Iranian Journal of Physics Research, Vol. 20, No. 1, 2020

Pumping electrolyte fluid using focal light and electric field in rectangular microchannel

R Kiani-Iranpour[1] and S N Rasuli[1,2]

1. Department of Physics, University of Guilan, Guilan, Iran
2. School of Physics, Institute for Research in Fundamental Sciences (IPM), Tehran, Iran

E-mail: rezakiani@phd.guilan.ac.ir

(Received 08 December 2019 ; in final form 26 May 2020)

Abstract

The absorption of the focused light inside aqueous electrolyte locally heats it; thus, it creates a temperature field and temperature gradient around the light-absorbing region. Due to a phenomenon known as Soret effect, positive and negative ions move in the presence of the temperature field toward the warmer or cooler region. However, this tendency and its corresponding motion are not the same for two types of ions; therefore, it ends up with a locally charged region. This means creating a pure electric charge suspended in the light absorption area. Applying an external electric field to the fluid then exerts a force to the net charge and its surrounding fluid, resulting in the fluid's motion. We investigate this problem for an electrolyte fluid enclosed between two parallel transparent dielectric blades closely located to each other. Based on analytic and finite element methods, we calculate the temperature field created by the Gaussian beam inside and outside the electrolyte. We then obtain its induced electric potential and charge density. Finally, we calculate the fluid velocity field and the total induced current. The analytical and numerical results well verify each other.

Keywords: microfluidics, micropump, Soret effect

For full article, refer to the Persian section