

Accepted Manuscript

Theoretical investigation of steady isothermal slip flow in a curved microchannel with a rectangular cross-section and constant radii of wall curvature

Andriy A. Avramenko, Andrii I. Tyrinov, Igor V. Shevchuk

PII: S0997-7546(15)00096-5

DOI: <http://dx.doi.org/10.1016/j.euromechflu.2015.07.002>

Reference: EJMFLU 2918

To appear in: *European Journal of Mechanics B/Fluids*

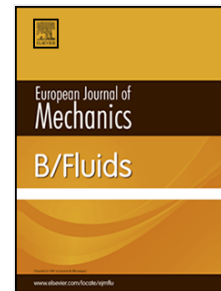
Received date: 15 January 2015

Revised date: 3 May 2015

Accepted date: 7 July 2015

Please cite this article as: A.A. Avramenko, A.I. Tyrinov, I.V. Shevchuk, Theoretical investigation of steady isothermal slip flow in a curved microchannel with a rectangular cross-section and constant radii of wall curvature, *European Journal of Mechanics B/Fluids* (2015), <http://dx.doi.org/10.1016/j.euromechflu.2015.07.002>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



Theoretical investigation of steady isothermal slip flow in a curved microchannel with a rectangular cross-section and constant radii of wall curvature

Andriy A. Avramenko^a, Andrii I. Tyrinov^a, Igor V. Shevchuk^b

^a *Institute of Engineering Thermophysics, National Academy of Sciences, Kiev 03057, Ukraine*

^b *MBtech Group GmbH & Co. KGaA, 70736 Fellbach-Schmiden, Germany*

Abstract

The paper presents results of an investigation of the slip flow in a curved microchannel with a rectangular cross-section. Solutions of the problem were obtained analytically using the Fourier method and the method of the eigenfunction decomposition demonstrating thus the applicability of two different analytical approaches to the solution of the fluid flow problems in microchannels. In addition, a numerical approach based on the Lattice Boltzmann method (LBM) was employed. The velocity profiles in the microchannel were obtained with the help of the infinite series solutions validated against the numerical simulations. The solution yields the relations, which enable estimating the hydraulic resistance coefficient and the initial length of the developing flow in the microchannel as the functions of the Knudsen number and the flow curvature parameter.

1. Introduction

The microchannel flows, which take place in various micro-fluidic devices such as micro-electro-mechanical systems, bioengineering and micro-energy systems, have been in the focus of the persisting scientific and practical interest during the last few decades. The micro-fluidic devices are extremely small and operate in the range of the micro-scales whose characteristic length is of the micrometer order of magnitude. This engenders the situation, where the scaling laws used for the common engineering applications do not hold for the microscale geometries influenced predominantly by the decrease in the length scales in the flow pattern and to a smaller extent by the rarefaction effects due to the reduced density [1].

Download English Version:

<https://daneshyari.com/en/article/650293>

Download Persian Version:

<https://daneshyari.com/article/650293>

[Daneshyari.com](https://daneshyari.com)