Red Blood Cell Separation Using Magnetophoresis Force

Tran Si Bui Quang[1]

[1]Agency for Science, Technology and Research (Institute of High Performance Computing), Singapore

Abstract

The separation of RBCs is needed in many biomedical devices. RBCs contain hemoglobin, which in turn consists of iron that helps transport oxygen throughout the body. The permeability of deoxygenated red blood cells is about (1 - 3.9e-6). The permeability of oxygenated red blood cells is about (1 - 9.2e-6). The permeability of plasma is about (1 - 7.7e-6). Due to the difference of permeabilities, the oxygenated and deoxygenated RBCs can be separated from plasma by using magnetophoresis force. In this paper, we present the study of red blood cell separation in the straight channel. The RBCs are assumed to be dense so that their motions can be treated by continuous convection and diffusion equation.

Three modules in COMSOL Multiphysics are utilized: magnetic fields, laminar flow and transport of diluted spices. The steady solutions of magnetic field and velocity of plasma are input into the transportation equation through the convection velocity. The diluted RBCs convection velocity is analytically calculated from the gravitational force, magnetophoresis force and plasma velocity. The steady solution of RBCs concentration shows the efficiency of the separation method. We also present the optimal design in this study.

Figures used in the abstract

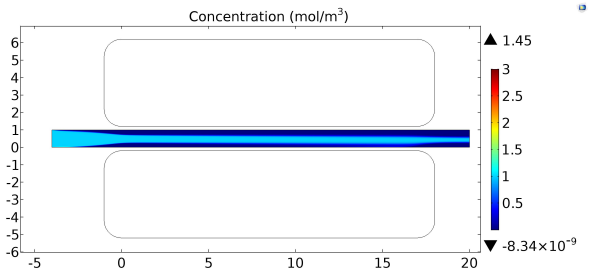

Figure 1: Figure 1: Concentration (mol/m^3) of oxygenated RBCs in the straight channel