Asymmetric reactions in dust-surface organic analogues induced by polarized quantum beams

JUN-ICHI TAKAHASHI[1]
[1]*SSOEL-Japan, Japan*

The origin of homochirality in terrestrial biological molecules (dominant L-amino acids and D-sugars) remains an unresolved important problem in the study for the origins of life. One of the leading hypotheses for the origin of biomolecular homochirality can be nominated as "Cosmic Scenario"; polarized excitation sources in space triggered asymmetric reactions of complex organic molecules (including amino-acid precursors) on the surfaces of such space materials as meteorites or interstellar dusts [1]. The typical polarized excitation sources are circularly polarized light (CPL) and spin-polarized electrons (SPE). It is advocated that CPL can be generated as synchrotron radiation (SR) from tightly captured electrons by intense magnetic field around neutron stars, and also can be generated as scattered light by aligned grains in dense molecular clouds. It is also well known that beta-ray electrons are SPE with only negative helicity, that is, the spin angular momentum vector is polarized to the anti-parallel direction of the kinetic momentum due to parity non-conservation in the weak interaction. It is advocated that SPE can be emitted from neutron fireballs generated by supernova explosion or from short-life radioactive nuclei in parent bodies of planets or asteroids.
We are conducting laboratory experiments for verification of the scenario by using simulating polarized excitation sources. Thin solid films of racemic mixtures of amino acids or those of their precursor molecules, as simulated organic molecules on dust surfaces, were irradiated with ultraviolet CPL from SR source [2] and with SPE from beta-decay radioactive source [3]. The circular dichroism spectra of the irradiated films presented apparent emergence of optical anisotropy by polarized excitation sources. These results are important for the solution of the biological homochirality problems.

Keywords: Homo-chirality; Amino Acids; Interstellar Dusts; Astrobiology

[1] K. Kobayashi, K. Kaneko, J. Takahashi, Y. Takano and S. Yoshida, in *ASTROBIOLOGY: Emergence, Search and Detection of Life*, pp.175-186 (2010).
[2] J. Takahashi, H. Shinojima, M. Seyama, Y. Ueno, T. Kaneko, K. Kobayashi, H. Mita, M. Adachi, M. Hosaka and M. Katoh, *Int. J. Mol. Sci.* **10,** 3044 (2009).
[3] J. Takahashi, P. K. Sarker, Y. Obayashi, T. Kaneko, K. Kobayashi, N. Okatyeva, N. G. Poluhina, G. A. Gusev, V. A. Tsarev, J. Xu, Y. Tao, K. Matsuo, K. Gekko, H. Yabuta, H. Mita and T. Saito, Orig. Life Evol. Biosph. to be submitted.