

Dynamical Properties of Syndiotactic Polystyrene (sPS) Crystalline Complex Phase

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Syndiotactic polystyrene (sPS) is a relatively new commodity polymer, which exhibits a variety of solid states. One of the important properties of sPS is the formation of crystalline complex phase, where organic compounds are stored in the cavities formed between sPS helices with TTGG conformation. Formerly it was considered that only relatively small molecules could be incorporated into sPS complex phase. However, recent our studies have clarified that sPS has an ability to form crystalline complexes with larger and bulkier molecules, exceeding the size limit expected in the previous studies. By using the help of a plasticizing agent, a wide variety of molecular compounds can now be introduced into the crystalline matrix of sPS. In this study, we have investigated the dynamical properties of such sPS complex systems containing relatively large molecules.

We chose several molecules consisting of ethyleneoxide (-CH₂CH₂O-) groups as guests. All QNS spectra were measured with AGNES spectrometer of JRR3M (Tokai). The mean-square displacement $\langle u^2 \rangle$ of hydrogen atoms was evaluated from the Q dependence of the elastic scattering intensity $I(Q)$ by using the following the Debye-Waller formula: $I(Q) = I(0) \exp[-(1/3)\langle u^2 \rangle Q^2]$, where $I(0)$ is the elastic intensity at $Q=0$.

Figure 1 shows the temperature dependence of $\langle u^2 \rangle$ for sPS complexes with triethylene glycol dimethyl ether (TEGDM) and an oligomeric sample (PEG1000). The $\langle u^2 \rangle$ s of the two sPS complexes show similar tendencies to temperature variations, but $\langle u^2 \rangle$ is clearly larger in sPS/TEGDM than in sPS/PEG at 160 and 230 K. The quasielastic component is also more intense in sPS/TEGDM. These ex-

perimental results indicate that TEMDM is more mobile than PEG1000 in this temperature region. The temperature dependence of $\langle u^2 \rangle$ can be interpreted as follows. The molecular motions of both the guest molecules confined in the cavities are restricted by the host-guest interaction in low temperatures, but the shorter molecule, TEMDM, having two mobile methyl terminals starts large diffusive motions from lower temperatures. For more detailed analysis, we are planning the experiment to evaluate the contribution of each component (sPS host framework, amorphous region and guest molecules) to QNS.

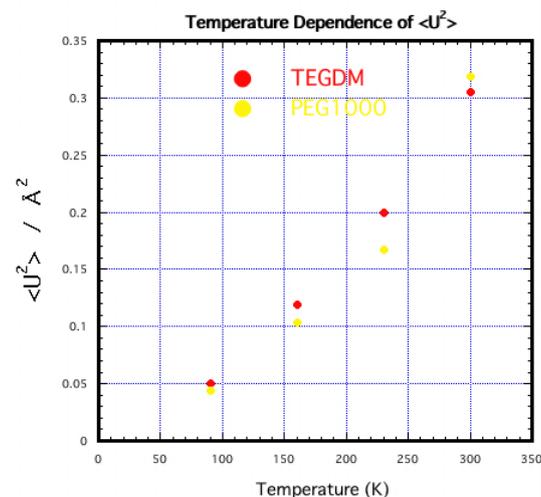


Fig. 1. Temperature dependence of $\langle u^2 \rangle$ for sPS crystalline complex phase