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The Ice Nucleation Activity of Surface Modified Soot

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The ice nucleation efficiency of many important atmospheric particles remains poorly understood. Since soot is ubiquitous in the Earth's troposphere, they might have the potential to significantly impact the Earth's climate (Finlayson-Pitts and Pitts, 2000; Seinfeld and Pandis, 1998).

Here we present the ice nucleation activity (INA) in immersion freezing mode of different types of soot. Therefor a CAST (combustion aerosol standard) generator was used to produce different kinds of soot samples. The CAST generator combusts a propane-air-mixture and deposits thereby produced soot on a polyvinyl fluoride filter. By varying the propane to air ratio, the amount of organic portion of the soot can be varied from black carbon (BC) with no organic content to brown carbon (BrC) with high organic content. To investigate the impact of functional sites of ice nuclei (IN), the soot samples were exposed to NO_2 gas for a certain amount of time (30 to 360 minutes) to chemically modify the surface.

Immersion freezing experiments were carried out in a unique reaction gadget. In this device a water-in-oil suspension (with the soot suspended in the aqueous phase) was cooled till the freezing point and was observed through a microscope (Pummer et al., 2012; Zolles et al., 2015)

It was found that neither modified nor unmodified BC shows INA. On the contrary, unmodified BrC shows an INA at -32˚C, which can be increased up to -20˚C. The INA of BrC depends on the duration of NO_2- exposure. To clarify the characteristics of the surface modifications, surface sensitive analysis like infrared spectroscopy and X-ray photoelectron spectroscopy were carried out.

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