Geophysical Research Abstracts, Vol. 7, 02954, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02954

Successive Hydrogenation of CO on Pure Solid CO and Water-CO Mixed Ice

A. Nagaoka, N. Watanabe, T. Shiraki and A. Kouchi

Institute of Low Temperature Science, Hokkaido University, Sapporo, Japan
(kouchi@lowtem.hokudai.ac.jp)

It is generally believed that successive hydrogenation of CO on interstellar icy grains is key process to produce significant amount of methanol (CH_3OH) and formaldehyde (H_2CO) that have been observed. Hiraoka et al. (2002) examined the hydrogenation of pure CO experimentally but found no evidence to explain the observed abundance of H_2CO and CH_3OH in molecular clouds, with only very low yield of H_2CO and no CH_3OH. Our group has shown experimentally that the hydrogenation of CO on H_2O ice is very efficient, producing H_2CO and CH_3OH under the conditions of molecular clouds (Watanabe & Kouchi 2002, Watanabe et al. 2003). However, the effect of surface composition on hydrogenation reactions remains open for discussion. It is therefore desirable to compare the CO hydrogenation mechanism on H_2O ice with that on pure CO.

Apparatus for SUrface Reaction in Astrophysics (ASURA) was newly designed and built. The ASURA consists of an atomic source chamber and main chamber in which Al substrate is mounted on the cold head of He refrigerator. After deposition of pure solid CO or CO-H_2O mixed ice at T=8-20 K, atomic hydrogen with a flux of $5x10^{14}$ cm^{-2} s^{-1} was irradiated. During exposure to H atoms, IR spectra were measured by FTIR.

We found that hydrogenation proceeds efficiently on both pure solid CO and CO-H_2O mixed ice below 12 K, but the rate of reaction on pure CO decreases significantly at 15 K compared to CO-H_2O mixed ice. Hydrogenation of CO at 12 K and above is found to be promoted by H_2CO and H_2O molecules on the CO surface.