# Homogeneous Nucleation of Water Droplets: Role of the Real Gas Behavior of the Vapor–Carrier Gas Mixture

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Most experimental studies on homogeneous nucleation (initial phase of phase transition in absence of foreign nucleation centers) of water droplets used argon, helium, or nitrogen as a ‘’carrier gas’’ in which water vapor was diluted. Heat capacity of the carrier gas helps to keep the nucleation process practically isothermal (although poor thermalization effects can be observed at high vapor concentrations), and it slows down the growth of nucleated droplets, which is governed by diffusion of vapor towards the droplet. At elevated pressure, the gas adsorbs onto the surface of molecular clusters. This leads to a reduction of the surface tension and, consequently, to an enhancement of nucleation rate.

Typically, the vapor–carrier mixture is considered as an ideal gas. This assumption is then used to evaluate the supersaturation and to deduce the nucleation temperature based on measured nucleation pressure in experiments based on adiabatic expansion.

We performed a study of homogeneous nucleation of water droplets in various carrier gases: argon, nitrogen, nitrous oxide [1], carbon dioxide, and mixtures of carbon dioxide with nitrogen. The pressure was close to atmospheric. Unlike in high-pressure experiments [2], the real gas effect on supersaturation was almost negligible. However, the effect on nucleation temperature was quite strong. When the expansions were evaluated with ideal-gas formulas, the measured nucleation rates showed a considerable effect of various gases. This was almost eliminated with real-gas computations.

We discuss modeling of the gaseous mixture with virial equation and implementation of the nucleation theorem in terms of fugacities [2].

## References

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