Abstract

This thesis presents results from molecular beam experiments performed with water ice in the temperature range 100-191 K. Some experimental results were also combined with molecular dynamics simulations. The main aim for the studies was to improve a molecular-level understanding of the formation of ice particles, to characterize the properties of the water ice surface and to gain further fundamental understanding of interactions between water ice and molecules of interest for the atmosphere.

Paper I and II describe studies of carbon monoxide and argon colliding with crystalline and amorphous ice. The collisions are highly inelastic and the energy loss to the surface is large. For thermal incident energies the trapping followed by thermal desorption is dominating. Scattering of argon from amorphous ice resulted in increased trapping.

Paper III describes studies of ice surface properties in the temperature interval 150-191 K. The conditions in the topmost surface layer were probed by elastic helium scattering. A rapid reduction in scattering intensity was observed above 180 K, which was interpreted as an onset of either strongly anharmonic surface vibrations or disorder in the ice surface. This change may be considered as a first sign of increased mobility of water molecules at the ice surface, which precedes the formation of a quasi-liquid layer that is known to exist at higher temperatures. The fact that the changes occur around 180 K indicates that water ice will have disordered surfaces under all conditions prevailing in the lower atmosphere on earth.

Papers IV and V deal with the formation of water and mixed water-ammonia ice layers on graphite surfaces in the temperature interval 100-180 K. The studies contribute to the fundamental understanding of water condensation on atmospheric aerosol particles.

Keywords: ice, surface, molecular beam, collision, dynamics, surface disorder, water condensation, helium, argon, carbon monoxide

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