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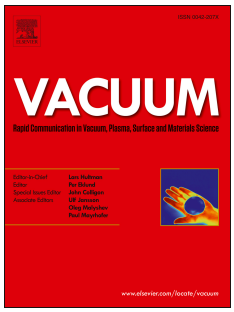

Investigation of rarefied gas flow through bended microchannels

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Abstract

Due to complexities of microfluidic devices, not all of the micro-ducts are straight. As a result, there is a need for utilizing geometric turns and serpentine microchannels. The main purpose of this study is to investigate the effect of applying sharp bends and curved corners to the microchannel geometry on the thermal and hydrodynamic behaviors of rarefied gas flow. In this regard Direct Simulation Monte Carlo method has been employed with pressure driven implicit boundary condition. Comparisons of mass flow rate, slip velocity, shear stress and heat transfer have been carried out between these cases. The obtained results depicted that the mass flow rate is increased by applying curvatures of various radii and the maximum enhancement in mass flow rate is for a radius-to-width ratio equal to 0.6.

Keywords: rarefied gas flow; microchannel; heat transfer

Introduction

In recent decades, micro-electro mechanical system (MEMS) devices have found numerous industrial and academic applications such as in micro-engines, micro-sensors, electronics cooling, etc. Study of gaseous flows has attracted interest among researchers due its wide range of applications such as in micro-fuel cells, micro-pumps and micro-valves. As the molecular mean free path becomes comparable to the length scale of the MEMS devices, the continuum flow assumptions behind extracting the Navier–Stokes (NS) equations deteriorate. At this point,