Optical Anisotropy Introduction by Polarized Excitation Sources into Thin Solid Films of Amino Acids and their Precursor Molecules

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 most attractive hypotheses for the origin of homochirality is 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 most typical polarized excitation source is circularly polarized light (CPL). It is advocated that CPL can be generated as synchrotron radiation 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. Recently, a wide-field and deep near-infrared CPL has been observed in the Orion nebula, where massive stars are forming [2]. On the other hand, it is well known that beta-ray electrons are spin-polarized electrons (SPE), that is, the spin angular momentum vector of beta-ray electrons 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 short-life radioactive nuclei in asteroids or from neutron fireballs generated by supernova explosion [3]. We are now conducting ground experiments for verification of the scenario by using simulating polarized excitation sources. Thin solid films of racemic mixtures of amino acids or their precursor molecules, as simulated organic molecules on dust surfaces, were irradiated with ultraviolet CPL from SR source or with SPE from beta-decay radioactive source. The circular dichroism spectra of the irradiated films presented apparent emergence of optical anisotropy due to molecular structure changes by polarized excitation sources [4]. These results are important for the solution of the biological homochirality problems.

Keywords: Homochirality; 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] T. Fukue, M. Tamura, R. Kandori, N. Kusakabe, J. H. Hough, J. Bailey, D. C. B. Whittet, P. W. Lucas, Y. Nakajima and J. Hashimoto, *Orig. Life Evol. Biosph.* **40,** 335 (2010).
[3] G. A. Gusev, T. Saito, V. A. Tsarev and A. V. Uryson, *Orig. Life Evol. Biosph.* **37**, 259 (2007).
[4] 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).