

Deactivation of ice nuclei due to atmospherically relevant surface coatings

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The ice nucleation characteristics of Arizona test dust (ATD) and illite clay, surrogates for atmospheric ice nuclei, have been determined at the Aerosol Interactions and Dynamics in the Atmosphere (AIDA) chamber located at the Research Center Karlsruhe in Germany. The objective of this research was to determine the effect of sulfuric acid and ammonium sulfate coatings on the ability of these mineral dust surrogates to nucleate ice in an environment where particles realistically compete for water vapor. Coated ATD particles required higher saturations at all temperatures considered, from -20 to -45 °C, than did identical uncoated particles. Freezing of coated particles often required saturations approaching those for the homogeneous freezing of aqueous solutions of the coating material alone. Less pronounced effects were found for illite, although the presence of a coating consistently increased the saturation or decreased the temperature required for ice formation. Analysis of ice residue at the single particle level suggests that the first coated particles to freeze had thinner or incomplete coatings when compared to particles that froze later in the expansion. This observation highlights a need to verify coating properties since an assumption of homogeneity of a group of coated aerosols may be incorrect. The increase in saturation ratio for freezing suggests that gas-phase uptake of sulfates, a large fraction of which are due to anthropogenic emissions, will reduce the ice and mixed-phase cloud formation potential of atmospheric ice nuclei.

Cziczo et al., Environ. Res. Lett. 4 (2009)

IN08-10 (2006-11-14 16:33) Activation of Arizona test dust coated with ammonium sulphate to an ice cloud.

IN08-11 (2006-11-15 11:05) Activation of Illit dust to an ice cloud.

IN08-12 (2006-11-15 13:30) Activation of Illit dust to an ice cloud.

IN08-13 (2006-11-15 16:47) Activation of Illit dust to an ice cloud.

IN08-29 (2006-11-24 11:00) Activation of Illit dust coated with SOA to an ice cloud.

IN08-30 (2006-11-24 14:30) Activation of Illit dust coated with SOA to an ice cloud.

IN08-31 (2006-11-24 16:45) Activation of Illit dust coated with SOA externally mixed with sulphuric acid aerosol.