

High Accurate Microarray Spotting for Lab-on-Chip Applications

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microdrop Technologies GmbH

Products and Services for Microdispensing and Material Deposition

• Micro Technologies

- Plastic Electronics
- Life Science / Medical Technology
- Material sciences





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Products - Microdrop



MD-E-3000



MD-K-130/-140



Micropipette AD-K-901



MD-K-801



Micropipette AD-K-501

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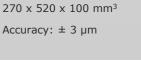
Advancing the Art of Microdispensing

Products – Autodrop Platform



200 x 200 x 100 mm³ Accuracy: ± 10 μm

Autodrop Professiona 200 x 200 x 100 mm³ Accuracy: ± 1 μm



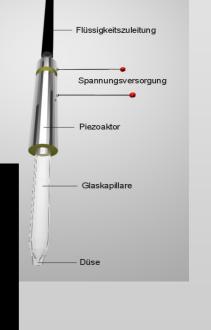




Spotting Methode

Droplet Generator

- Viscosity 1 150mPas •
- Material resistance: glass and PTFE •
- Parameter control $v_{drop} = f(U,t,T)$ •
- refilling: design of fluidic inlet •
- results comparable with other inkjet heads •
- No follow on costs •

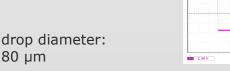




80 µm

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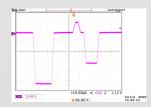
Small Droplets from Large Nozzles



H 10.0µs A Ch3 J -800m

24 Jul 2008





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Harima Silver Nano Ink with 80 µm nozzle diameter





Lab-on-Chip Devices

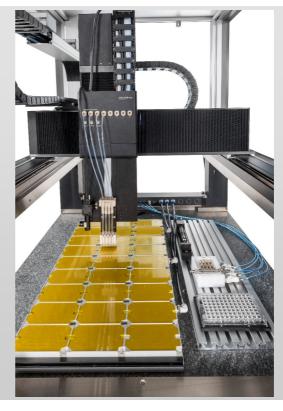
- Fluidic Elements
 - Channels
 - Arrays
 - Chambers
- Different substrates
 - Plastics; e. g. PC
 - Silicon
- Customized formulations
 - DNA, proteins, cells,...





Lab-on-Chip Devices – High Throughput

- High Throughput Requirements
 - Fast
 - High number of fluids
 - High numer of chips
 - Precise
 - Pre-structured pattern
 - Volume accuracy
 - Reliable
 - High quality





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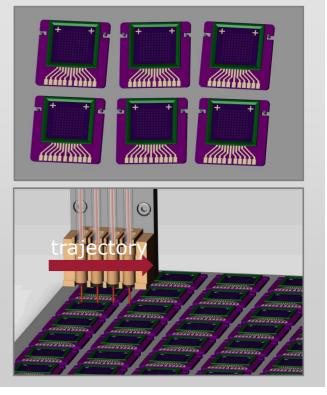
Lab-on-Chip Production - Example

Objectives

- High-throughput spotting of biochips
- Precise spotting of DNA oligos, proteins, ...
- Automated handling of different liquids

Challenges

- Chips are randomly placed ~100 μm
- Extremely small tolerance for positioning of droplets $\sim 5 \,\mu m$
- Perfect repeatability of dispensing volumes required; spot size $\sim 100 \ \mu m$







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Lab-on-Chip Production - Example

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Sequence of operations

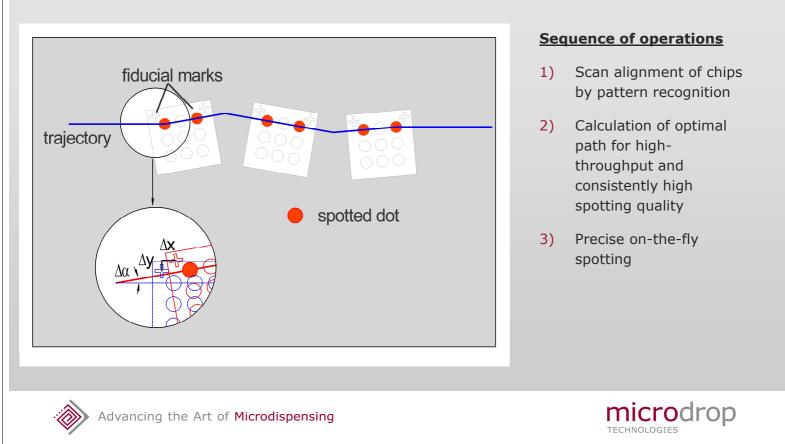
- Flexible and easy-to-use • graphical user interface
- Management of individual • workflow
- Process control •

> Handle multiple liquids by • imported data tables

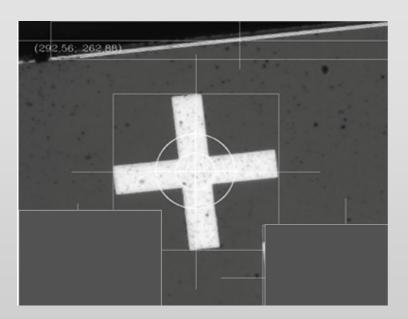




Lab-on-Chip Production – Spotting Path Compensation



Pattern Recognition Features



Automated alignement

Accuracy $< 5 \mu m$

Automated Head Calibration



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Lab on Chip - Application







Pattern Recognition Features

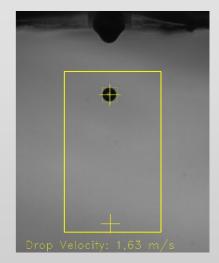
Quality of spotting process



Droplet diameter measurement



Droplet volume measurement



Drop speed measurement

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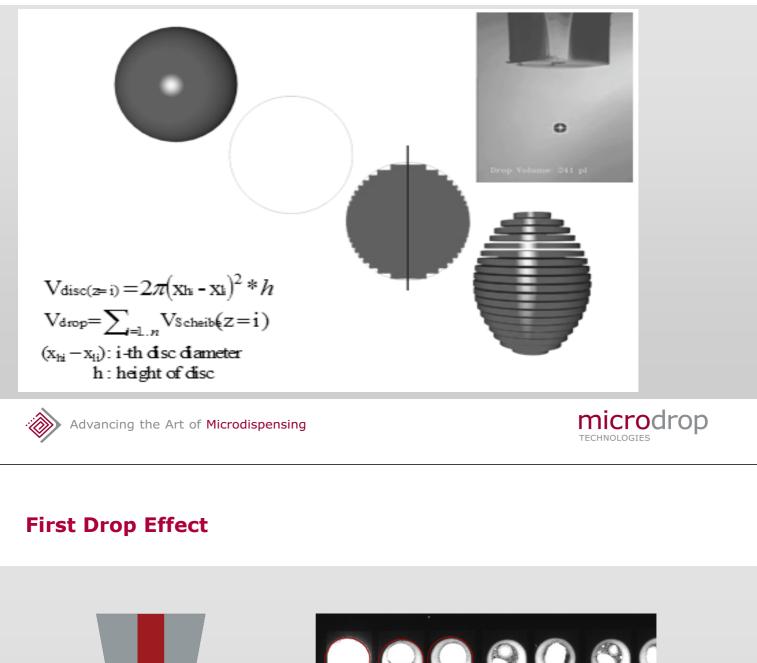


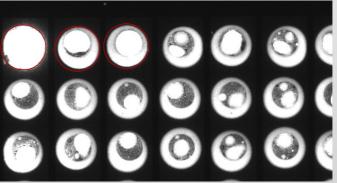
Polystyrol chip Channel width: 100µm

Pipette AD-K-901 Drop size: 85µm Drop volume: 320 pl



Drop Volume Measurement by Pattern Recognition



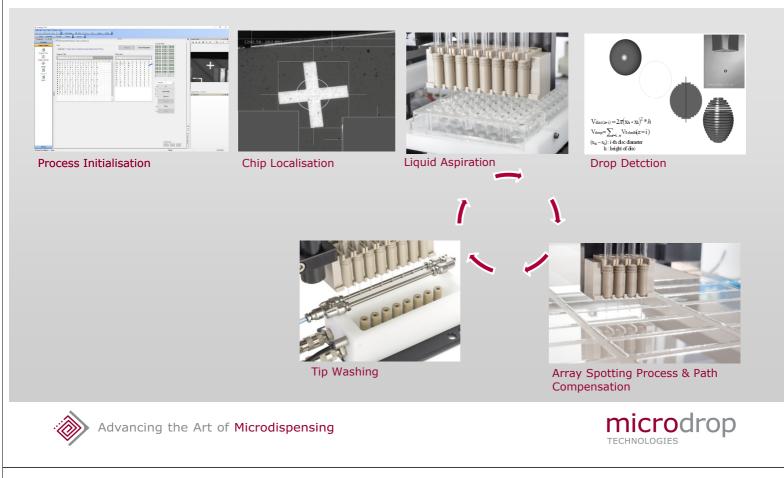


Microarray with flourescent marker / Spot diameter 100 μm

- Evaporation at nozzle front end
- Concentration of solved material increased
- Resulting spot show increased signal
- Slightly larger Spot due to wetting effects

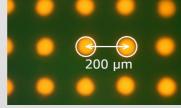


Demonstration of Workflow



Spotting of Microarrays

 Printing of fluorescently labelled DNA oligo / silicone substrate

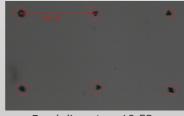


droplet volume < 50pl



droplet volume ca. 500pl

 Dispensing of PMMA beads onto functionalized surface



Bead diameter: $10.53 \mu m$



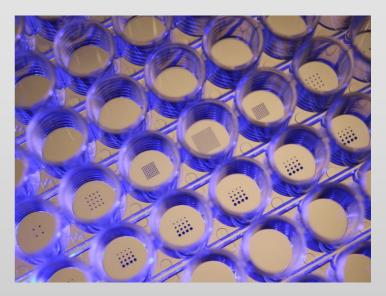
Bead diameter: 2µm





Conclusions

- Utilization of inkjet spotting enables high throughput chip production
 - Highly automated workflow by use of pattern recognition & printing path compensation
 - High precision
 - Spot location within 5 μm
 - Volume 1% CV
- Throughput numbers? Well, it depends!
 - Number of fluids?
 - Chip geometry & Pattern?
 - Individual process!





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