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Low energy electron impact on hydrocarbon-water ice thin films at cryogenic temperatures

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Icy mantles on dust grains are subjected to the cosmic ray. It is well known that various transient active species are generated in condensed matter. Among these species, secondary electron is believed to be the most abundant and can bring about substantial chemical reactions taking place in the dust grains. Therefore, it will be meaningful to study low energy electron impact on the ice thin film.

We recently made a new apparatus that makes it possible to irradiate electrons, ions, and fast atoms on the very lowtemperature thin film. An ultra high vacuum (～ 10^{-9} Pa) manifold is equipped with the electron gun and ion (FAB) gun. These guns are in bent structures so that the radiation from the filament should not illuminate the surface of the cooled substrate directly.

Pre-mixed water-hydrocarbon gas sample is deposited on the gold-coated copper substrate, which is mounted on the cold head of helium refrigerator.

The temperature of the sample is variable between 4K and 300K. The *in situ* monitoring of reactions is made by FT-IR. After electron irradiation, the reaction products are analyzed by the temperature programmed desorption mass spectrometry, using a quadrupole mass spectrometer.

The temperature programmed desorption spectra of H_2O / C_2H_4 (10:1) mixture irradiated by the electron beam at 300eV, 0.25 μ A / cm^2 for 60min are shown in Figure 2. CH_4, C_2H_6, CH_3OH and C_2H_5OH are observed as reaction products with an approximate conversion yield of 1 %. Similar product distribution is also obtained for the H_2O/C_2H_6 sample. It is interesting to note that CH_3OH is generated from C2 reactants as one of the major products.

Keywords: molecular evolution, cosmic ray, methanol, hydrocarbon

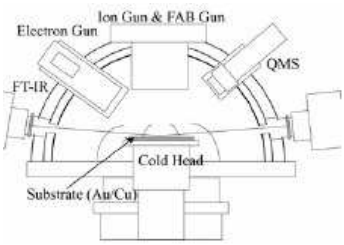

Figure 1: Experiment setup

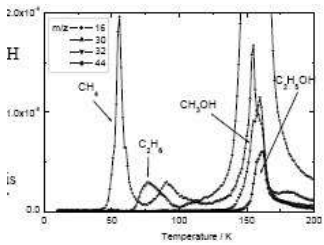

Figure 2: Temperature programmed desorption specta of H_2O / C_2H_4 (10:1) mixture irradiated by an electron beam at 300eV, 0.25μA / cm^2 for 60min