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Nanoparticle Knudsen Layers in Gases J.R. TORCZYNSKI, M.A. GALLIS, D.J. RADER, Sandia National Laboratories — When diffusing toward a wall bounding an air-filled microscale region, nanoparticles form a particle Knudsen layer similar to the molecule Knudsen layer formed by a gas. At the wall, the particle number density has a nonzero value proportional to the particle flux. An approximate theory based on the generalized Fokker-Planck equation is developed for the nondimensional "particle-flux coefficient" of the proportionality, which depends on the reflection process and the drift velocity. Massively parallel Langevin particle simulations are performed to assess the accuracy of the theory. The particle-flux boundary condition can be used in advection-diffusion simulations of gas-phase nanoparticle transport in the same way that the velocity-slip and temperature-jump boundary conditions are used in fluid-dynamics and heat-transport simulations. This approach agrees well with Langevin simulations of particles injected into the gas-filled gap between two parallel plates. Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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