Deformability-based (micro)fluidic sorting

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1. Introduction

Biomedical applications often require to sort cells according to their intrinsic properties. Cell deformability has been identified as a promising biomarker in several pathologies. As microfluidic systems allow to generate well-controlled hydrodynamic forces and to manipulate microscopic objects individually, they are good candidates for probing cell deformability. A simple sorter, consisting of a straight channel obstructed by an obstacle and connected to a diverging chamber, has been studied numerically and suggested as a way to separate microcapsules according to their mechanical properties [1]. In such a system, the trajectory of capsules depends on their deformability but also on their lateral position in the main channel [2].

2. Methods

Channels are fabricated in PDMS. A flow focusing module is placed upstream of the main channel in order to center the capsules. The main channel is obstructed by a semi-cylindrical obstacle and suddenly widens. The flow in the diverging chamber is split towards five different exits. Channel dimensions are adapted to the size of objects to be sorted.
Ovalbumin microcapsules are diluted in glycerol and infused into the chip by the means of a pressure controller. Non-adherent cell lines are cultured in liquid media and treated with drugs (blebbistatin or cytochalasin D) to modify their mechanical properties.

3. Results

We first perform experiments at low pressures, so that hydrodynamic forces induce no significant deformation of the capsules. In this regime, capsule populations can be sorted according to their size. We measure how the trajectory of micro-objects in the sorter is influenced by their off-centering. Using a flow focusing module, we show that we can keep the off-centering below a desired threshold. We then demonstrate that a population of homogeneous size can be sorted according to deformability, provided objects are well-centered. Using microcapsules with controlled mechanical properties we show that our system can separate micro-objects whose surface shear modulus differs only by a factor 3.

References

[1] L. Zhu et al. A microfluidic device to sort capsules by deformability: a numerical study. *Soft Matter,* 10, 7705-7711 (2014)
[2] E. Häner, PhD thesis, University of Manchester (2017)
[3] D. Vesperini et al., Deformability- and size-based microcapsule sorting, *Medical engineering and Physics*, 48 68-74(2017)