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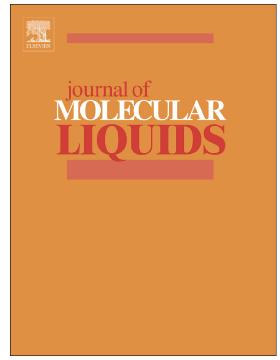

Electroosmotic flow of Williamson ionic nanoliquids in a tapered microfluidic channel in presence of thermal radiation and peristalsis

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Electroosmotic flow of Williamson ionic nanoliquids in a tapered microfluidic channel in presence of thermal radiation and peristalsis

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Abstract

This paper aims to analyze the electroosmotic flow of non-Newtonian ionic nanoliquids in presence of peristaltic propulsion. A geometric model is employed for a microfluidic tapered channel flow regime. Williamson's fluid model is utilized to characterize non-Newtonian nature of the base fluid. The normalized governing equations are reduced with lubrication approximations (long wavelength and low Reynolds number assumptions). Poisson-Boltzmann equation is also simplified by using Debye-Hückel linearization. No slip conditions are imposed at the channel walls. The analytical solutions are obtained for temperature field and nanoparticle volume fraction. However, a perturbation method is used to find out an approximate solution for axial velocity, pressure rise and volumetric flow rate. The perturbation solutions are further graphically illustrated with MATLAB software. The perturbation solution is also validated with numerical results simulated by MATLAB coding through BVP command. The effects of thermal radiation and non-Newtonian parameters on flow characteristics, pumping characteristics, wall shear stress and trapping phenomenon are discussed. A comparative study is also made to study the electroosmotic flow through uniform and nonuniform asymmetric microfluidic channel. This model can help to study the intrauterine fluid dynamics governed by electroosmosis mechanism. It can also be applicable in drug delivery, in vivo diagnostics, food diagnostics, packaging (smart sensors), DNA chips, protein chips and cell chips.

Keywords: *Williampson's fluid model; electroosmosis; peristaltic pumping; intrauterine fluid dyanamics; ionic nanoliquids; perturbation theory.*

1. Introduction

In rheology, most of the fluids are non-Newtonian in nature. However, the pseudoplastic fluids (viscosity of such fluids drops upon enhancement in the shear rate) are most commonly