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FTIR Studies of Adsorption on Dispersed Ice

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The work presents methods of FTIR spectroscopic studies of adsorption and surface reactions on disperse ice. Ice interaction with ecologically important gases, such as ozone, ethylene, methane and fluoroform has been investigated.

The earlier described cell for spectral studies of adsorbed molecules at variable temperatures (55-370 K) was equipped with a device for water film sputtering, where water vapor was inserted through the capillary heated by a thin nichrom filament (to avoid condensation) and deposited onto the inner windows of the cell, cooled by liquid nitrogen (or, to obtain T as low as 55K - solid N_2 - by lowering the pressure of coolant). The advantage of this system is in the possibility to run the spectra in the presence of a considerable adsorbate pressure, and even to perform adsorption from the solution in liquid oxygen. The latter possibility is very helpful to carry out adsorption at temperatures too low for adsorption from gas phase because of negligible pressured of adsorbate.

The technique was tested in the studies of fluoroform, ethylene and ozone adsorption on H_2O and D_2O ice and ozonolysis of adsorbed ethylene at 100-120 K. At higher temperature the film looses its porosity that is why the method of adsorption from the solution in liquid oxygen was tried for less volatile species. This enabled adsorption of CHF_3 and its interaction with preliminary adsorbed ethylene to be seen already at 77 K. Besides the perturbation of dangling hydroxyl groups of ice surface, spectral changes of adsorbed molecules were detected, which point to the interaction of fluoroform with the unsaturated surface water oxygen atoms.

The developed methods provide means to further studies of mechanisms of heterogeneous chemical and photochemical processes, which occur on the surface of aerosols.

The preliminary results of experiments point to some interaction between the adsorbed pollutants that could lead to mutual enhancement of their uptake by ice particles as compared with the same molecules adsorbed separately. This should be taken into account when considering heterogeneous degradation processes of organic molecules on aerosol particles.

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