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Investigation of Microcrystalline Cellulose as Ice Nucleus in Immersion Freezing Processes

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Aerosol-cloud interactions play an important role in earth's radiation balance. Aerosol particles act as cloud condensation nuclei for liquid droplets and/or as ice nuclei for the formation of ice particles. Previous research in our group has been related to biological ice nucleation.[1−3] Here, we present a proxy for many biological macromolecular substances, i.e. microcrystalline cellulose. Due to the chemical convenience of cellulose compared to other biological ice nuclei, basic, but still unknown ice nucleation mechanisms can be investigated. Cellulose is a polysaccharide consisting of a linear chain of several hundred to many thousands of $\beta(1\rightarrow4)$ linked D-glucose units. It is an important structural element of the primary cell wall of green plants, many forms of algae and the oomycetes.

Several types of microcrystalline cellulose were analysed and investigated due to their physico-chemical properties. Immersion freezing experiments were carried out in a unique reaction gadget. In this device a water-in-oil suspension (with the cellulose suspended in the aqueous phase) was cooled till the freezing point and was observed through a microscope. The results of the immersion freezing experiments of the different cellulose types showed variable ice nucleation activities depending on their morphology (e.g. particle size) and their concentration. Further analysis methods as scanning electron microscopy (SEM) and small angle X-ray scattering (SAX) were carried out to entirely describe the cellulose and their ice nucleation activity.

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