Aggregation States and Dynamics of Poly(methyl methacrylate) at Interfaces with Non-solvents

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Polymeric materials have been widely used for medical diagnosis and treatment in such applications as DNA arrays, tips for micro-total-analysis and scaffolds for artificial organs. When they are used in a human body, the surface is contact with liquid. In such cases, the interfacial structure and properties strongly affect the stability of the materials. We have hitherto studied aggregation structure of poly(methyl methacrylate) (PMMA) at the interfaces with liquids such as water, hexane and methanol by neutron reflectivity (NR) measurement.[1] As a result, the liquid/polymer interfaces were diffuse in comparison with the air/polymer interface, probably due to interfacial roughening and the partial dissolution of segments at the outermost region of the film. This means that mobility of chains in the interfacial region is enhanced in comparison with that in the internal region, and motivates us to examine interfacial mobility. PMMA with number-average molecular weight of 300 k was used as a sample. Here, PMMA particles were used to increase the ratio of interface to volume rather than using a film. Deuterated water (D2O) and methanol (CD3OD) were used as liquids. PMMA particles were filled into a quartz cell with 2 mm optical length. Normalized intermediate scattering function (I(q,t)/I(q,0)) for PMMA being contacted with D2O and CD3OD at 293 K were evaluated by neutron spin echo (NSE) measurement.

Panels (a) and (b) of Figure 1 show (I(q,t)/I(q,0)) for PMMA in D2O and CD3OD at q = 0.6 nm-1, respectively. The open symbols show experimental data and solid lines are drawn as a guide for eyes. The I(q,t)/I(q,0) value decreased with increasing time for the both cases. However, the relaxation behavior was not the same for each other. Although it is too early to conclude that the relaxation reflects mobility of segments at the liquid/polymer interface, the idea could well explain the result. We will report more conclusive work in the near future.

[1] K. Tanaka, Y. Fujii, H. Atarashi, K. Akabori, M. Hino, and T. Nagamura, Langmuir, 24, 296 (2008).

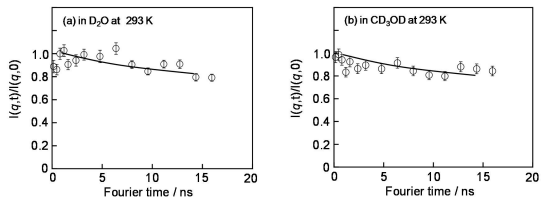

Fig. 1. Normalized intermediate scattering functions for PMMA (a) in D2O and (b) in CD3OD at 294 K. The Open symbols show experimental data and solid lines are drawn as a guide for eyes.