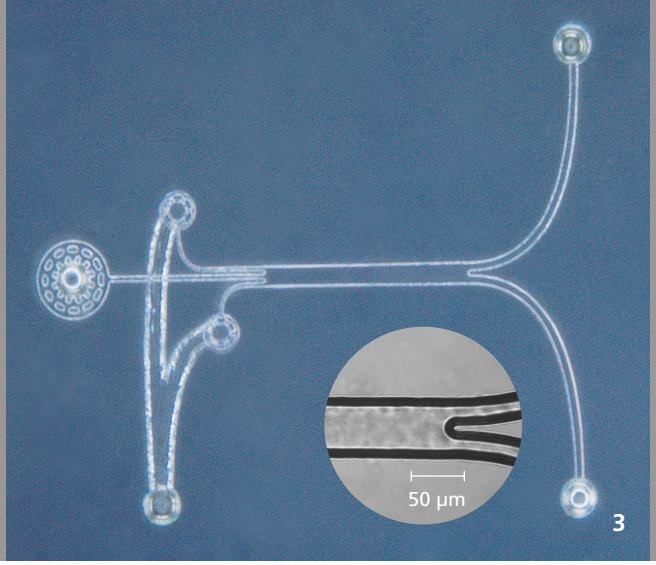
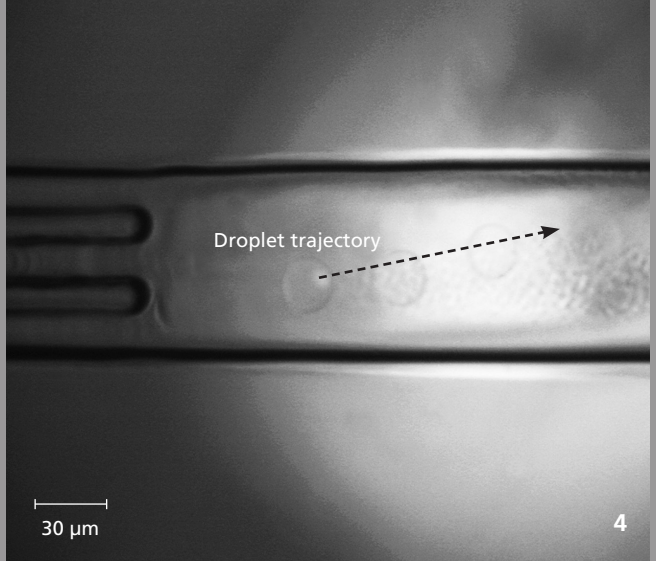


3



4

OPTOFLUIDIC SORTER FOR HIGH-THROUGHPUT SCREENING OF ENZYMES

Task

The advantages of biotechnology lie in its ecological and economical production compared to large-scale chemical production. In addition, it can be used to produce completely new types of products. The key to advancing biotechnological production processes is using the appropriate technical enzymes that catalyze these processes. To find such process-optimized technical enzymes, research needs to be able to screen millions of candidates obtained from gene libraries. This requires high-throughput processes that screen the activity of the enzymes and separate out the candidates with good catalytic properties.

Method

For each individual gene in the library, the corresponding enzyme is expressed in a micro-droplet in a cell-free manner. The enzyme activity in each micro-droplet can be measured via its fluorescence through enzymatic conversion of a substrate into a fluorescent product. In a microfluidic system, these droplets are examined for their fluorescence intensity at high-throughput with kilohertz frequencies. Droplets of high fluorescence intensity are separated from the droplet stream in a sorting chamber with dynamic optical tweezers. The force for deflecting the droplets is generated by the momentum transfer when the laser beam is refracted at the drop.

In collaboration with Fraunhofer IME, Fraunhofer ILT has developed this method as part of the DARWIN preliminary research project funded by the Fraunhofer-Gesellschaft. The institutes intend to screen a gene library with one million candidates within a few hours.

Results

In a fused silica microfluidic system, the droplets were hydrodynamically focused and classified according to their fluorescence signal. To date, screening rates of up to 5 kHz have been achieved. With optical tweezers, micro-droplets with a fluorescence signal above threshold can be deflected from the hydrodynamic focus within 8 ms. In this process, forces of several nanonewtons are achieved.

Applications

The optofluidic sorter can be applied primarily to screen enzymes expressed in a cell-free manner. It can also be used, however, to develop pharmaceutical products, screen chemical syntheses and sort heterogeneous cell ensembles.

Contact

Dipl.-Phys. Georg Meineke
Telephone +49 241 8906-8084
georg.meineke@ilt.fraunhofer.de

Dr. Achim Lenenbach
Telephone +49 241 8906-124
achim.lenenbach@ilt.fraunhofer.de

3 Microfluidic sorting chamber of the optofluidic sorter.
4 Trajectory of a microdroplet sorted out in the tweezer focus.