

عنوان مقاله:

Effects of roughness on rarefied gas flow in a microfluidic channel with porous walls

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خلاصه مقاله:

This study attempts to investigate the effect of roughness on rarefied gas flow inside microchannels with rough walls. The model presented in this paper makes use of a microchannel with cuboid geometry. In this simplified microchannel, the rough walls have been modelled as porous media, which are assumed to exhibit a similar behavior to rough surfaces. Using this simplification, both Navier-Stokes and Darcy-Brinkman equations were used to derive analytical solutions for velocity profile, pressure distribution, and mass flowrate inside the microchannel. Subsequently, these analytical solutions were plotted and numerically visualized to study the effects of the inverse Knudsen number, porous media thickness and permeability on the gas flow from a theoretical point of view. Furthermore, a separate means of numerically simulating the porous interface inside the microchannel was implemented via COMSOL Multiphysics to cross-check the analytical solution. The results of the COMSOL simulation were, then, compared with the numerical visualizations of our analytical results to provide a ground for comparison between these two. This comparative study showed agreement between these two methods in velocity profile of the core region of the microchannel and the pressure distribution, while also demonstrating a disparity in the predicted velocity profiles inside the porous regions. Ultimately, the reason behind this difference was investigated and hypothesized about

کلمات کلیدی:

Roughness, rarefied gas flow, porous media

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