Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PPS24-05 会場:A02 時間:5 月 27 日 12:00-12:15

Evolution of organic molecules in space: characteristics and properties of experimental organic residues.

Evolution of organic molecules in space: characteristics and properties of experimental organic residues.

PIANI, Laurette[1*] ; TACHIBANA, Shogo[1] ; HAMA, Tetsuya[2] ; KIMURA, Yuki[2] ; ENDO, Y.[1] ; FUJITA, K.[2] ; NAKATSUBO, S.[2] ; FUKUSHI, H.[2] ; MORI, S.[2] ; CHIGAI, T.[2] ; YURIMOTO, Hisayoshi[1] ; KOUCHI, Akira[2]
PIANI, Laurette[1*] ; TACHIBANA, Shogo[1] ; HAMA, Tetsuya[2] ; KIMURA, Yuki[2] ; ENDO, Y.[1] ; FUJITA, K.[2] ; NAKATSUBO, S.[2] ; FUKUSHI, H.[2] ; MORI, S.[2] ; CHIGAI, T.[2] ; YURIMOTO, Hisayoshi[1] ; KOUCHI, Akira[2]

[1]Department of Natural History Sciences, Hokkaido University., [2]Institute of Low Temperature Science, Hokkaido University.
[1]Department of Natural History Sciences, Hokkaido University., [2]Institute of Low Temperature Science, Hokkaido University.

In the interstellar medium (ISM), dense clouds and circumstellar regions around young stars are favorable environments for the accretion of ice mantles around dust grains and their irradiation by energetic particles (UV-photons and cosmic rays). The partial collapse of dense cloud gives birth to stars generally surrounded by disks of dust and gas which can lead to planetary systems.

Organic-rich mantled dust is thus among the potential building blocks of our solar system and could be at the origin of a part of the organic matter found in comets and meteorites. However, it is not clear how the organic components formed in the ISM may have evolved before being incorporated in their parent bodies.

A new laboratory experimental apparatus PICACHU (Photochemistry in Interstellar Cloud for Astro-Chronicle in Hokkaido University) was recently developed to simulate the formation and evolution of organic ice mantles. This apparatus is focused on organic compound evolution through UV irradiation and heating. Typical ISM gases (H_2O, CO, NH_3, CH_3OH) are deposited onto the three faces of a refrigerated substrate (about 12K) and simultaneously irradiated by UV under ultra-high vacuum. The gases, desorbed from the ice during heating and post-irradiation, are monitored by a quadrupole mass spectrometer in the vacuum chamber. The final organic residues obtained after warm-up and/or post-irradiation are then characterized.

Here we report the first descriptions of the organic residues produced by the experiments. At the micron scale, the thin deposits are not homogenous showing desiccation-like networks. From atomic force microscope observation, it seems that the main deposits are made of the aggregation of round particles of some tens of nanometers. Porous membrane-like textures are also observed for post-irradiated sample. Transmission electron microscopy confirms the presence of round organic particles and shows their amorphous nature. These particles could resemble to the organic nanoglobules commonly found in the organic matter of carbonaceous chondrites, which contain isotopic anomalies and a dusty core [2, 3, 4]. Moreover, the porous nature of organic aggregates may enhance the efficiency of dust aggregation in the early solar system [5, 6].

[1] Herbst E. and van Dishoeck E. F. 2009. Annu. Rev. Astron. Astrophys. 47:427-480. [2] Garvie L. A. J. and Buseck P. R. 2004. EPSL 224:431-439. [3] Nakamura-Messenger et al. Science 314:1439-1442. [4] Hashiguchi M. et al. 2013. GCA 122:306-323. [5] Kouchi A. et al. 2002. Astrophys. J. 566:121-124. [6] Kudo T. et al. 2002. Met. Plan. Sci. 37:1975-1983.

キーワード: organic synthesis, low temperature experiment, UV irradiation, thermal evolution, Interstellar medium, meteorite & comet
Keywords: organic synthesis, low temperature experiment, UV irradiation, thermal evolution, Interstellar medium, meteorite & comet