The photodesorption efficiency of OH radical on ice from ultraviolet to visible range

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The OH radical plays a vital role on the ice and in the gas phase in the atmosphere of planets and cold interstellar regions. Therefore, the photodesorption of OH by the irradiation of UV and X-ray photons has been investigated, however, the photodesorption induced by visible photons has not been considered in the past, since both isolated water molecule and OH radical are considered to be transparent in the visible range. Photodesorption of OH radicals adsorbed on ice triggered by visible 532 nm was first observed by recent work[1], which was performed by a novel PSD-REMPI method, a combination of photostimulated desorption (PSD) and resonance-enhanced multiphoton ionization (REMPI). According to quantum chemical calculations, although the electronic transition of isolated OH happens at 308 nm[2], it is possible to extend to 600 nm when OH has strong binding with water molecules, indicating that the photon absorption is highly sensitive to the photon wavelength as well as adsorption sites of OH on the ice surface. In order to further understand the relationship between photoabsorption and the population of OH adsorption sites, wavelength-dependent experiments are necessary.

In this study, the photodesorption efficiency of OH on ice at the wavelength from UV to visible range (310–700 nm) was measured for the first time. The photodesorption efficiency strongly depends on the wavelength with a maximum of around 370 nm. In addition, through the measurements of photodesorption cross section at different wavelengths, we found the behavior of OH attenuation caused by photodesorption can be categorized into two types. We propose that the photons at shorter wavelengths from 310 to 455 nm can be absorbed by OH at both strong and weak binding sites, whereas those above 480 nm photons are only absorbed by OH stayed at strong binding sites for the photodesorption process.

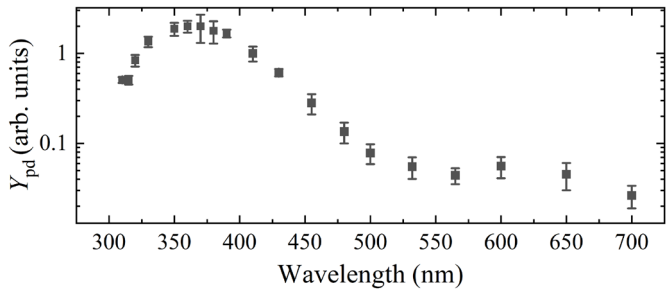

Figure: The photodesorption efficiency (Y_{pd}) as a function of wavelength from UV to visible light.

[1] Miyazaki, A.; Watanabe, N.; Sameera, W.; Nakai, Y.; Tsuge, M.; Hama, T.; Hidaka, H.; Kouchi, A., Photostimulated desorption of OH radicals from amorphous solid water: Evidence for the interaction of visible light with an OH-ice complex. *Phys. Rev. A.* **2020,** *102* (5), 052822.
[2] Crawford, T. D.; Abrams, M. L.; King, R. A.; Lane, J. R.; Schofield, D. P.; Kjaergaard, H. G., The lowest ^{2}A' excited state of the water-hydroxyl complex. *J. Chem. Phys.* **2006,** *125* (20).