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Simulation Of Microfluidic Blood Cells Micro-Separator

Aissa Foughalia

International Islamic University Malaysia (IIUM), Electrical & Computer Engineering

Malaysia

Abstract

Micro-sized separation devices are in a state of research globally due to its simplicity; cost effectiveness and high precision for analyzing biological and medical samples, e.g. blood cells. Magnetophoresis is a technique to separate cells on biochip by manipulating the magnetic property of biochemical substances, which can be used in special separation devices to separate blood cells based on their size and magnetic susceptibility.

COMSOL Multiphysics is ideal for the modeling and simulation of those devices. In this work, the micro-separator uses the combination of magnetophoresis with hydrodynamics in order to separate white blood cells and red blood cells by taking into account the magnetization of the ferromagnetic elements and fluidic forces on the cells. Here, the numerical analysis of the magnetic force on white blood cells and red blood cells were studied together with the effect of hydrodynamic elements inside the U-shape micro-channel. We used the calculated magnetic field for a quadruple configuration of permanent magnets to solve the recently-developed model for particles separation using hydrodynamic and magnetophoretic forces.

The three-dimensional results show that the combination of magnetophoresis and hydrodynamic force is capable of separating white blood cells and red blood cells as they flow through the micro-channel. The simulation made by COMSOL assisted us effectively to arrive at the best configuration of the magnet, microchannel and outlets before building those devices for experimental trials.