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Kiril S. Shterev, Stefan K. Stefanov

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A two-dimensional computational study of gas flow regimes past of square cylinder confined in a long microchannel

Kiril S. Shterev*, Stefan K. Stefanov

Institute of Mechanics, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., Block 4, Sofia 1113, Bulgaria

Abstract

In this paper, the transition between steady and unsteady regimes of the two-dimensional gas flow past a moving square cylinder confined between two parallel plates with equal temperatures was investigated for different subsonic and transonic speeds and blockage ratios B=3, 5, 10 and 20 (B is the ratio between microchannel height and square size). The influence of B on the drag coefficient of the square, pressure at stagnation point and transition between steady and unsteady regime were studied. A set of transition curves were obtained for different blockage ratios. The results showed a similar shape of the neutral curves, which shifts to lower Knudsen and Mach numbers when B decrease. A continuum approach based on the Navier-Stokes-Fourier equations was basically applied to all flow regimes. Navier-Stokes-Fourier equations was calculated numerically by using pressure based finite volume algorithm SIMPLE-TS. For the initial transition velocity slip regime, the results were compared to data obtained by using the particle Direct Simulation Monte Carlo (DSMC) method.

Keywords: transition, steady flow regime, unsteady flow regime, microflows, continuum model, SIMPLE-TS, molecular model, DSMC, SBT
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*Corresponding author
Email addresses: kshterev@imbm.bas.bg (Kiril S. Shterev), stefanov@imbm.bas.bg (Stefan K. Stefanov)