

Sunlight-Induced Structural Change of Liquid Water

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Sunlight irradiation induced structural change of liquid water to form clathrate-like structure, which was evidenced by XRD and IR spectroscopy. Irradiation of sunlight on liquid water resulted in a change in the XRD pattern.¹ In addition to the peak at $2\theta = 28^\circ$ ($\sin\theta / \lambda = 1.6 \text{ nm}^{-1}$) which was observed for a non-irradiated water, a peak at $2\theta = 12^\circ$ ($\sin\theta / \lambda = 0.7 \text{ nm}^{-1}$) appeared on irradiation of sunlight and developed with the irradiation time. The peak continued to be intensified over a period of 1 h and more. Radial distribution function analysis of the diffraction pattern indicated that the ordering range expanded as the irradiation period was prolonged from 5 min to 1 h. Tetrahedral arrangement of non-irradiated water gradually changed to clathrate-like structure on irradiation of sunlight. Definite changes in IR spectrum of liquid water in the O-H stretching region were also observed on irradiation of sunlight at room temperature.² The spectrum shape in the range $2800 - 3800 \text{ cm}^{-1}$ became trapezoidal on irradiation of the sunlight for more than 30 min under the sunlight strength of 3 MJ m^{-2} . The spectrum gradually changed to restore the original spectrum in 3 h when sunlight irradiation was shut off. These results indicate that the formation and elimination of a clathrate-like structure of water occurred reversibly at room temperature in response to irradiation and shutoff of the sunlight, respectively. The structural change induced by the sunlight irradiation occurred over a period of several minutes to hours. The structural change of liquid water implies that the physical properties of liquid water also change on sunlight irradiation. It is important to take into account the structural change in understanding the phenomena of nature associating with water.

1) S. Shimokawa, T. Yokono, M. Yokono, T. Yokokawa, T. Arais: Effect of sunlight on liquid structure of water, *Jpn. J. Appl. Phys.* 46 (2007) 333.

2) T. Yokono, S. Shimokawa, M. Yokono, H. Hattori: Infra-red spectroscopic study of structural change of liquid water induced by sunlight irradiation, *Water*, 1 (2009).