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初期太陽系星雲中での FT 型触媒反応による分子形成の再現実験
Reproduction experiment of molecular formation based on Fischer-Tropsh-type catalytic reaction in the early solar nebula

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Catalytic reactions such as the Fischer-Tropsch type and Haber-Bosch type reactions are able to produce organic molecules efficiently on the surface of cosmic dust analogues, such as iron, magnetite, amorphous iron silicate and graphite at temperature above 573 K and pressure at 10^5 Pa in the laboratory [1-4]. In these experiments, organic molecules ranging from methane (CH_4), ethane (C_2H_6), benzene (C_6H_6) and toluene (C_7H_8), to more complex species such as acetone (C_3H_6O), methyl amine (CH_3NH_2), acetonitrile (CH_3CN) and N-methyl methylene imine (H_3CNCH_2) have been produced so far. However, it is not obvious the reaction similarly works in the solar nebula and is able to extrapolate to the actual early nebula environment at lower temperature below 500 K and lower pressure under 10^2 Pa. Therefore, we developed a new experimental system to test the catalytic chemical reactions in the early nebula environment [lower temperature (100-500 K) and pressure (10^{-3}-10^0 Pa)] using a substrate of magnesium silicate or iron. Our experimental system has a temperature-controlled substrate, a Fourier transform infrared spectrometer (FT-IR), and two quadrupole mass spectrometers (Q-MSs). FT-IR measures the vibration modes of adsorbed and produced molecules on the surface and the Q-MSs detect volatile molecules, respectively. As a preliminary experiment, the substrate of a magnesium silicate thin film was used in a continuous gas flow of a mixture gas of H_2 and CO for Fischer-Tropsch type reactions. Unfortunately, however, we do not find any signal of the Fischer-Tropsch type reaction and resulting organic molecules on the amorphous magnesium substrate, whereas the signal of CHO molecule and ethane (C_2H_6) have been detected on the Q-MS spectra in some experimental condition on a different substrate. In the workshop, the detail results using iron substrate will be presented as a function of temperature and pressure.

References

[1] H. G. M. Hill, J. A. Nuth, *Astrobiology*, **3** (2003) 291.
[2] J. A. Nuth, N. M. Johnson, S. Manning, *The Astrophysical Journal*, **673** (2008) L225.
[3] N. M. Johnson, M. McCarthy, J. A. Nuth III, *45th Lunar and Planetary Science Conference*, (2014) 2702.
[4] J. A. Nuth, Y. Kimura, C. Lucas, F. Ferguson, N. M. Johnson, *The Astrophysical Journal Letters*, **710** (2010) 98.
[5] Y. Kimura, J. A. Nuth, N. M. Johnson, K. D. Farmer, K. P. Roberts, S. R. Hussaini, *Nanoscience and Nanotechnology Letters*, **3** (2011) 4.

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