Photon Pressure Chemistry of Crystallization and Molecular Arrangement Control in Crystals

Hiroshi MASUHARA

(Osaka University, Department of Applied Physics, Professor)

【Outline of survey】

We have been developing the molecular science research on the photon pressure effect induced by the interaction of a focused laser beam with polymers, dendrimers, and various nanoparticles in solution. As an example, we have succeeded in preparing molecular assembling structures reflecting the photon pressure, and clarified its formation dynamics and mechanism. In this research, for a variety of organic compounds such as proteins, we intend to prove experimentally such novel phenomena induced by the photon pressure as laser-induced crystallization, enantioselective chiral crystallization from achiral molecules, and control of supermolecular structure. Furthermore, unique organic crystals, whose molecular arrangement is controlled by the photon pressure, will be fragmented to nanocrystals by the laser ablation technique, and then their increased surface layer will make an enantioselective reaction in the solid state to proceed efficiently. On the other hand, in order to investigate the crystal growth process under the photon pressure for general nonfluorescent organic compounds, we will construct a new system which can measure not only the fluorescence spectrum but also the Rayleigh-scattering one in real time. By using this developed system, we will observe and analyze the crystallization dynamics at a single nanocrystal level.

【Expected results】

We believe that the preparation of crystals with controlled molecular arrangement, which is one of the most promising goals in crystal science, can be achieved by combining the photon pressure of a focused laser beam and the technique of femtosecond laser-induced crystallization. We strongly hope that new solid-state reaction will be realized and their dynamics and mechanism can be clarified at a single nanocrystal level.

【References by the principal researcher】

• Assembling and Orientation of Polyfluorenes in Solution Controlled by a Focused Near-Infrared Laser Beam; S. Masuo, H. Yoshikawa, H. –G. Nothofer, A. C. Grimsdale, U. Scherf, K. Mullen, and H. Masuhara, The Journal of Physical Chemistry B, Vol.109, pp. 6917-6921 (2005).

• Spacial Control of Urea Crystal Growth by Femtosecond Laser Irradiation; H. Y. Yoshikawa, Y. Hosokawa, and H. Masuhara, Crystal Growth & Design, 6, 302 (2006).

【Term of project】FY2006－2010	【Budget allocation】27,900,000 yen

【Homepage address】 http://dolphin.ap.eng.osaka-u.ac.jp/