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Investigation of Volume-Dependent Homogeneous Ice Nucleation of Water Droplets Using a Microfluidic Device

B. Riechers (1), F. Wittbracht (2), A. Hütten (2), and T. Koop (1)

(1) Bielefeld University, Faculty of Chemistry, Bielefeld, Germany (thomas.koop@uni-bielefeld.de), (2) Bielefeld University, Faculty of Physics, Bielefeld, Germany

Investigations of the kinetics of phase transitions are of fundamental importance for the understanding of many atmospheric processes occurring in aerosols and clouds. However, existing measurements often show a wide range of reported nucleation rates, in particular for ice nucleation processes.

Here, we focus on studying volume-dependent homogeneous ice nucleation in water droplets. As homogeneous nucleation is a stochastic process, studying many droplets of the same size is a prerequisite for deducing meaningful nucleation rates. We have prepared monodisperse water droplets with mean diameters between 50 μm and 100 μm and small standard deviations by employing microfluidic channels on a lab-on-a-chip device. Rather than studying the produced droplets on-chip in a very complicated and delicate device, we collected the droplets for off-chip ice nucleation analysis with a standard differential scanning calorimeter. The obtained freezing signals were analysed to obtain volume-dependent homogeneous ice nucleation rates, which are then compared to previously reported values.