micromachines

Micromachines for bio-medical applications

Separation microfluidic device fabricated by micromilling techniques

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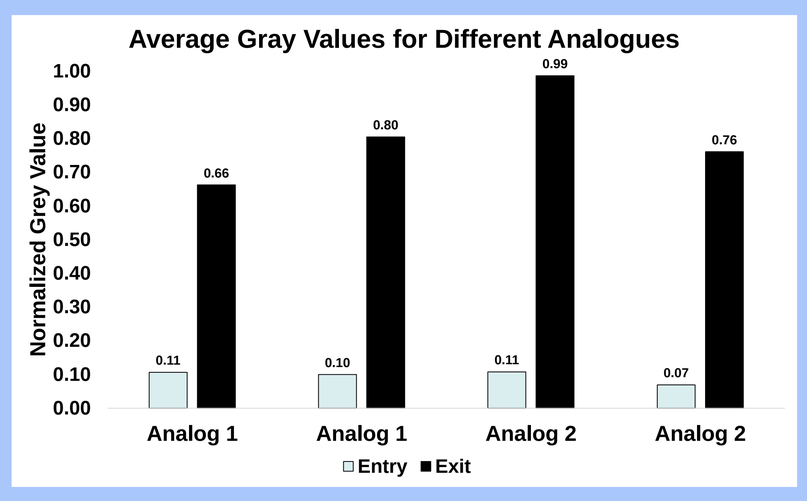
Background & Aim

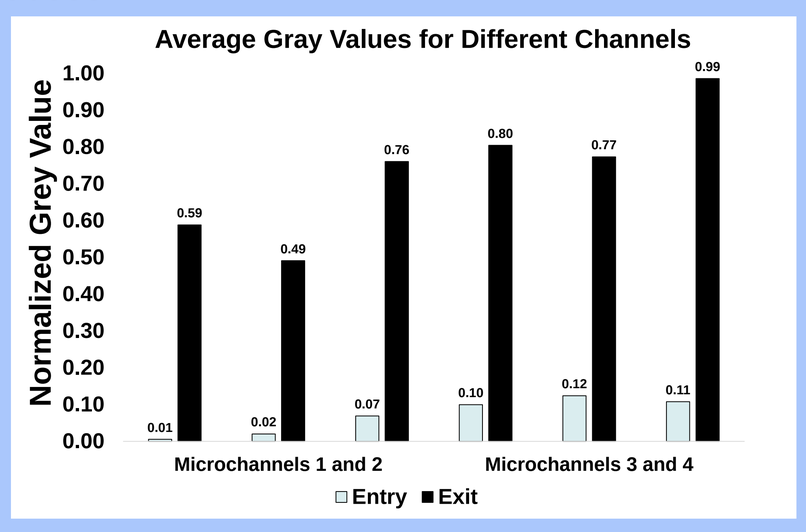
- Diagnostic of several diseases can be performed by analyzing the blood plasma of the patient
- Separation of the plasma from the blood cells methods still need to be improved
- Microfluidic biomedical devices can provide a low-cost solution
- A microfluidic device made by micromilling and sealed with the oxygen plasma technique was tested by means of two different blood analogue fluids

Results

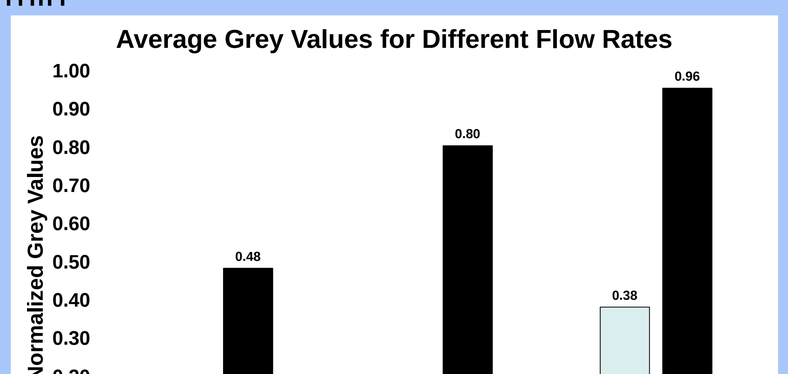
- Significant reduction of the amount of cells between the entrance and the exit of the microchannels



- No major influences from the depth of the channels and size of the particles on the separation process



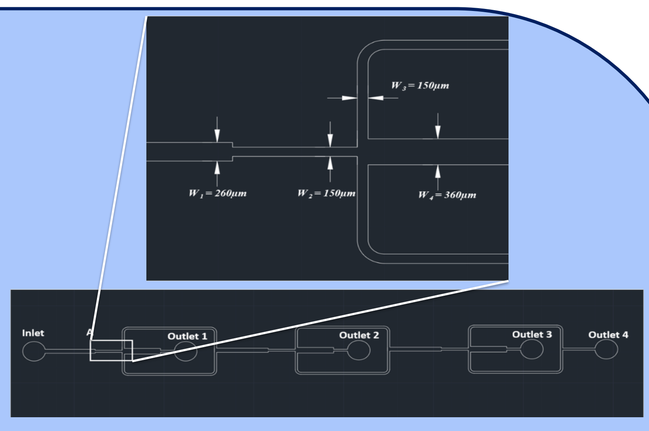
- Flow rate influenced the separation process. Best results were obtained for a flow rate of 100 µL/min

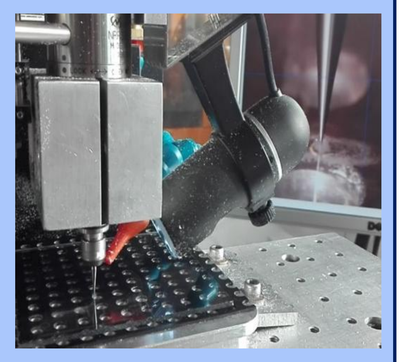


Methodology

<u>Microchannel geometry and fabrication</u>

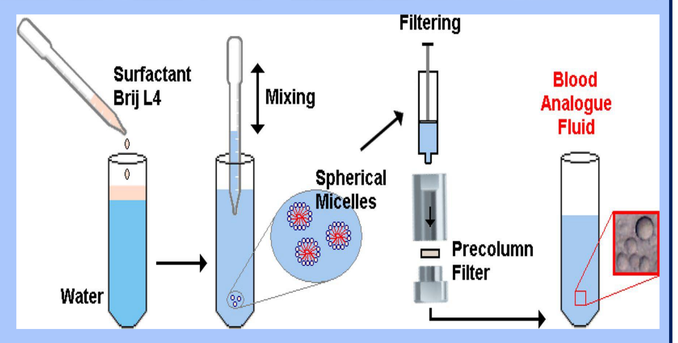
- Each microchannel has three separation segments connected in sequence
- Microchannel presents four different depths
- Device made from poly(methyl methacrylate) (PMMA) by a micromilling process





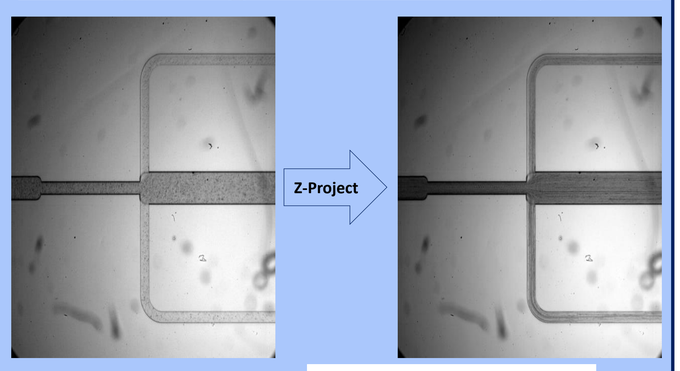
<u>Experimental Setup</u>

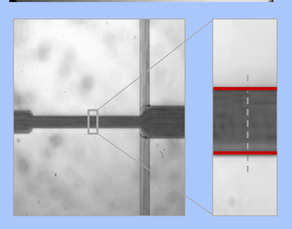
- Visualization and acquisition of the fluid flow using a high-speed video microscopy system
- Analogue solutions were made by adding the surfactant Brij L4 to distilled water (1 wt.%)
- Solutions were filtered by two filters of 10 and 20 µm average pore size
- Flow rates of 60 µL/min, 100 µL/min and 150 µL/min were used

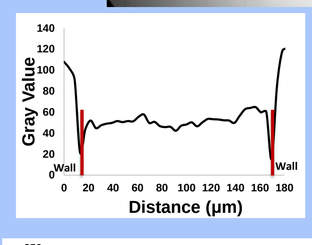


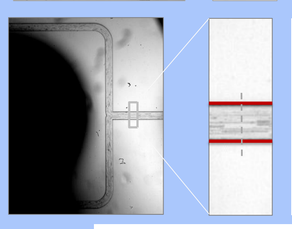
<u>Image processing</u>

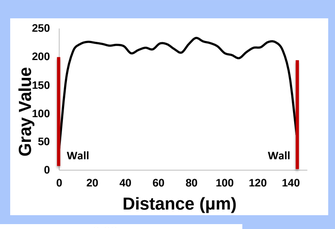
- Separation of particles and plasma was evaluated using the software ImageJ
- The gray intensity value was measured transversely to the entrance and exit of the channel
- High values correspond to brighter pixels which indicate regions with less particle density
- Lower values correspond to darker pixels and high particle density or channel walls
- The average of the values obtained was then calculated and normalized, considering the maximum gray value obtained using water, to a scale of 0 to 1 for result comparison

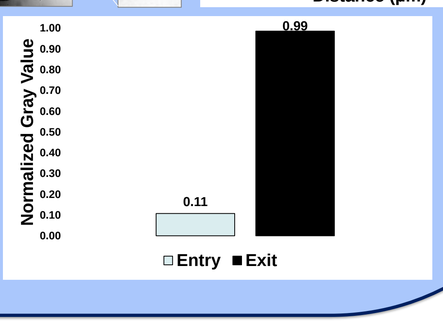












Conclusions

- Significant reduction of the amount the particles throughout the microchannel was registered
- Little influence of the microchannel depth and particle size on the particle separation process
- Further analysis and optimization of the microfluidic devices will be conducted
- The used method for microchannel sealing will be compared with the solvent bonding technique
- Different image analysis studies will be performed

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