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Nitrogen Flow in a Nanonozzle with Heat Addition SERGEY AVERKIN, ZETIAN ZHANG, NIKOLAOS GATSONIS, Worcester Polytechnic Institute — The nitrogen flow in conical nanonozzles at atmospheric pressures are investigated using a three-dimensional unstructured direct simulation Monte Carlo (U3DSMC) method. The DSMC simulations are performed in computational domains that feature the plenum, the nanonozzle region and the external plume expansion region. The inlet and outlet boundaries are modeled by the Kinetic-Moment (KM) boundary conditions method. This methodology is based on the local one dimensional inviscid (LODI) formulation used in compressible (continuous) flow computations. The cross section for elastic collisions is based on the variable hard sphere (VHS) model. The Larsen–Borgnakke (L-B) model is used to simulate the exchange of the internal energy in the collision pair. Solid surfaces are modeled as being either diffuse or specularly reflecting. The effects of Knudsen number, aspect ratio, and nanonozzle scale on the heat transfer are investigating by ranging the throat diameters from 100-500 nm, exit diameter from 100-1000 nm, stagnation pressure from 1-10atm, and wall temperature from 300K-500K. Finite backpressure and vacuum conditions are considered. Macroscopic flow variables are obtained and compared with continuum predictions in order to elucidate the impacts of nanoscale.

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