

Structure Analyses of Ultra-Hydrophilic Zwitter-ionic Polymer Brush at Water Interface by Neutron Reflectivity

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Poly(2-methacryloyloxyethyl phosphorylcholine) (PMPC) is a highly hydrophilic polyelectrolyte specially designed for bio-compatible medical devices[1]. Neutron reflectivity (NR) of surface-grafted PMPC in an aqueous solution have been studied to analyze the interface structure of swollen polymer brushes, which are fairly extended in a good solvent due to the high osmotic pressure[2]. In this study, the authors investigated the salt effect on the swollen PMPC brush structure by NR.

High-density PMPC brush was prepared by surface-initiated atom transfer polymerization from the quartz immobilized with surface initiator. NR measurements were carried out with the multilayer interferometer for neutrons (MINE), using wavelength of 0.88nm. Neutron beam irradiated from quartz to the interface between heavy water and PMPC brush on quartz glass. A critical angle was clearly observed at $q = 0.11 \text{ nm}^{-1}$ in Figure 1 owing to the difference in scattering length density between quartz and heavy water. Scattering length density profiles of PMPC brush in heavy water calculated from the reflectivity curves in Figure 1(b) and (c) indicated that the PMPC chains were stretched up to 50 nm in heavy water forming concentration gradient of heavy water. Interestingly, quite similar reflective curve was observed from the interface of PMPC brush at 0.1 M of NaCl deuterium oxide solution. Generally, isolated polyelectrolyte would shrink in salt solution because the electrostatic repulsion between polymer chains decrease. However, salt ion cannot be diffused into a high-density polymer brush layer due to the high osmotic pressure and high local charge density. Similar results have already been reported by Matsuoka[3], and

Kurihara[4]. In addition, the authors have found that the dimension of free PMPC in water is independent on the ionic strength of salt solution[5]. Therefore, the thickness of PMPC brush in solution was supposed to be hardly changed even in a salt solution.

References

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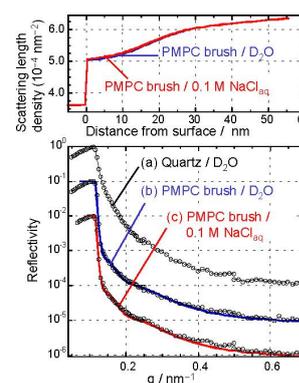


Fig. 1. Experimental NR profiles of bare quartz (a), PMPC brush (b) in heavy water, in 0.1 M NaCl solution (c), and corresponding fits. Assumed scattering length density profile for (b) and (c) is shown above.