Microfluidic chips with microscale traps for cancer cells study by confocal laser scanning microscopy

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Simulation

Simulation of cells movement in the work area of the microfluidic chip (MFC) was performed by numerical solution of equations with a help of finite element method. The sphere with the size of 20 microns was used as a model object (similar to cancer cells line K562). Simulation confirmed objects' fixation in traps (Fig. 1) and absence of device clogging.

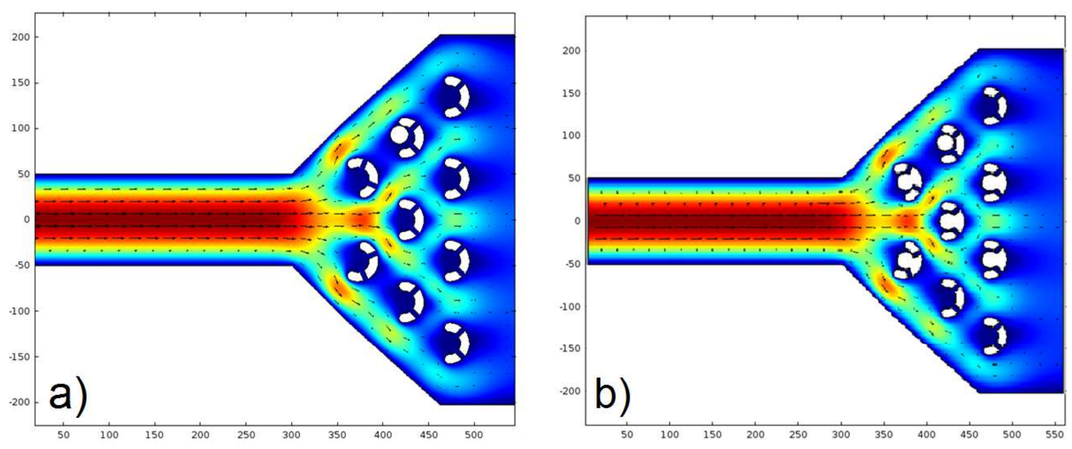

Fig. 1. The simulation results: a – fixation of one object; b – fixation of objects' group.

Fabrication

Using the results of the simulation MFC was designed (Fig. 2). Microstructures of MFC were fabricated by UV-lithography in SU–8 photoresist that is coated a glass substrate. SEM image of trap obtained by electron microscope CrossBeam Neon 40 (Carl Zeiss, Germany) is shown in Fig. 3.

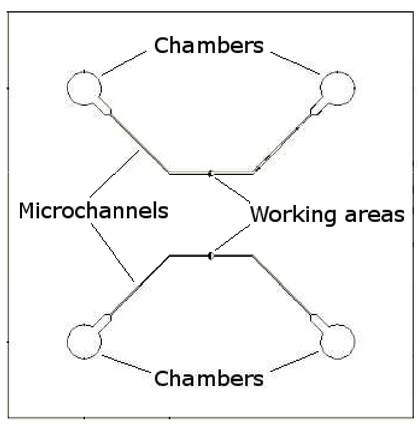

Fig. 2. Design of MFC with traps

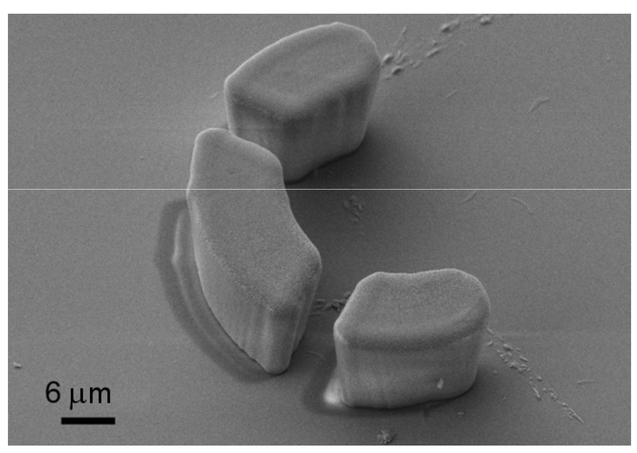

Fig. 3. SEM image of trap

Experimental results

Experimental setup was based on a confocal laser scanning microscope TCS SL (Leica, Germany) (Fig. 4). The results of experiment (Fig. 5) showed that trapping of K562 cells occurs in all traps of MFC. In the case when all traps filled cells flowed around the traps that fully complies with the simulation results.

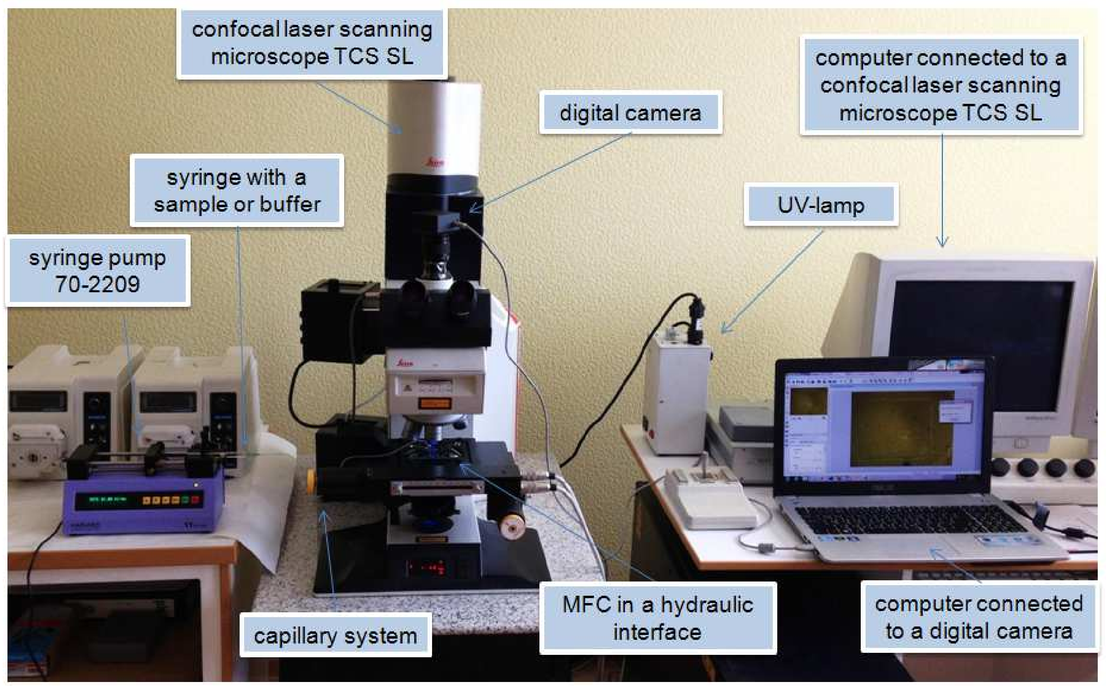

Fig. 4. Experimental setup

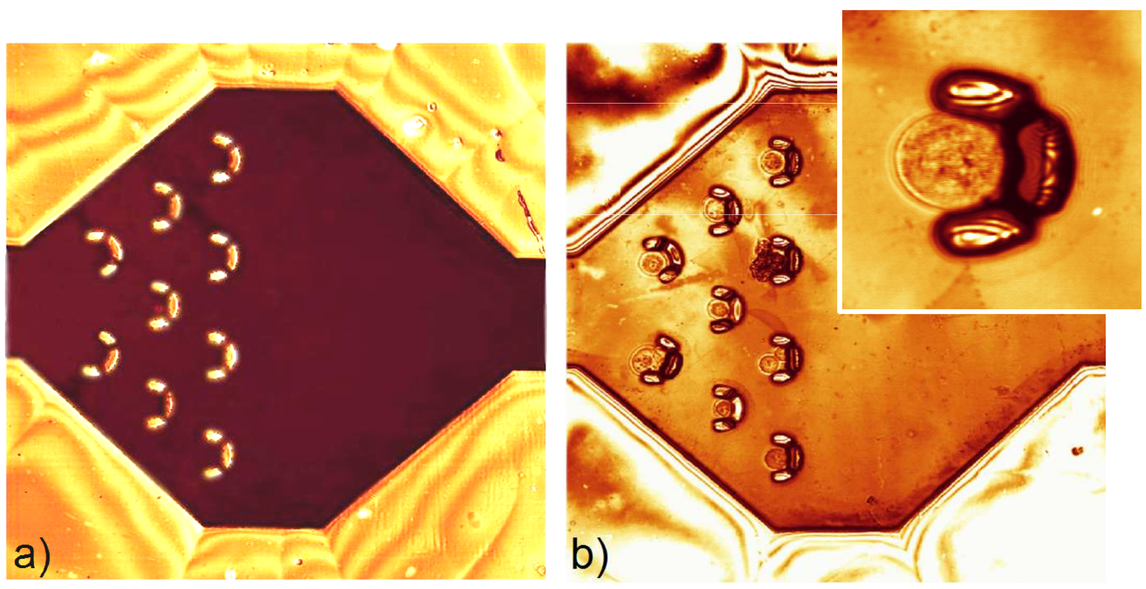

Fig. 5. Images (500x500 μm) of MFC's working area with traps: a – before cells' loading; b - after cells' loading.

Conclusion

Experimental results showed agreement with the model data and confirmed effective trapping of cancer cells for their study by confocal laser scanning microscopy in real time mode.

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