Abstract

To describe the nucleation process with the help of modern theories, the exact knowledge of the intermolecular potentials is essential. In order to provide a consistent dataset for a critical test of these theories, the homogeneous nucleation of simple substances like argon and nitrogen with helium as carrier gas has been investigated. Therefore the onset of nucleation of argon at temperatures from $42 \leq T / \mathrm{K} \leq 58$ and supersaturations from $11 \leq S \leq 105$ as well as the onset of nucleation of nitrogen at temperatures from $42 \leq T / \mathrm{K} \leq 54$ and supersaturations from $9 \leq S \leq 36$ is determined. Unfortunately the growth of the droplets was too fast to measure directly the experimental nucleation rate J_{exp}. On the other hand it is possible to estimate a nucleation rate of $\log(J_{exp}/\mathrm{cm^{-3}s^{-1}}) = 7 \pm 2$ for the measured onsets. At the experimental supersaturations and temperatures the classical nucleation theory by *Becker* and *Döring* predicts nucleation rates for argon which are 16 to 26 and for nitrogen 9 to 19 orders of magnitude below the experimental results. Also compared to classical theory a weaker temperature dependence is found, an effect which is well known for many other substances like water and alcohols. None of the presently existing theories can explain these discrepancies. A promising ansatz to calculate the nucleation rates of argon with the help of scaling laws and Monte-Carlo simulations is discussed. In addition, an empiric function for the quantitative calculation of nucleation rates of argon and nitrogen is given.