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# Structure and property of water ice existing far from the Earth

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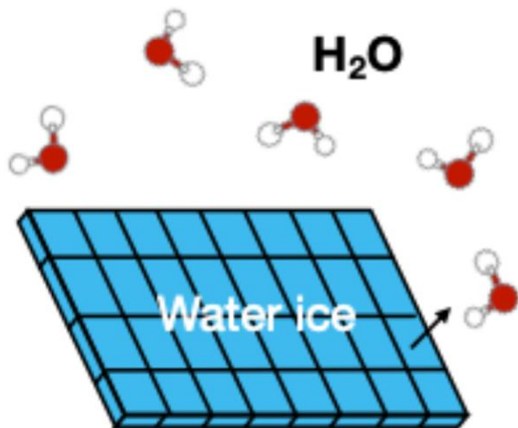


Figure. Schematics of adsorption and desorption of water molecules from the surface of water ice. The vapor pressure of water ice  $P_i$  will be proportional to the rate for the desorption of water molecules from water ice, which can be written as (R. J. Speedy, et al, 1996, JCP);

$$[\text{desorption rate}] = P_i / (2\pi mkT)^{(1/2)}.$$

In vacuum chamber, the pressure of water vapor in the background deposition  $P_v$  for the formation of water ice by vapor-deposition will be proportional to the deposition rate of water ice on a substrate as well as that of water ice, which can be written as (R. Sato, et al, 2025, JPCL);

$$[\text{deposition rate}] = P_v / (2\pi mkT)^{(1/2)}.$$

Therefore, the vapor pressure of water ice is essential to discuss the kinetic theory of water molecules in the “gas”.

## Content:

Ice is a solid constructed by hydrogen-bonding (H: double-donor, O: double-acceptor). Ice will exhibit twenty-one crystalline structures (ice Ih, Ic, Icd and ice II-XIX), and even three amorphous states (low-density amorphous ice, high-density amorphous ice, and very high-density amorphous ice). The conditions for the formation of ice is determined by experiments. The structure of ice will affect the physical properties of ice, such as density, thermal conductivity, vapor pressure, morphology, and shape. Therefore, the conditions for the formation of ice will be important to discuss the physical properties of ice. In addition, although the partial water vapor pressure in mesosphere is very low ( $10^{-5}$ - $10^{-7}$  Pa) in contrast to the partial water vapor pressure near the ground (103 Pa), the temperature will decrease significantly (100-150 K) in contrast to the temperature near the ground (300 K), which leads to the formation of polar mesospheric clouds (noctilucent clouds). The formation of polar mesospheric clouds itself connects with the physics and chemistry in mesosphere, therefore, our group focus on the conditions for the formation of ice under mesospheric temperature, pressure, and also size.

Keywords: Crystal growth

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