

Ionic Strength Dependence of Chain Conformation of Hydrophilic Polymers at Water Interface

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In general, an isolated polyelectrolyte in pure water forms a relatively expanded state due to the electrostatic repulsion of ionic functional groups in the chain, while it would shrink in salt solution by the reduction of electrostatic repulsion between polymer chains. However, the influence of the ionic strength on a dimension of charged polymers should largely depend on chain flexibility and environment. Polymer brush, for example, is the densely tethered polymer chains on a solid substrate through the covalent bonds.[1] Brush layer in a solution affords unusual high concentration of polymer and high osmotic pressure, resulting in a fairly extended conformation of the brush chains. In this study, interface structure of surface-grafted polyelectrolyte brush at aqueous solution containing a salt was analyzed by neutron reflectivity (NR) measurements. High-density polyelectrolyte brushes on quartz were prepared by surface-initiated atom transfer radical polymerization of 2-methacryloyloxyethyl phosphorylcholine (MPC) [2] and N,N-dimethylaminoethyl methacrylate, which was transformed to 2-(methacryloyloxy)ethyltrimethylammonium iodide (META). 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 swollen brush on quartz glass. Scattering length density profiles of PMETA brush in heavy water calculated from the reflectivity curves indicated that the PMETA chains were stretched up to 70 nm in heavy water forming concentration gradient of heavy water. Interestingly, quite similar reflective curve was observed from the interface of

PMETA brush at 1.0 M of NaCl deuterium oxide solution. Salt ion cannot be diffused into a high-density polymer brush layer due to the high osmotic pressure and high local charge density. Therefore, the thickness of PMPC brush in solution was supposed to be hardly changed even in a salt solution. Similar results in another type of polyelectrolyte have also been discussed by Matsuoka[3] and Kurihara[4] using X-ray reflectivity and surface-force measurement, respectively.

References

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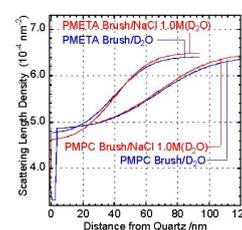


Fig. 1. Figure 1. Scattering length density profiles of PMETA and PMPC brush in D₂O and 1.0 M NaCl solution.