 Performance Specs

<b>Volume (<math>\mu</math>l)</b>	<b>Min Flow Rate (<math>\mu</math>l/min)</b>	<b>Max Flow Rate (<math>\mu</math>l/min)</b>	<b>Step Size (<math>\mu</math>l)</b>	<b>Max Pressure (psig)</b>
4	0.05	282	0.005	>500
8	0.10	565	0.01	>500
20	0.25	1410	0.02	>500
40	0.5	2820	0.05	300
80	1.0	5650	0.10	200

# Refillable uCartridge for Concentration Clean-up, Chromatography, and ...



# Automating Centrifugation



Sample cleanup of labeled and lysed *Bacillus subtilis* spores prior to on-chip analysis

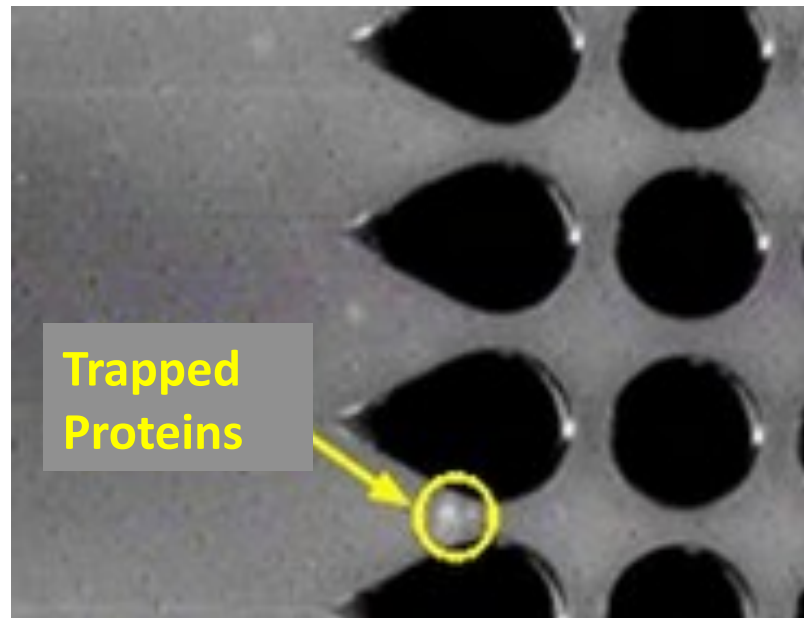
Chirica, *et al.* *Anal. Chem.* **2006**, **78**, 5362-5368

# The LabSmith Synchronized Video Microscope, SVM340



- Sensitive 30 fps color and B&W video cameras for low-light imaging
- Synchronous pulsed illuminator fights blur and photo-bleaching
- Bottom-up viewing and illumination
- Motionless stage for unperturbed microsystems
- Snap in filter and camera options
- Epi-fluorescence version

# Imaging On-Chip Protein Concentration with the SVM 340



Lapizco-Encinas, B.H., *et al.*, “Protein manipulation with insulator-based dielectrophoresis and direct current electric fields , *Journal of Chromatography A*, Volume 1206, Issue 1, 3 October 2008, Pages 45-51.

# Snap-In Camera Modules for Ease of Use

- The **snap-in camera modules** for the SVM340 include a CCD camera, optional fluorescence filter and threading for standard DIN microscope objective:
- **Black and White Module** High sensitivity analog black & white camera with 640 x 480 pixels, 600 lines of resolution, 30 frames per second.
- **Color Module** Bayer-pattern analog color camera with 640 x 480 pixels, 490 lines of resolution, 30 frames per second, S-Video output.

# Illumination LEDs

You can specify the color for each channel from the following LED wavelengths:

- **Blue:** 464-476 nm

**Green:** 520-535 nm

**Red:** 615-636 nm

**White**

**Custom wavelengths** are also available

# Filter Options

- The SVM uses **12.5 mm diameter** long pass filters. Filters are available through LabSmith in wavelengths of **515nm, 530nm, 550nm, 570nm, 590nm, 610nm, 630nm and 665nm.**

# Objective Options

Power	Numerical Aperture	Working Distance	Focal Length	Field of View
4X	0.10	15.97 mm	31.0 mm	1.5 x 1.5 mm
10X	0.25	6.3 mm	16.76 mm	0.6 x 0.6 mm
20X	0.40	3.3 mm	8.55 mm	0.3 x 0.3 mm

# SVM Applications

Application	Illuminator	Camera Module	Filter
Fluorescein	3 blue channels & 1 white channel	Black & White	530 nm
Rhodamine	3 green channels & 1 white channel	Black & White	515 or 530 nm
Colored Dyes	1 blue, 1 green, 1 red, & 1 white channel	Color	None

# Detection – Lab Automation

- Embed the SVM340 in your  $\mu$ TAS for an automated system with LabView
  - Motionless sample stage
    - Simplifies physical interfacing
    - Reduces microsystem perturbation
  - Motorized focus and X/Y traverse
  - Software developers kit.
  - Standard composite and S-Video analog outputs and USB and RS232 digital ports simplify electronic interfacing.

# Software that Saves You Time

- Losslessly record data to disk (640 x 480 pixels)
- Post-save and instant replay so you never miss an event
- Auto-acquisition by hardware, software, or real-time image processing
- Track and trigger by local intensity or color
- Analyze and trigger by high-resolution PIV.

# Standard Chips

We recommend and can provide the following chips that are compatible with our CapTite™ fittings:

Material	Manufacturer
Polymer	microfluidicChipShop Fluigence
Glass	Micronit

# Conclusion

- LabSmith provides practical solutions to control your lab-on-a-chip experiment
  - Voltage control
  - Pressure-driven flow control
  - Fluid interconnects
  - Modular sample prep
  - Imaging and detection
  - Controllable with LabView drivers