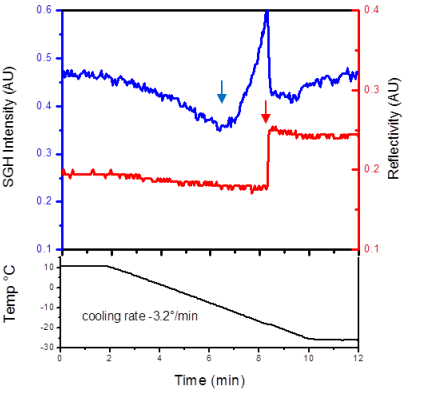
First experimental evidence of ice-crystallization dependence on the degree of order induced by the ice nucleating surface on water

Ahmed Abdelmonem[1], T. Leisner[1]
[1]*Karlsruhe Institute of Technology (KIT) - Germany*

Atmospheric aerosols can enhance heterogeneous ice nucleation (IN) which in turn has its impact on the radiative properties of clouds and thereof our climate. Heterogeneous IN enables the formation of ice particles at temperatures above the limits of homogeneous freezing. It is not known which structural and chemical characteristics of aerosol particles account for the variability in IN efficiency. IN by a surface remains poorly understood on the molecular level. Recent molecular Dynamic simulations by Lupi et. al. [1] showed that good ice nuclei induce layering of liquid water at the surface. They concluded that layering of water is associated with the formation of the ice nucleus where the increase of layering results in an increase in the local ordering of the first water layer in contact with the surface.

We use NLO Spectroscopy to investigate IN processes on ice-nucleation-active atmospheric substances on the molecular level. The presentation will show the evolution of the freezing process of water on the surface of Mica (one of the common IN atmospheric substances) during cooling process from 10°C to -26°C. Our preliminary results indicate an increase in the local ordering of the first water layer in contact with the surface which is expected to facilitate and control the crystallization of ice at the surface.



To our knowledge, this is the first direct experimental evidence on the molecular level that the ice crystallization on a surface is controlled by the degree of order induced by the surface on supercooled water.

[1] Laura Lupi, Arpa Hudait, and Valeria Molinero, J. Am. Chem. Soc., 136 (8), pp 3156–3164, (2014)

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