Heat and Mass Transfer in Open Nanosystems of Cylindrical Type

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Heat and mass transfer in open systems is of great interest from both theoretical and practical points of view. The research of transfer process in a simple system (cylindrical, slot) is of particular interest because the equations describing the transfer process are the simplest form.

Particle transfer process is carried out in different flow regimes. The macroscopic and the intermediate transfer regimes are characterized by the transfer of multiple interactions of particles and double-particle collisions, respectively. In the free molecular regime ($K_n \to \infty$) the transfer process is characterized by almost complete absence of particle collisions in the gas phase. Particle fluxes in the free molecular regime are determined by particle collisions with the walls of systems. This circumstance is of particular interest it can reveal fundamental aspects of gas-solid interaction. The description of a stationary process of heat and mass transfer in the free molecular regime is impossible with macroscopic equations and the Boltzmann equation. There can be large fluctuations of the density of gas particles in this flux and non equilibrium interaction of gas particles with the surface of the walls. For the analysis of particle flux in this chaotic regime can be used either the Monte Carlo method or the molecular dynamics method [1,2].

The peculiarity of particle transfer in nanosystems is that the sizes of particles are commensurable with the sizes of systems. In this work have been analyzed the influence of system sizes and the dimensionless parameter r = U / kT, where U is the binding energy with the walls of systems and surface of the condensed phase, T is the system temperature, k is the Boltzmann constant on the particle fluxes.

As a result of the computer research have been defined probabilities of particle escape from the systems, particle distribution on the sprayed surfaces and the energies of particles escaping from the systems for different values of parameter r.

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