

# Microdroplet arrays: Printing and analyzing liquid sample at high throughput

Petra S. Dittrich

ETH Zurich, Department Biosystems Science and Engineering, Schanzenstrasse 44, 4056 Basel, Switzerland

petra.dittrich@bsse.ethz.ch

## Abstract:

High throughput analysis is the ultimate challenge in many applied fields across the life sciences such as biotechnology, single-cell analysis, drug screening or screening for reaction conditions. The key parameters are the number of samples that can be analysed, and the time needed for the analysis. The current gold standard for high-throughput screening are microtiter plates, which are highly standardized platforms that enable parallel analysis of commonly 96, 384 or even 1536 samples. We overcome inherent limitations of these classical platforms by employing microdroplet-based methods on an open platform.<sup>[1]</sup> Thousands of aqueous nL-droplets are deposited on a custom-made glass slide with a defined hydrophilic-hydrophobic surface pattern. The droplets are covered by fluorinated oil and remain stable for several days. We employ optical microscopy for droplet assessment as well as MALDI-MS imaging for analysis of the droplet content. In this presentation, I will show recent technological developments of the printing mechanism, where we control the size of the droplets, form chemical gradients and add compounds in defined patterns and at a defined time. Various applications will be discussed, such as encoding chemical information [2], label-free kinetic analysis of enzymatic reactions [3], microbial growth and antibiotic drug testing [4].

## Keywords:

Droplet microfluidics, droplet arrays, high-throughput analysis, drug screening, label-free analysis

## References:

- [1] R. Strutt, B. Xiong, V. F. Abegg, P. S. Dittrich: Open Microfluidics: Droplet Microarrays as Next Generation Multiwell Plates for High Throughput Screening, *Lab Chip* 24, 1064-1075 (2024); doi: 10.1039/D3LC01024D
- [2] M. Breitfeld, R. Strutt, L. Fröhlich, C. L. Dietsche, S. Bargfrede, P. S. Dittrich: Liquid-in-Liquid Prints: High-Density Biochemically Encoded Information Preserved in Microdroplet Arrays, *Adv. Mat.* 38, e16338 (2026); doi: 10.1002/adma.202516338
- [3] M. Breitfeld, C. L. Dietsche, M. A. Saucedo-Espinosa, S. F. Berlanda, P. S. Dittrich: Ultrafast formation of microdroplet arrays with chemical gradients for label-free determination of enzymatic reaction kinetics, *Small* 21, 2410275 (2025); doi: 10.1002/sml.202410275
- [4] B. Xiong, M. Breitfeld, P. S. Dittrich: Two-Layer Droplet Arrays Enable Dynamic Manipulation of Cell Microenvironment During High-Throughput Bacterial Cultivation, *Small Meth.* 9, e01417 (2025); doi: 10.1002/smt.202501417