Abstract

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Prediction of the Thermal Conductivity of Gas Mixtures Using Direct Simulation Monte Carlo Method

The thermal conductivity of gas mixture filling the gap between two parallel plates was obtained and analyzed using Direct Simulation Monte Carlo technique (DSMC). The thermal conductivity of the gas mixture is not a simple linear relation between the conductivities of gas species in the mixture. The DSMC method provides the right technique for simulating molecules to determine the thermal conductivity of the mixture. The molecules are considered as hard sphere ones while the gas gap boundaries are diffusive surfaces. Two sets of values of temperatures had been used. The first set considers the hot and cold plate temperatures at 325.7 and 245.7 K, respectively. This set is used to examine the efficiency and credibility of the DSMC method when used for a gas mixture and to assure that the results show the expected temperature and pressure profiles similar to those obtained in the case of single gas molecules. The second set uses temperatures of 306 and 300 K to evaluate the thermal conductivity at the average temperature value of 303 K. The molar fractions with position had been checked to make sure that the DSMC simulates the collisions and motion of different gas molecules in the right way. The results were consistent and the relative difference between them is due to the normal statistical fluctuations arising due to the low number of simulating molecules than real ones. The DSMC technique is a well-established method to represent and calculate the macroscopic properties of a gas mixture especially when the gas is in the transition region between continuum and free molecular regimes.