

Fully Automated Liquid Handling

Motivation

When dispensing liquids manually the volume changes with each stroke. When it comes to miniaturization, slight changes in volume have a big impact on the outcome of an experiment. Therefore the dispensing process has to be highly reproducible and precise. Working with a fully automated robot just does that – automatically dispensing reproducible minute amounts of liquid or solution. Working in the low pico liter range, allows a miniaturization of almost any assay while saving time, space and costs.

Background

In the field of fully automated liquid handling, a technique called „spotting“ is used. The term spotting includes non-contact liquid handling as well as contact based liquid handling and is general in used to describe the transfer process of any liquid or solution onto any kind of support.

When it comes to non-contact liquid handling, a droplet is formed and transferred to a surface without touching it. Depending on the used surface and the physicochemical characteristics of the solution or liquid, the formed droplet may vary in size. Droplets transferred this way can be spotted in any imaginable pattern, creating a custom array with a feature to feature offset of only a few 100 μm . Delicate samples can be transferred this way without causing stress to the sample or surface. This technique is commonly used in research and development and is known for its flexibility.

The contact based liquid dispensing is conducted using a so called pin. While touching the surface with the tip of the pin, the liquid transfer takes place. This technique is commonly used for difficult samples and high throughput production making it a robust and fast technique for even very diverse sample types.

**Fraunhofer Institute for Cell
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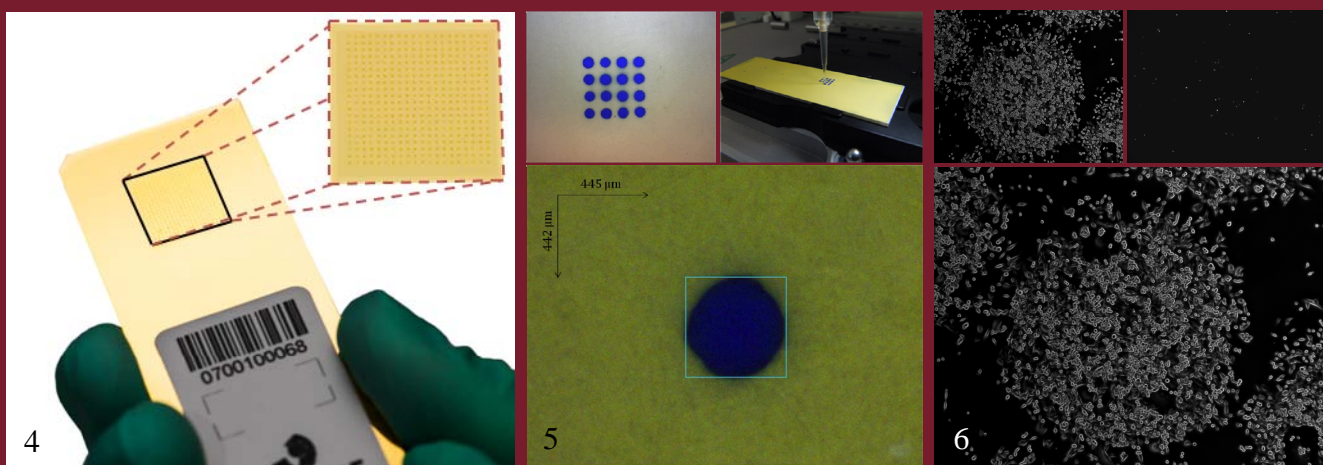
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Dispensing Techniques

Sample deposition in the contact based liquid handling is realized with split-pins (figure 7). While touching the surface with the tip of the pin, the small liquid reservoir is used to sequentially deposit tiny droplets onto the surface.

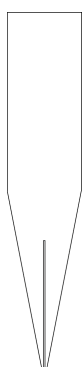


Abb. 7:
Pin-based dispensing of liquids.

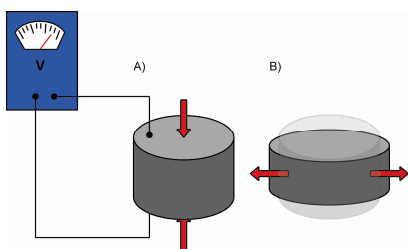


Abb. 8:
Functional principle of a piezo ceramic.

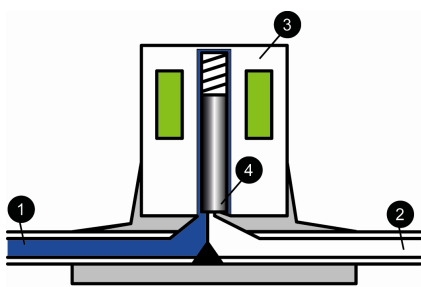


Abb. 9:
Functional principle of a solenoid valve

Non-contact based liquid handling is realized using so called piezo ceramics. These ceramics are used as internal components surrounding a glass capillary. Directed deformation of the ceramic (figure 8) creates waves, traveling through the liquid stream inside the capillary. At the orifice the waves are reflected, causing a droplet to detach from the capillary tip. Droplets formed with this technique have an average volume of 100 pL.

If a higher amount of volume is desired or the sample is more delicate in handling, the dispensing is conducted using a solenoid valve. This valve is controlled using a an inducible electromagnet (figure 9). Upon induction of the magnet, the valve opens for a short time (in micro seconds). This short opening (comparable to a water tap) leads to volumes in the lower nano liter range (50 nL +).

Applications

- MALDI
- Microarrays
- *in vitro* Diagnostic
- Micro fluidics
- Point-of-Care
- Etc.

Documentation

The documentation consists of a spotting report and an overview of the created pattern.

We offer

- Contact-based dispensing
- Non-contact dispensing
- Volume range: 30 pL – 90 nL
- Dispensing of solutions and liquids::
 - High viscosities (figure 5)
 - Particles
 - Cells (figure 6)
 - DNA/RNA
 - Peptides/Proteins (fig. 4)
 - Aptameres
- Consultation::
 - Selection of surfaces
 - Sample preparation
 - Coupling chemistry
 - Assay development
 - Validation

Parameters

- Low sample consumption
- Custom surface modifications
- Different substrates available
- Fully automated