Quantum Calculations of Transport Coefficients for Helium-Argon Mixture at Low Density
Based on Ab Initio Potentials

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The transport coefficients for helium-argon mixture at low density have been calculated for a wide range of temperature and various molar fractions, applying the Chapman-Enskog method to the Boltzmann equation using the 10th order approximation of the Sonine polynomial expansion. The transport cross sections and omega integrals have been obtained considering the quantum effects for all kinds of intermolecular collisions. A combination of the quantum and semi-classical approaches allows us to calculate the transport coefficients, i.e. viscosity, thermal conductivity, diffusion coefficient, and thermal diffusion factor, in a wide range of the mixture temperature, viz., from 5 K up to 5000 K. We have used the most complete ab initio intermolecular potentials available in the open literature to describe the intermolecular collisions. Since each employed potential has different accuracy, the uncertainty related to such accuracies was analyzed considering the contribution of each potential uncertainty. The analysis of the uncertainty related to the ab initio potentials, an estimation of numerical errors, and comparisons with other results for the same mixture obtained in the frame of classical theory show that the reported results are most exact for the helium-argon binary mixture at the moment, which shows that these results can be used as standard values for the temperature range considered here.