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Isothermal Nucleation Rates in Supersonic Nozzles and the Properties of Small Water Clusters.
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We have measured quantitative nucleation rates for water condensation in supersonic nozzles. To summarize, we use conventional pressure trace measurements to define the characteristic time, temperature and supersaturation that correspond to the maximum nucleation rates. Small angle neutron scattering experiments yield the number concentration of the aerosol that formed during the nucleation burst. After correcting for density changes, the experimental nucleation rate J is simply equal to the aerosol number density divided by the characteristic time. Nozzles with different expansion rates have characteristic nucleation rates ranging from $10^{14} < J / cm^{-3}s^{-1} < 10^{17}$. By applying the first and second nucleation theorems to the data we can directly estimate the number of molecules in the critical cluster n^* and the excess internal energy $E_x(n^*)$, respectively. The agreement between these values and the classical values predicted assuming the critical cluster is a compact spherical object are really quite good even though under our conditions n^* is less than10.