

Direct Simulation Monte-Carlo Method for Modeling of Particle Deposition at High Knudsen Numbers

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ABSTRACT

There are many papers published recently, in which the deposition of particles of fibrous collectors is considered, using the classical continuum approach for description of the process. Such a model cannot be used in the case of nanofibrous filter, when the continuum feature breaks down.

The direct simulation Monte-Carlo method (DSMC) was used for description of the gas flow and particle motion and deposition on a single fiber as an element of the hexagonal array of multifibrous filter model. The carrier gas velocity distribution is described as a result of an evolution of initial Maxwell distribution due to collision of gas particles (molecules) in the cell system of the domain of calculation. The aerosol particle velocity is calculated from the balance of its momentum after collision with a gas molecule. The random trajectory of particle was used for calculation of the deposition efficiency. Results of calculation of the particle deposition efficiency as a function of the particle diameter are qualitatively similar for those obtained from experiment. The relation of the deposition efficiency and Knudsen number was found as a power law with the power coefficient equal -1.8.