Aggregation Structure and Relaxation Dynamics of Polymers at the Interface with Water: II. Analysis of Relaxation Dynamics by Neutron Spin Echo

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Recently, polymer and liquid interface is widely studied, because aggregation states of polymers at liquid interface are important for science and technological application such as lubricate, adhesive, and biocompatibility. We have studied about the structure of poly(methyl methacrylate) (PMMA) contacted with non-solvent by using neutron reflectivity and scanning force microscope.[1] As a result, water and methanol, in spite of non-solvent for PMMA, made PMMA film swollen. In this study, the swollen structure, especially the interface structure between PMMA and non-solvent, of PMMA particles were studied by using small angle neutron scattering instrument, University of Tokyo (SANS-U) and new issp neutron spin echo (iNSE).

PMMA particles with diameter of about 300-500 nm (MP-2200 produced by Soken Chemical & Engineering Co., Ltd.) were used as a sample. Deuterated water (D2O) and deuterated methanol (CD3OD) was used as a non-solvent. The PMMA particles mixed with non-solvent were filled into quartz cell with 2 mm optical length. The sample-to-detector distance was chosen to be 2 and 12 m.

Figure 1 (a) shows the SANS profiles for PMMA particles on 25 and 40 °C mixed with water. Incoherent component was bated as background, and the profiles were fitted with power function. The value of fitted power was almost about 4 both in whole q region. It means that the shape of PMMA particles was not changed with temperature change. Additionally, to see more detail in small range, Porod plot was carried on. As a result, the power for q increased with increasing temperature. It means that the interfacial thickness between PMMA and water became broader with temperature increasing. Figure 1(b) shows the SANS profiles for PMMA particle mixed with methanol. In high q region, it is clear that the value of power was lower than it in low q region. That means the interfacial thickness between PMMA and methanol is broad and that broadening is bigger in compared with the case of water. We performed iNSE measurement using same sample. A certain relaxation was observed in the case of PMMA particles in D2O at 85 °C. We will clarify the dynamics of PMMA chain at the interface between PMMA and non-solvent.

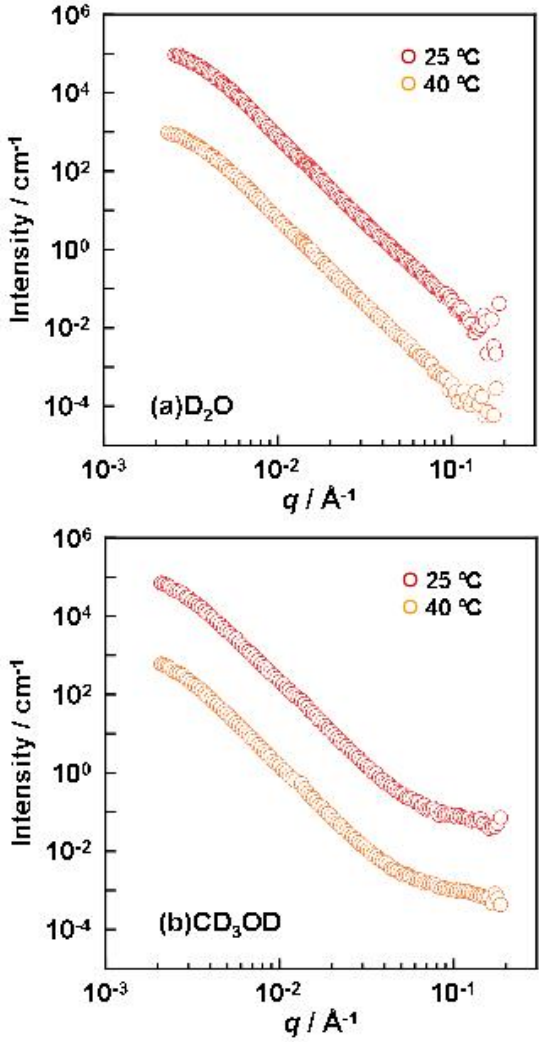

Fig. 1. Figure 1 Temperature dependence of SANS profiles (a) in D2O and (b) in CD3OD.