

Preparation of Human Whole Blood Samples for Spectral Analysis of Soluted Blood Components with Magnetophoresis

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Introduction

- The goal of our project is the development of an optical sensor for human blood component analysis.
- Scattering of blood cells influences the absorption spectrum.
- Blood consists of 55 % blood plasma and 45 % blood cells.

Theory

- Fe^{2+} Atom inside hemoglobin is responsible for magnetic properties of red blood cells (RBC) [1].
- RBC should move along a high gradient magnetic field [2].

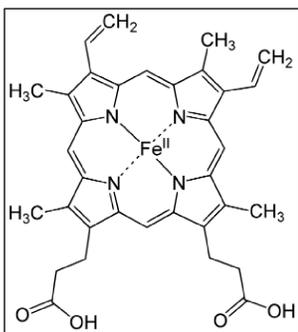


Fig. 1 - Constitutional formula of haemoglobin with iron ion (Fe^{2+}) surrounded by a heterocyclic porphyrin ring

	unpaired electrons	magnetic susceptibility
oxyhaemoglobin	0	diamagnetic
deoxyhaemoglobin	4	paramagnetic
methaemoglobin	5	paramagnetic

Methods

- N48 and N50 Neodymium-magnets are used for magnetic field.
- Rectangular ferromagnetic wire to generate high gradient magnetic field inside the channel.
- Preparation of whole blood samples using phosphate buffer saline and sodium nitrate in ratio of 1:20.

Outlook

- Investigation of diamagnetic capture mode.
- Increase of efficiency with two side channels.

Materials

	printed channel structure	main channel	side channel
width in mm	11.6	0.5	0.12
height in mm	3	0.1	0.1
length in mm	39.5	31	2

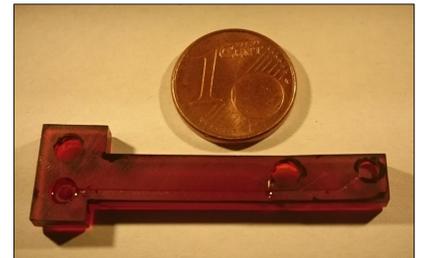


Fig. 2 - 3D printed microchannel with one euro cent for scale

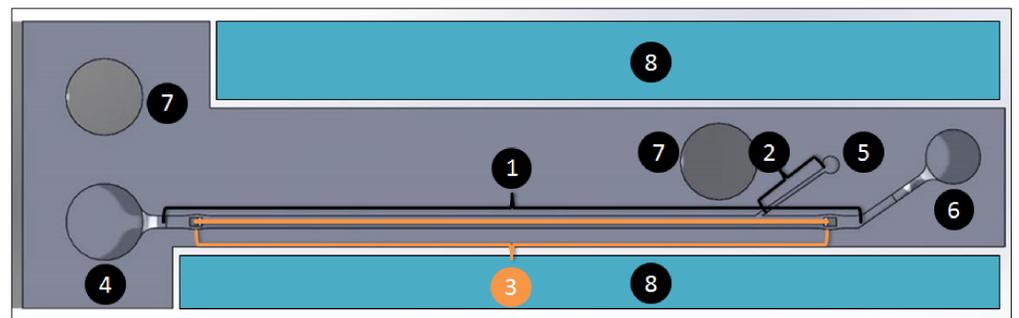


Fig. 3 - Design of microchannel: 1 main channel, 2 side channel, 3 ferromagnetic wire, 4 inlet, 5 plasma outlet, 6 cell outlet, 7 screw holes, 8 magnets

Results

- Blood cells move along high gradient magnetic field on rectangular wire.
- Cell free plasma can be captured on side channel.

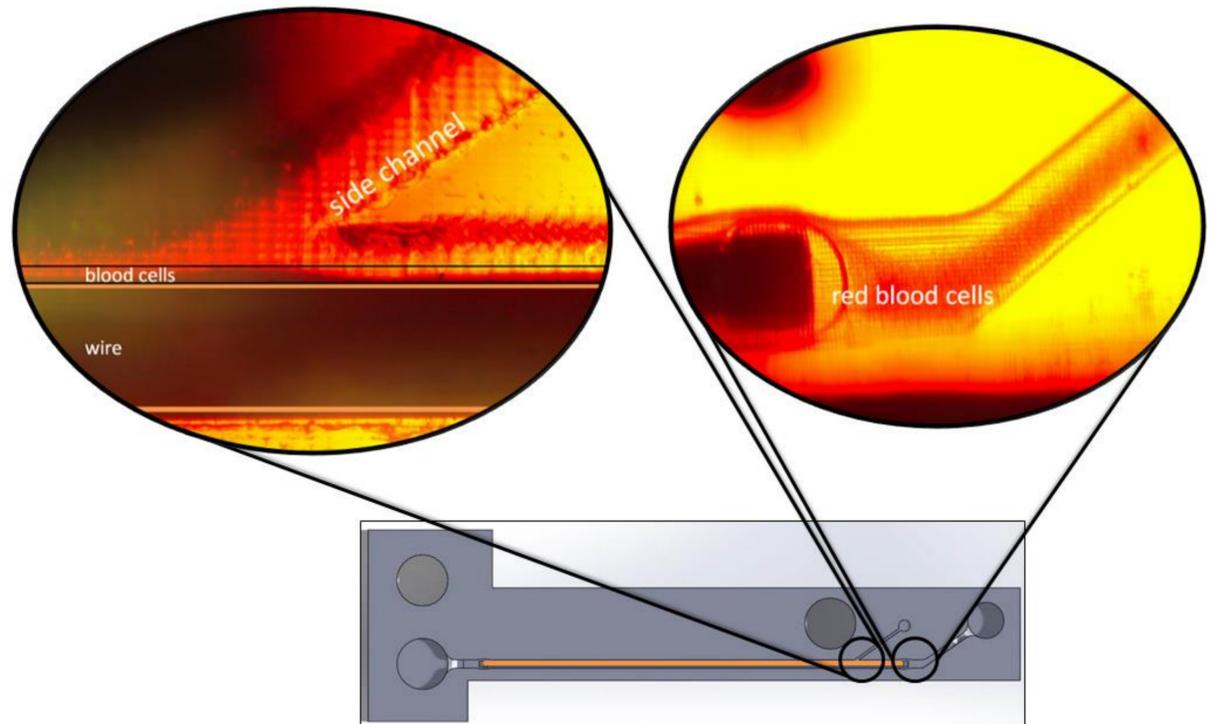


Fig. 4 - Separation of blood plasma and blood cells at different points with magnification of 200 in 3D printed microchannel with diluted blood

References

- Linus Pauling and Charles D. Coryell "The magnetic properties and structure of haemoglobin, oxy-haemoglobin and carbonmonoxyhemoglobin", Gates chemical laboratory, California institute of technology, communicated March 19, 1936
- Ki-Ho Han and A. Bruno Frazier; „Paramagnetic capture mode magnetophoretic micro separation for high efficiency blood cell separations“, Lab Chip, 6, 265-273, DOI: 10.1039/B514539B, 2006

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