

Low temperature reaction kinetics of molecular cluster formation

of interest for planetary atmospheres

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Pathways leading to the formation and growth of aerosols in planetary atmospheres remain far to be well understood. From a physical viewpoint, the precise steps of molecular condensation remain elusive too. Although nucleation processes have been intensively studied (see Ref. (1) and references therein), major uncertainties remain in our understanding of the mechanisms involved. The usual experimental methods generally provide a means for estimating the nucleation rates, i.e., the number of nuclei formed per unit time and per unit volume, as a function of saturation and temperature. These rates vary over orders of magnitude as they appear to be very sensitive to the physical conditions. Classical nucleation theory generally fails to provide accurate estimates of the absolute nucleation rates. This shortcoming motivates continuing efforts to develop a fundamental understanding of the nucleation mechanisms at the molecular level where the intermolecular interaction potential is of crucial importance.

We will first present an experimental and theoretical kinetic study of neutral water molecular cluster formation at low temperature (2). Preliminary results on the kinetics of formation of small hydrocarbon dimers of interest for cold planetary atmospheres such as Titan's, will also be presented. The experiments were performed using cold uniform supersonic flows generated by a series of Laval nozzles in a CRESU (Cinétique de Réaction en Ecoulement Supersonique Uniforme) apparatus (3).

References

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