Analysis of red blood cells behaviour in the microfluidic device

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The blood flow dynamics through the microvascular system, which is the end of our vascular system, depends on many factors, such as the exact shape of the vessels and the aggregation and deformation of the red blood cells (RBCs). [1] The effects of these parameters have been systematically studied in microfluidics, always using 2D channels with rectangular cross section. It has been shown, for example, that RBCs are not equally distributed between the main vessel and the daughter vessels. [2] The main drawback of this approach is that the micro-channels are inherently different from the physiological vessels, not only because the channels are rectangular, but also because they are confined to 2D.

The goal of this research project is to understand the interplay between aggregation, deformation and flow in model 3-D microfluidic channels as well as physiologically relevant shaped channels. The breakup of red blood cell aggregates as well as red blood cell dynamics will be studied by systematically varying the interaction strength between the red blood cells and the complexity of flow geometries. To this end, we will make use of a novel technique, Selective Laser-induced Etching (SLE), to produce 3D structures in glass that allows the design of bifurcations into different planes with any desirable shape. [3] This 3D design will be exploited to investigate shape memory effects and traffic of the red blood cells, using ultra-fast confocal microscopy.

References

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