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Rarefaction effects in microchannel gas flow driven by rhythmic wall contractions KRISHNASHIS CHATTERJEE, ANNE STAPLES, Virginia Tech, DEPARTMENT OF BIOMEDICAL ENGINEERING AND MECHANICS, VIRGINIA TECH COLLABORATION — Current state of the art microfluidic devices employ precise and timely operation of a complex arrangement of micropumps and valves for fluid transport. A much more novel flow transport mechanism is found in entomological respiratory systems, which involve rhythmic wall contractions for driving the fluid flow. The practical viability of using this technique in future microfluidic devices has been studied earlier. The present study investigates the incorporation of rarefaction effects in the above model of microscale gas flow by including slip boundary conditions. The Navier Stokes equations for gas flow in rectangular microchannel are solved analytically with microscale and lubrication theory assumptions. First order slip boundary conditions are incorporated to account for the rarefaction effects. The dependence of fluid velocities and pressure gradient on the slip boundary conditions is studied. Time averaged unidirectional fluid flow rates are plotted for different phase lags between the contractions, with and without slip in order to obtain an optimum range under different conditions.

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