

# Reactive desorption of methanol from amorphous solid water at 10K

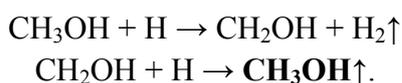
Hiroshi Hidaka<sup>1</sup>, Yukiko Yarnall<sup>2</sup>, Akira Kouchi<sup>1</sup>, and Naoki Watanabe<sup>1</sup>

<sup>1</sup>*Institute of Low Temperature Science, Hokkaido University, Japan,* <sup>2</sup>*Department of Chemistry and Biochemistry, George Mason University, USA*

Many kinds of gaseous molecules have been observed in molecular clouds. It implies the following two facts: first, the molecule synthesis occur in spite of very low temperature circumstances (~ 10K), second, the formation rate of gaseous molecule (ie. the rate of synthesis in the gas phase and desorption from the icy dust) is larger than the loss rate (ie the rate of destroy in gas phase and accretion on icy dust). Therefore, to understand the formation process of gaseous molecules observed contributes to evaluate the physical and chemical conditions in molecular clouds. From such background, methanol molecule have attracted astronomer's and astrochemist's interest in the formation process, because it has been abundantly observed in many molecular clouds and has been considered to be a precursor of complex organic molecules.

For the synthesis in the gas phase, most plausible and efficient reaction would be dissociative electron capture of CH<sub>3</sub>OH<sub>2</sub><sup>+</sup> formed by ion-molecule reactions[1]. However, the formation rates by this process have been proven inefficient to explain the observed amount of methanol. On the other hand, successive CO hydrogenation on icy dust surface, CO → HCO → H<sub>2</sub>CO → CH<sub>3</sub>O → CH<sub>3</sub>OH, was proposed theoretically and confirmed by experimentally as an efficient pathway[2]. That is, if methanol molecules desorb to some extent at the formation on the dust, it can be a dominant process in the supply of gaseous methanol.

The desorption processes triggered by energy inputs such as photodesorption and thermal desorption are inefficient in the molecular clouds, because of low UV fields and low temperatures. As the promising desorption process which will work effectively even in molecular clouds, reactive desorption has been proposed. Because this desorption process is triggered by the heat of reaction when the molecule is synthesized by chemical reactions, any additional energy input is not required. Although this desorption process may play an important role in supplying gaseous methanol, only small number of studies have been performed. In this presentation, we introduce the chemical desorption process of CH<sub>3</sub>OH on ASW triggered by following reactions:



Our experimental results show that this process will strongly depend on the adsorption sites of CH<sub>3</sub>OH on the surface. Additionally, we will introduce the geometric structure of ASW observed by an atomic force microscope, because the surface structure affects directly the characteristic of adsorption site.

## References

- [1]. R. Garrod et. Al., *Faraday Discuss*, **133**, 51-61 (2006).
- [2]. N. Watanabe and A Kouchi, *The Astrophysical Journal*, **571**, L173–L176 (2002).