

DSMC simulation of the gas flow through a bend and a short microchannel

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Abstract

The present work is related to the study of the gas flows through micro-channels with 90° bend, and short straight channels. The direct simulation of Monte Carlo (DSMC) method has been used to study the flow. The DSMC simulations of the gas flow through micro-channels of real dimensions, which are used in the laboratory or in industry, are computationally very expensive, requiring large amounts of the computer resources and time. This fact places a limit on the applicability of the DSMC method while considering the real channel dimensions. It is a good practice to approximate the three dimensional micro-channel into two dimensions, and to study the flow characteristics. When the channel width is essentially large in comparison with their heights, however, the simulation of gas flows in more complicated channels with rectangular cross-section having comparable height and width unavoidably requires a 3D consideration. In the present paper, the 3D flow through a bend and short straight channels are presented, and the flow characteristics studied using the DSMC method. The complete 3D simulations were carried out for the case the height H at $19.83e-6\text{m}$ considering to the same as the one used in the laboratory (without taking similarity of the flow into consideration for the reduction of the actual dimensions of the channel). However, the other dimensions (length and width) were chosen different from the real channel due to the computational requirements. Two types of pressure boundary treatment have been implemented in three dimensions using the DSMC method.