# Proteins and Cells on Chips: Microfluidic devices for biological applications

Hoon Suk Rho(h.rho@maastrichtuniversity.nl)
Instructive Biomaterials Engineering, MERLN Institute for Technology-Inspired Regenerative Medicine,
Maastricht University, THE NETHERLANDS

## Abstract

Microfluidics, a technology that manipulates fluids in micro-/nano-scale volumes [1], has been highlighted as a promising alternative for traditional analytics and diagnostics in chemistry and biology. In addition to benefits from a small volume, e.g., low sample consumption, precise control of fluids, and fast processing, microfluidics provides possibilities for high-throughput screening by automation and parallelization. With the concept of the miniaturized systems, we have developed various microfluidic platforms for rapid and multiplexed analysis of proteins and cells [2-4]. The devices composed of multiple PDMS (polydimethylsiloxane) layers, and microfluidic components, such as microvalves, micromixers, and microstructures, were combined on the chips. The operation of devices was automated with an in-house built pressure control system and LabVIEW software program. By adapting tens or hundreds of microvalves in a single device, multiple nanoliter reactors were integrated to perform parallel bio-analytical processes. Also, the concentration gradients of cofactors which influence on the behavior of target biomolecules were formed in the reactors for combinatorial analysis. Hence, the device could provide not only detailed information to identify the target molecule but also the interactions between various parameters to achieve a bird's-eye view on a complicated target system. Also, we have developed a new microvalve which can capture and release cell/particle in a microchannel [5], and the valve allowed various single cell analysis in microfluidic chips. Several prototypes will be presented to show the potential of microfluidic approaches in biological and biotechnological applications, e.g., protein adsorption, protein separation, enzyme kinetics, single cancer cell PCR, and drug dose response on single cancer cells. We evaluated the performance of our microfluidic designs, and the microfluidic chips have successfully shown to give comparable or even higher resolution and sensitivity than conventional analytical methods. The microfluidic analysis with extremely small sample consumption could be beneficial for the characterization of rare and expensive materials and identification of process conditions for bioprocessing. Also, the flexibility of the device in handling reagents and parallelization provides high potential for use in many different analytical applications.

***Keywords:*** *microfluidics, lab on a chip, high-throughput, protein separation, single cell analysis*

## References

[ 1 ] George M. Whitesides, Nature 442, no. 7101 (2006).
[ 2 ] Yoonsun Yang, Hoon Suk Rho, Michiel Stevens, Arjan GJ Tibbe, Han Gardeniers, and Leon WMM Terstappen., Lab on a Chip 15, no. 22 (2015).
[ 3 ] Hoon Suk Rho, Alexander Thomas Hanke, Marcel Ottens, and Han Gardeniers., PloS one 11, no. 4 (2016).
[ 4 ] Hoon Suk Rho, Yoonsun Yang, Alexander T. Hanke, Marcel Ottens, Leon WMM Terstappen, and Han Gardeniers., Lab on a Chip 16, no. 2 (2016).
[ 5 ] Marcia AMM Ferraz, Hoon Suk Rho, Daiane Hemerich, Heiko HW Henning, Helena TA van Tol, Michael Hölker, Urban Besenfelder et al., Nature communications 9, no. 1 (2018).

## Biography

Hoon Suk Rho received his B.Sc. in metallurgical engineering from Yonsei University, South Korea, M.Sc. in material engineering from Auburn University, USA, and Ph.D. in chemical engineering from University of Twente, the Netherlands. His research interests include microfabrication, microfluidics, single cell analysis, and biomaterials.