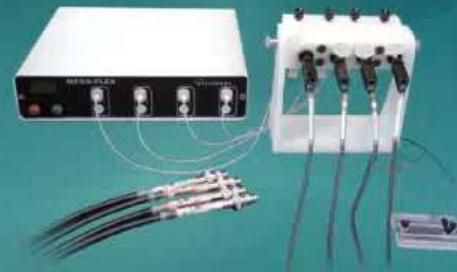


Steering of particles by EO actuation

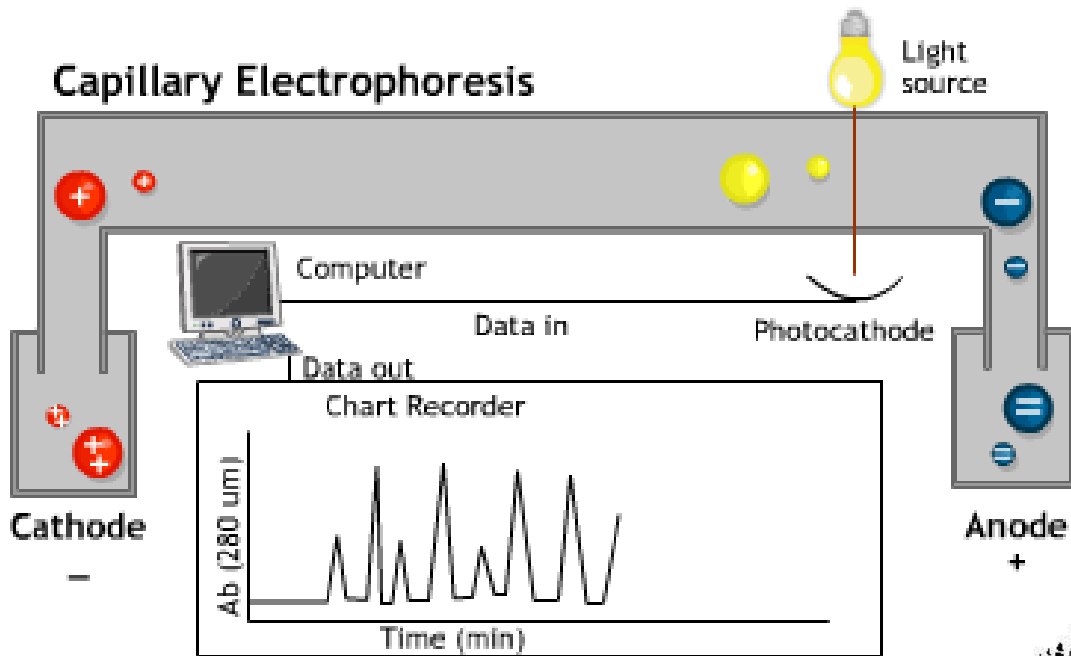


**Example of applications using the
MFCS series,
Combining pressure and voltage
controls**

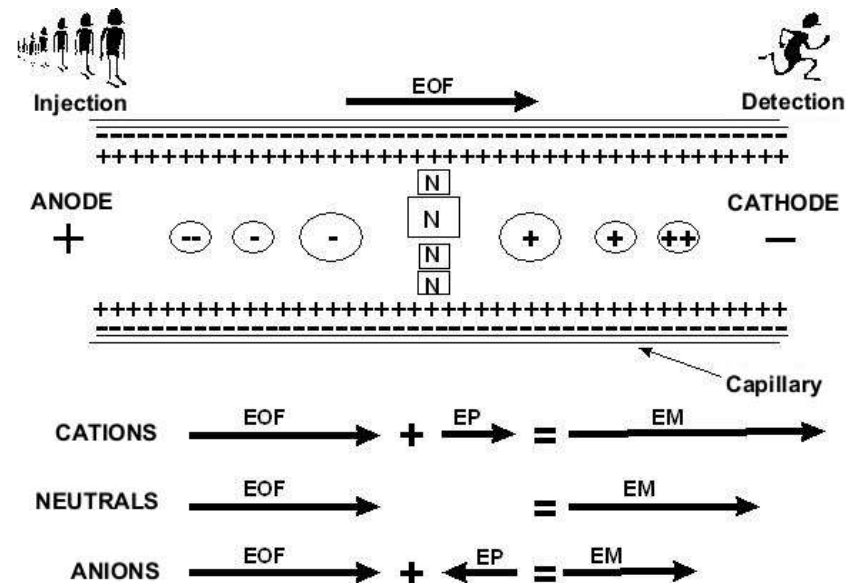
MFCS Series
MICROFLUIDIC FLOW CONTROL SYSTEM



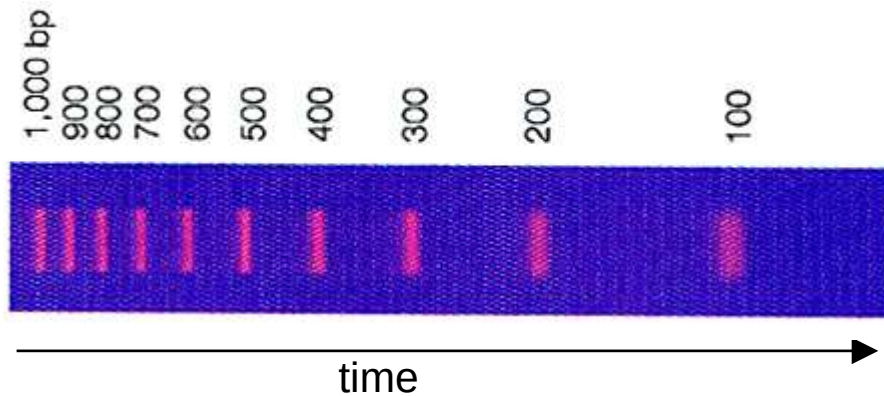
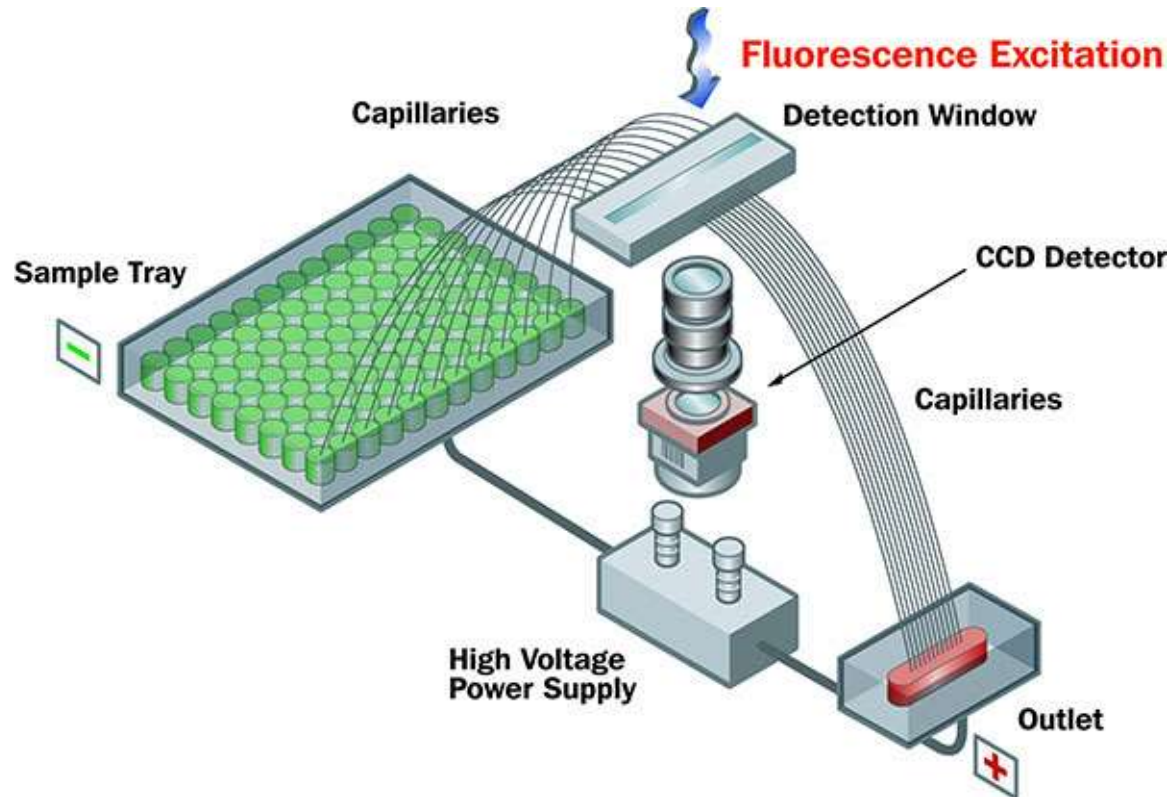
Capillary Electrophoresis



Advantage of EO flow vs. pressure-driven flow:
Much less dispersion (→ “band broadening”).



Capillary Electrophoresis

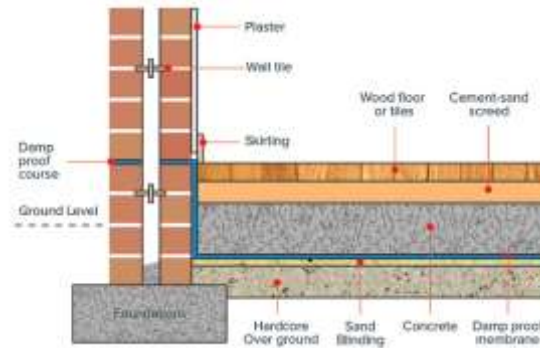


Electro-osmotic damp proofing

Why “damp proofing”?



<http://www.kein-schimmelpilz.de>



<https://www.rentokil.co.uk/damp-proofing/>



<https://en.wikipedia.org/wiki/File:FlexibleRainPipe.JPG>

Electro-osmotic damp proofing:



<https://www.prlog.org>

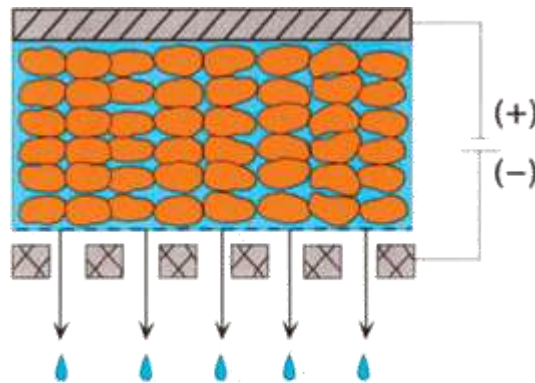
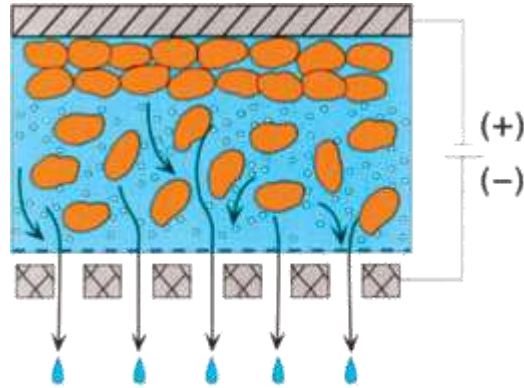


<http://www.tectonica-online.com>

Electro-osmotic dehydration

Operation principle:

EO flow drives water out of sludge



<http://www.esi.info>

<http://sdt-h.eu>

“Smart clothing”

HYDRO_BOT® electroosmotic membrane is able to pump up to 200 liter / m² h

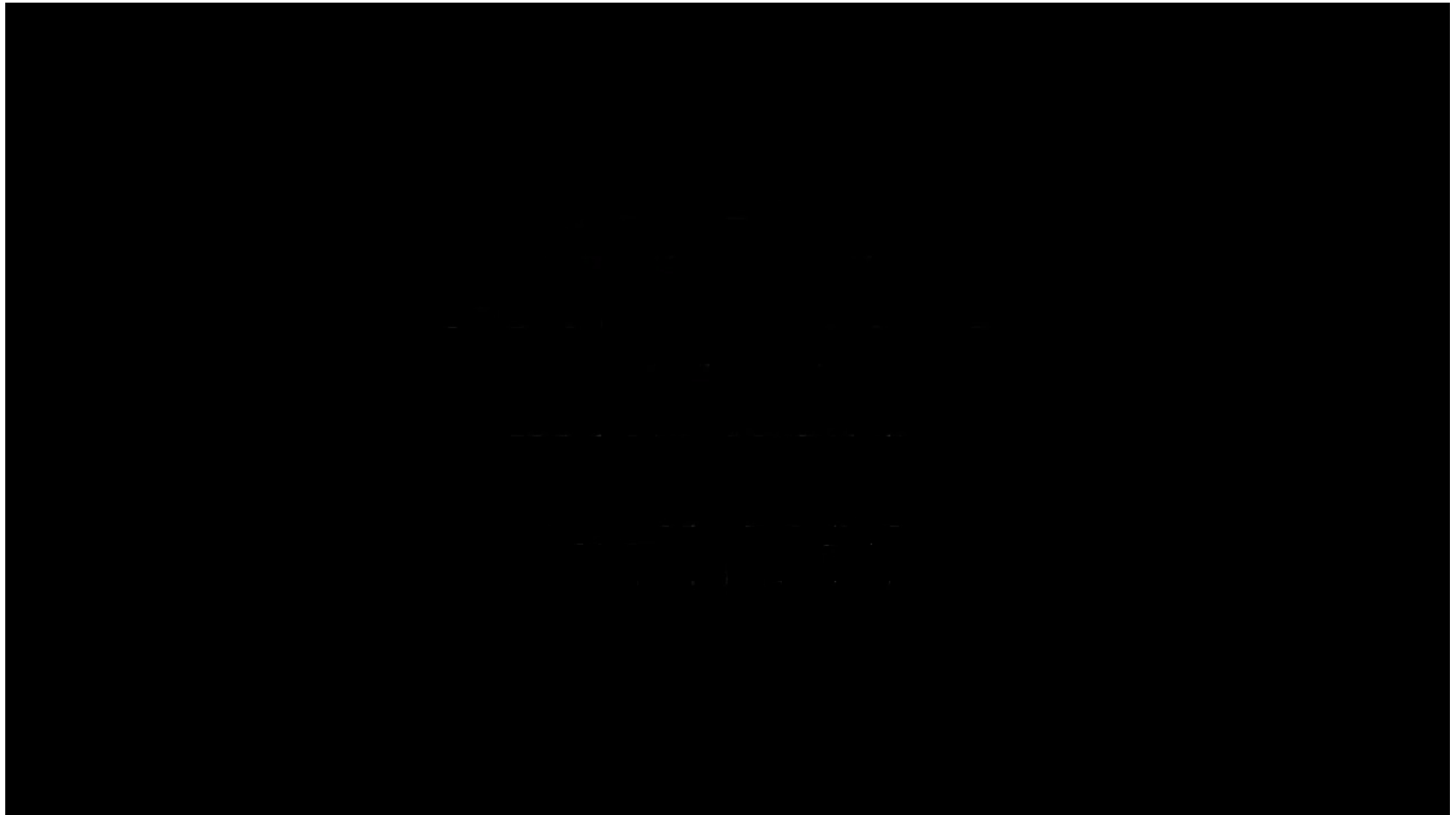


<http://www.osmotex.ch>
Physik Journal **17** (2018) S. 17



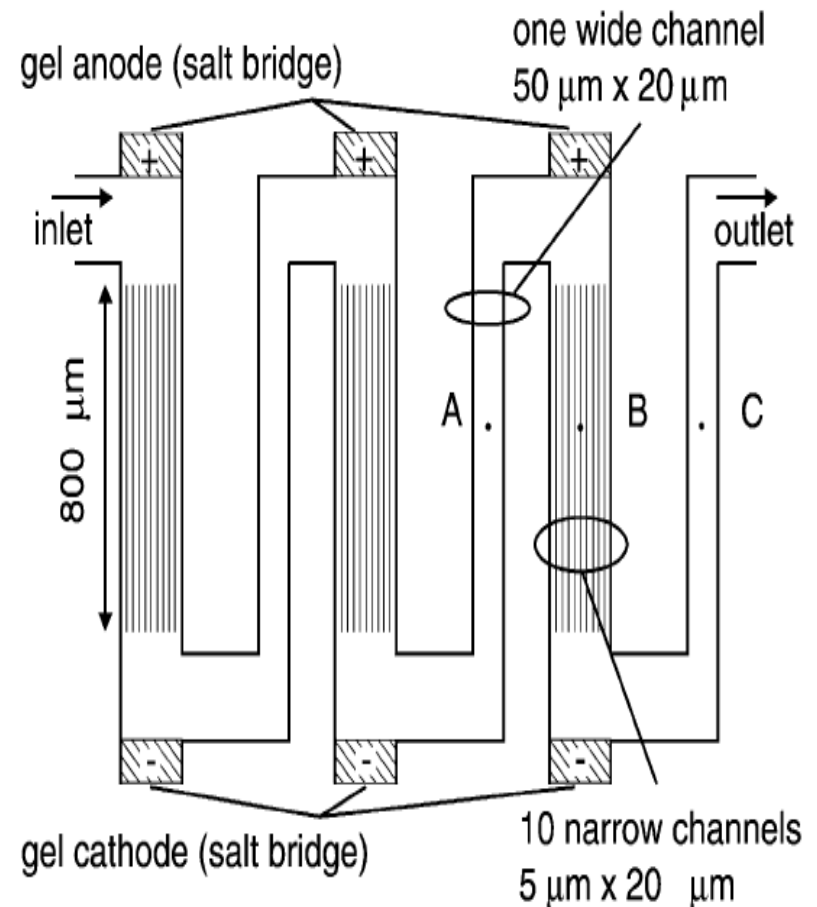
Electro-osmotic dehydration

Electroosmotic membrane, 300 L/h per square meter



Low voltage cascade pump

- Low voltage consumption (10 V)
- Suitable for on chip applications
- Single stage
 $P_{\max}=281$ (Pa)
- 15 stage
 $P_{\max-15}=4200$ (Pa)
- $Q_{\max}=34.6$ (nl/min)

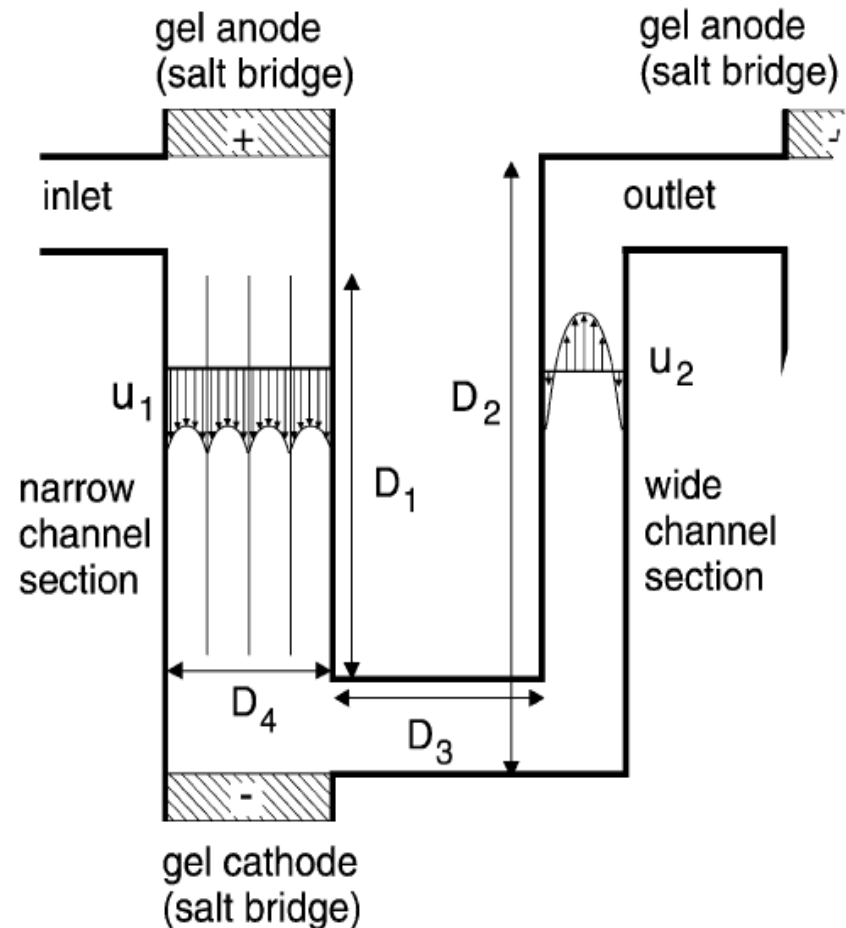


Low voltage cascade pump

- Narrow channels work as high pressure pump
- Wide channel works in opposite direction as a low pressure pump

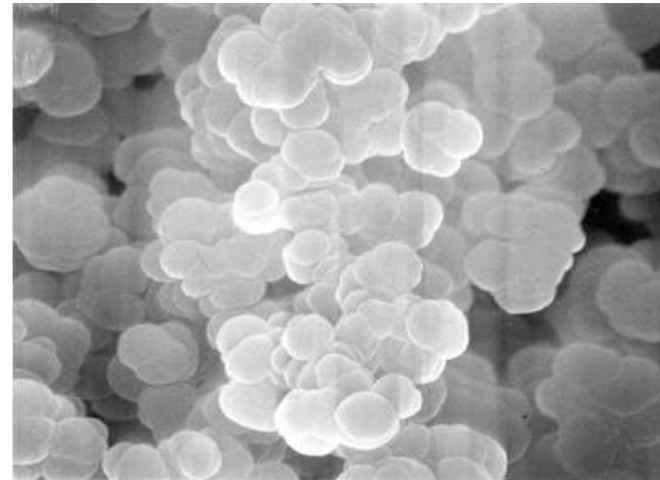
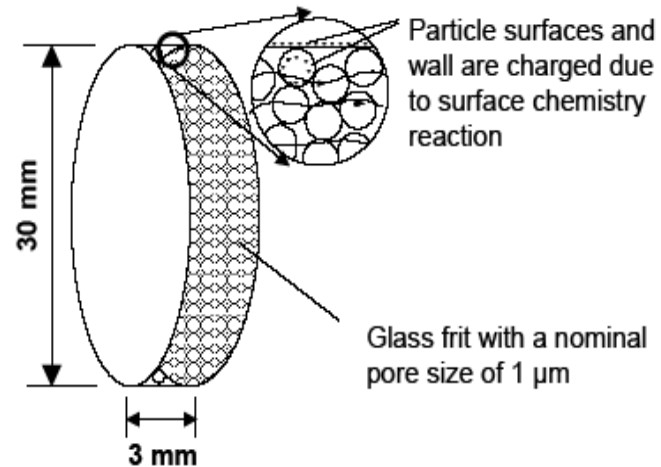
Disadvantages

- Low flow rate
- Electrode span life

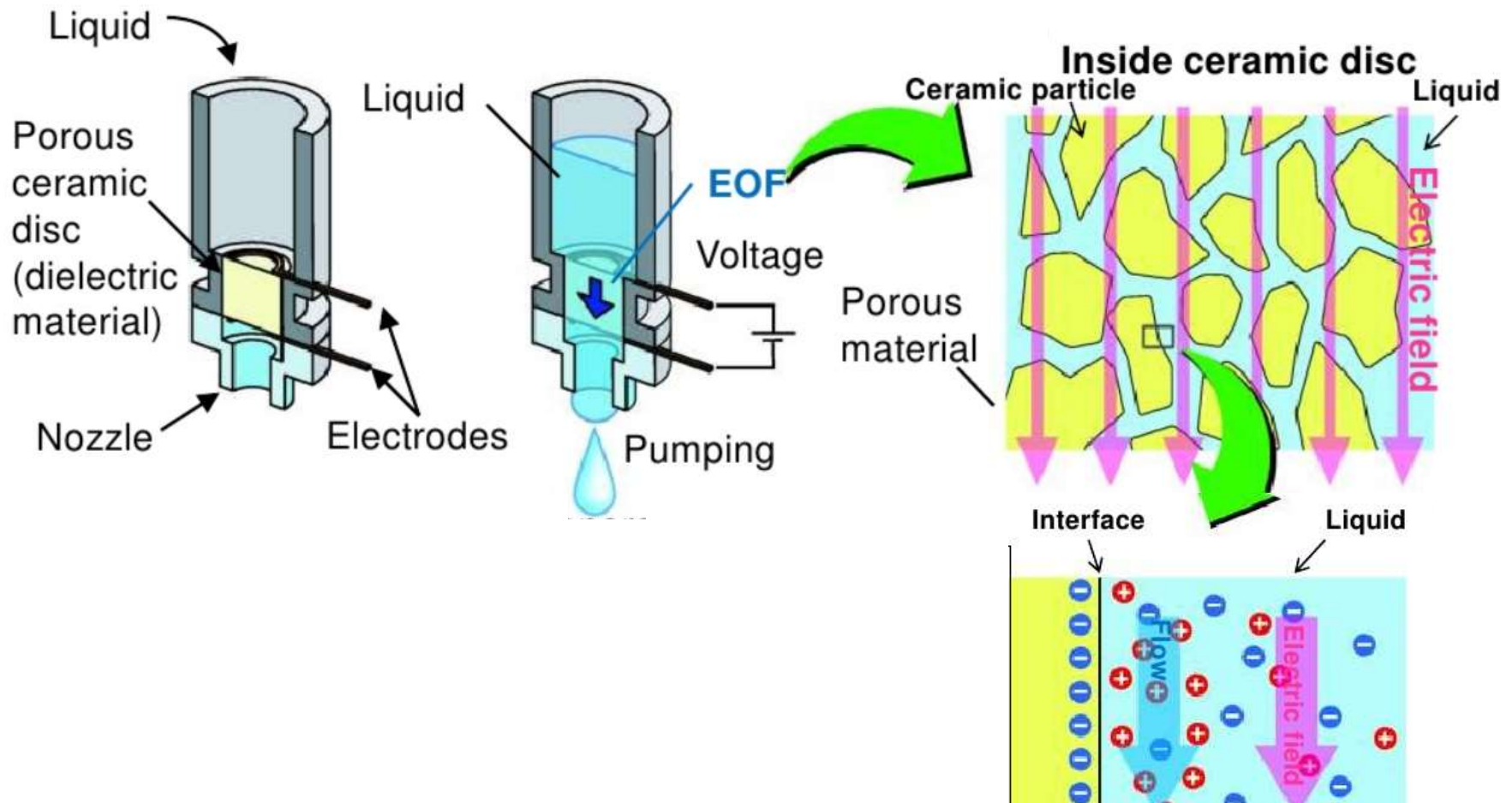


Porous type electro-osmotic pumps

- Whole frit surface is charged
- Fluid flows through the tiny irregular channels of the frit
- High flow rates ($Q \approx 1 \text{ mL/min}$)
- High backpressure range ($\Delta p = 1 - 5 \text{ bar}$)

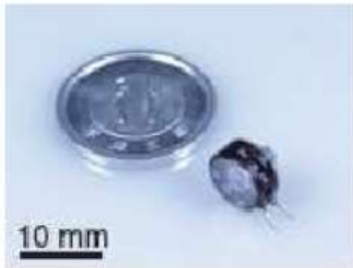


Microfluidic EO Pumps



Microfluidic EO Pumps

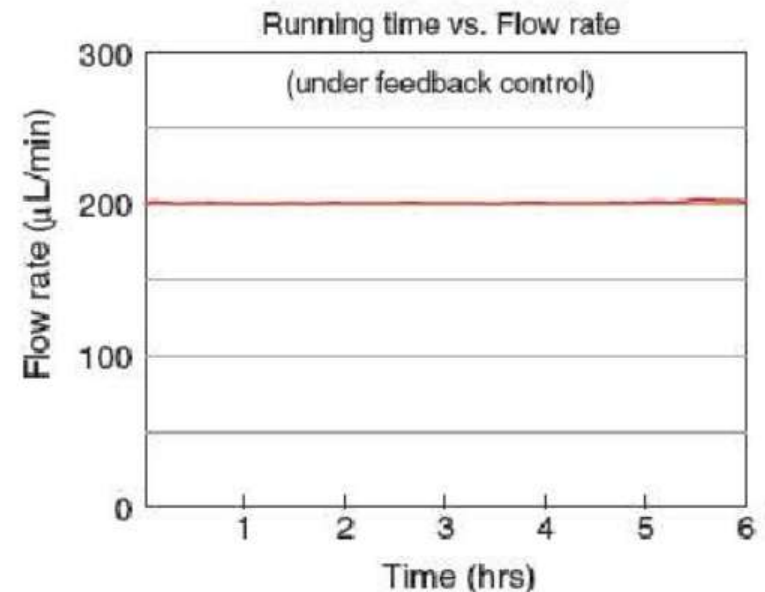
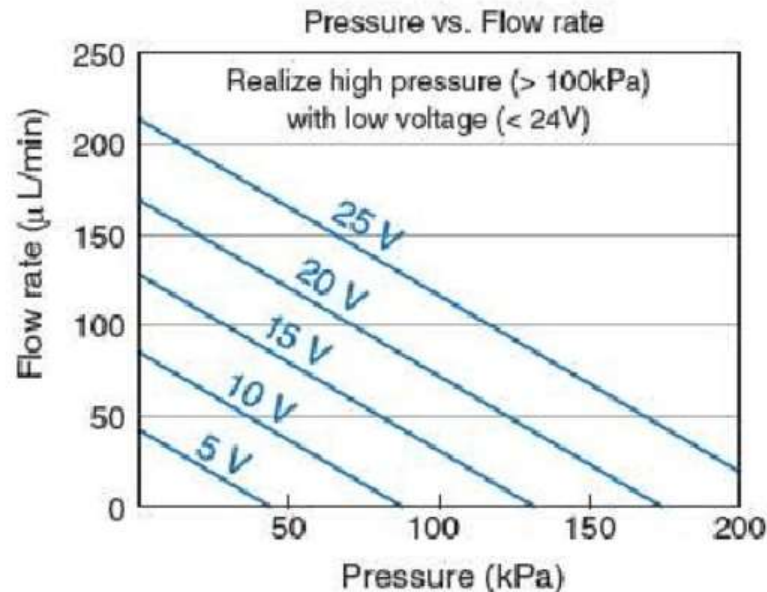
Small body size / Light weight / High pressure generation / No mechanical moving part



- Pump size: $\phi 8 \times 4$ mm
- Weight: 0.1 g
- High pressure with low voltage (> 100 kPa)
- No sound noise with no mechanical moving part

Stable flow without pulsation

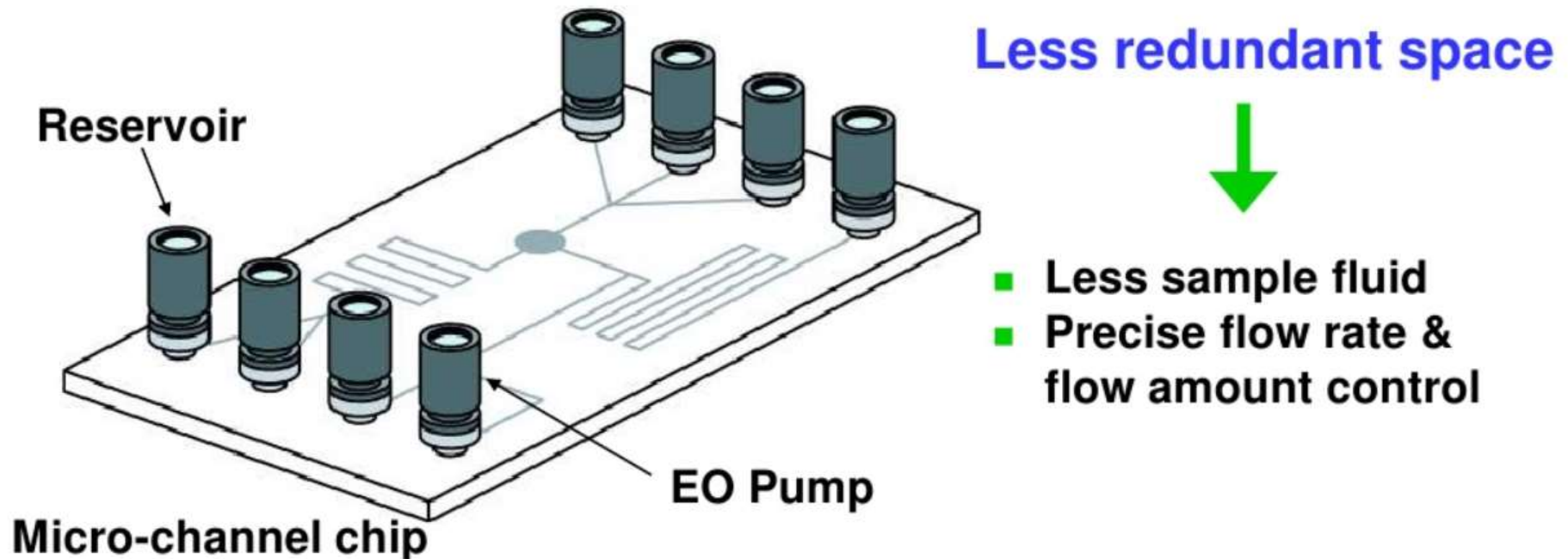
- Driving mechanism brings no-pulsation flow.
- Realizing perfect stable flow under feedback control with flow sensor.
- Coverage from low flow rate to high flow rate.
- Stable flow under long-time running



Microfluidic EO Pumps

Basic Concept

- Direct mount on micro-channel chips (Pump-on-chip)
- Integrated pump (Reservoir-on-pump)

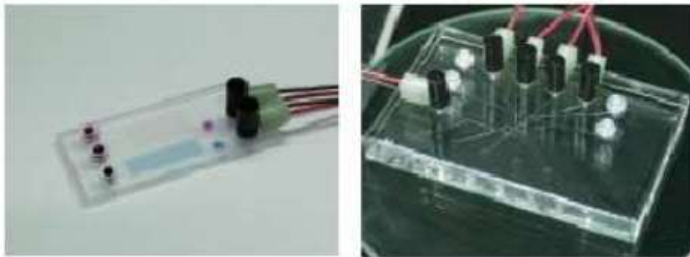


Microfluidic EO Pumps

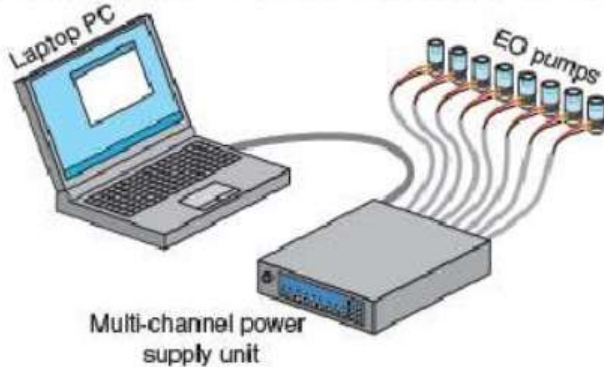
Mounted on Microfluidic Chip

- Multiple pumps on a chip
 - Flow control by voltage
- Realize complex and functional liquid manipulation.

Sample electro-osmotic pumps on a chip



Parallel control by PC and power supply control unit

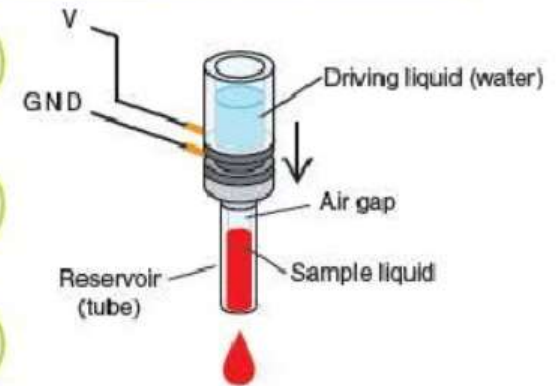


Indirect Pumping of Liquid

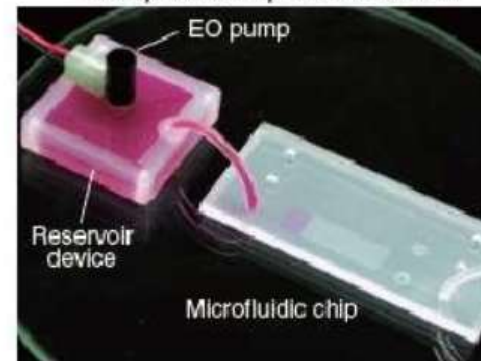
Fill up the reservoir with a sample liquid.

Driving liquid pushes the sample liquid.

Any kinds of liquids can be pumped.



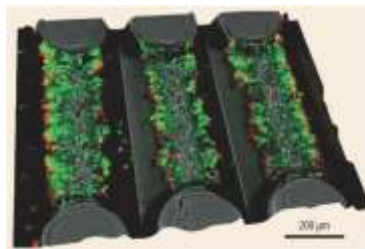
Setup with a special reservoir



Applications of Microfluidics / Nanofluidics



<http://www.gene-quantification.de/lab-on-chip.html>



(Desired) benefits

- Higher sensitivity
- Faster system response
- Low fluid volumes consumption
- High throughput analysis
- Controlled microenvironments for studies of fundamental cell biology
- Lower costs
- Realization as **lab-on-a-chip!**
- Or even organ on a chip