Mobility of Polymer Chain in Clathrate Phase of Syndiotactic Polystyrene

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Syndiotactic polystyrene (sPS) is widely known to show interesting crystalline phases. One of them is characterized by the clathrate formation with various organic molecules, so called delta-form crystal. Recently, we reported that a wide range of compounds can be inserted as a guest molecules by guest exchange phenomenon. It became apparent that relatively large molecules can be easily incorporated into the cavity especially with a solution mixed with penetrable solvents. We thought that the plasticizing effects the acceleration of guest exchange. We aimed to produce a new kind of polymer based functional materials and thought it is worth investigating the chain dynamics in amorphous region of sPS delta-phase.

We performed quasielastic scattering measurements on the inelastic neutron spectrometer, AGNES, installed at the JRR-3M reactor. The sPS sample was supplied by Idemitsu Petrochemical Co., Ltd. The delta-phase samples of sPS were obtained by exposing amorphous sPS films, which were previously prepared by quenching the melt in ice-water, to fully deuterated toluene vapor at 300K for 3days. After exposure process, the sPS delta-phase samples were dried in a vacuum for 8h to eliminate excess toluene from amorphous region. The delta-phase samples were processed by treatment with boiling acetone for 8h followed by washing with methanol to prepare the delta_empty-phase sample. The delta-phase samples were inserted into cells in two ways. First, the cell was filled with delta-phase sample and a little amount of dueterated toluene providing saturated toluene vapor as a plasticizer, denoted “wet”. Second, the cell was filled with delta-phase films only, denoted “dry”. We calculate the mean square displacement $<U^2>$ from the momentum transfer $Q$ dependence of the elastic scattering for each measurement. The $<U^2>$s of “wet” is larger than others especially above room temperature. The quasielastic scattering components of “wet” are also larger than others especially above room temperature. On the other hand, at a very low temperature, there are few differences between $<U^2>$s and/or $S(Q,E)$ spectra of each samples.

We have been trying to analyse the data to obtain details.

![Figure 1](image-url)

Fig. 1. Figure 1. Temperature dependence of $S(Q,w)$ of “wet” sPS delta-phase.