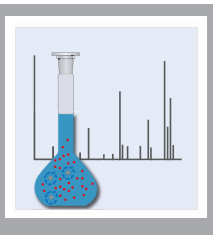
doi:10.2533/chimia.2011.978



Highlights of Analytical Chemistry in Switzerland

Division of Analytical Chemistry

A Division of the Swiss Chemical Society

Microdroplets and Magnetic Beads: Fishing for Molecules in nL Volumes

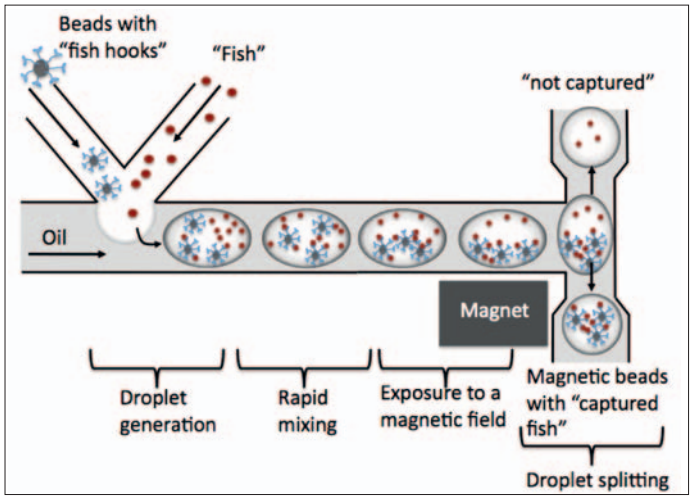
Dario Lombardi and Petra S. Dittrich*

*Correspondence: Prof. Dr. P. S. Dittrich, ETH Zurich, Wolfgang-Pauli-Str.10, CH-8093 Zurich, Tel.: +41 44 633 68 93, Fax: +41 44 633 16 21, E-mail: dittrich@org.chem.ethz.ch

Keywords: Lab-on-Chip device · Magnetic beads · Microdroplets · Microfluidics · Protein–drug interactions

Microfluidic platforms (more general: lab-on-chip devices) are nowadays widely used for applications in analytical and bioanalytical chemistry due the appealing properties they provide, *e.g.* for handling of small sample volumes and the integration of sample (pre)treatment steps. In recent years, microdevices designed for droplet-based microfluidics have attracted increasing interest, particularly for screening applications.

Microfluidic devices facilitate the continuous and robust generation of extraordinary monodisperse, aqueous droplets into a carrier stream (hydrophobic liquid or gas), having volumes as small as a few micro- to picoliters. These tiny droplets could serve as microreactors for synthesis and crystallization, or as microcarriers to provide a defined microenvironment for cells. Using chemical gradients during droplet formation, it becomes possible to screen for optimum reaction conditions, or to systematically investigate reaction kinetics or influences of chemical compounds (*e.g.* drugs) on cells. Despite their utilization in many scientific areas, it remains still challenging to integrate standard procedures such as washing and separation steps with continuous droplet microfluidics.



Scheme of the method for droplet generation and removal of molecules captured by magnetic beads.

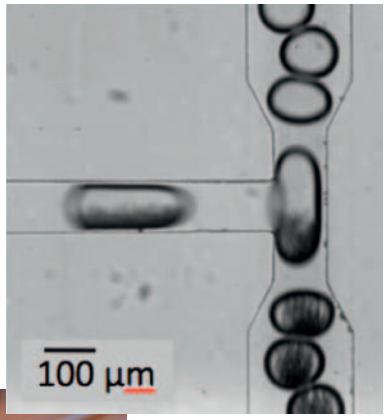
Recently, we could expand the applicability of droplet microfluidics by integrating a permanent magnet in the device and employing a magnetic bead-based assay. We used the method for characterization of drug-protein binding constants, here warfarin to human serum albumin (HSA). HSA is the most abundant protein in the human blood plasma and therefore, binding of drug molecules to HSA is an important parameter for drug characterization. Beads with surface-bound target molecules (HSA) are introduced the droplet generating microdevice together with target-binding molecules (warfarin). At the T-junction, droplets are split into two daughter droplets, one of which contain the beads and move towards the direction of the magnet, the other daughter droplets are free of beads and contain only residual unbound target molecules. Hence, the magnetic beads with bound molecules are efficiently separated from the bead-free solution. After analyzing the droplet content, we could derive the HSA-warfarin binding constant. **The continuous method lays the basis for a microfluidic droplet-based screening device aimed at investigating the interactions of drugs with specific targets including enzymes and cells. Furthermore, it could be employed for various applications, in which rapid removal of a (reactive) component or catalyst (immobilized on the magnetic beads) is required.**

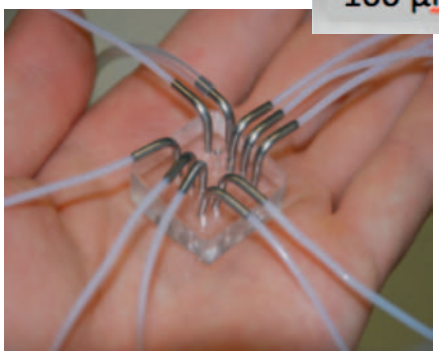
Received: September 27, 2011

Reference

D. Lombardi, P. S. Dittrich, *Anal. Bioanal. Chem.* **2011**, *399*, 347.

Micrograph of the T-junction, where droplets are split into two daughter droplets (flow from left to right). The black magnetic beads are moving towards the outlet where the magnet is placed, while the bead-free droplets are flowing towards the other outlet.





Photograph of a microdevice made of poly(dimethylsiloxane), channel inlets and outlets are connected to tubings.

Can you show us your analytical highlight?
Please contact: Dr. Veronika R. Meyer, EMPA St.Gallen, Lerchenfeldstrasse 5, 9014 St.Gallen
Phone: +41 58 765 77 87, Fax: +41 58 765 77 62, Mail to: veronika.meyer@empa.ch