

Observation and Manipulation of Macromolecules by Terahertz Waves

RIKEN [○]Hiromichi Hoshina

E-mail: hoshina@riken.jp

In this presentation, potential of the terahertz (THz) waves as a new tool for polymer science will be discussed. In the first part, THz spectroscopy of polymers will be presented. Absorption spectra of polymer reflect their higher-order conformation which provides information about polymer crystallization, degradation and water adsorption. We have succeeded to develop method for the assignment of low-frequency vibrational modes of polymers and obtained information of their higher-order conformations. By the temperature dependent THz spectra, the change of the hydrogen-bond interaction and the structure of the polymers during the phase transition were observed.

In the second part, THz-wave manipulation of polymer structure will be presented, in which we succeed in altering polymer morphology using THz wave irradiation. We irradiate a poly(3-hydroxybutylate) (PHB) / chloroform solution during cast crystallization using a THz wave generated by a free electron laser (FEL). Morphological observation shows the formation of micrometer-sized single crystals via the THz wave irradiation. Further, a 10-20% increase in crystallinity is observed through analysis of the infrared (IR) absorption spectra. The power density of the irradiating THz wave is 40 MW/cm^2 , which is significantly lower than the typical laser intensities used for material manipulation.

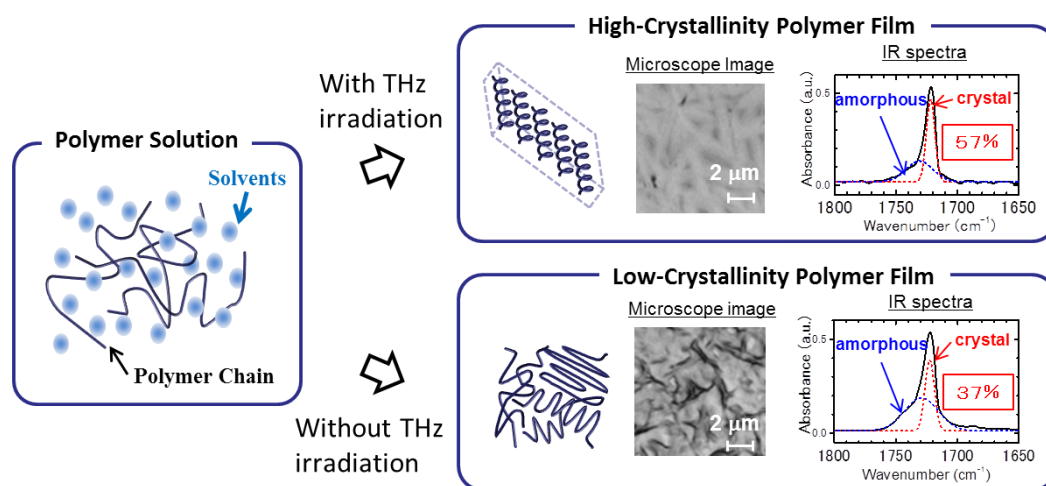


Figure 1: Morphological change of PHB thin films with the irradiation of the intense THz waves during cast crystallization.

References:

1. Hiromichi Hoshina, et al. IEEE Transactions on Terahertz Science and Technology, 3, 248 (2013)
2. Hiromichi Hoshina, et al. Scientific Reports, 6, 27180 (2016)