Geophysical Research Abstracts, Vol. 8, 04674, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04674

Crystallization kinetics and morphology of nitric acid trihydrate

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Only very recently nitric acid trihydrate (NAT) has been identified by optical spectroscopy. [1] These spectra beside absorption also depend on the Mie scattering of the particles. Therefore, the morphology of NAT is particular important. We have aimed to understand the crystallization kinetics of α-NAT and β-NAT at different temperatures and concentrations carrying out time dependent X-ray diffraction measurements under isothermal conditions, respectively. The resulting conversion curves have been evaluated according to the model of Avrami. [2][3] It has been shown that in diluted samples hexagonal ice plays an important role, inhibiting the phase transition from α-NAT into β-NAT. Therefore, α-NAT might exist even at stratospheric temperatures (T>180 K) for several hours. From Avrami's law we have derived also a subtle hint to the crystal's growth mechanism. By the aid of environmental scanning electron microscopy (ESEM) we have checked out for the particles morphology. We have found spherical particles in the case of α-NAT and platelets and needles for β-NAT. In the latter case hexagonal ice has an impact on the change of morphology. This should be taken into account when interpreting LIDAR and MIPAS spectra of PSC and Cirrus clouds.

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