Solution and Bulk Properties of Highly-Purified Ring-Shaped Polystyrenes

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Introduction

Ring polymer is one of the interesting model polymers with no chain end, and also is the simplest system which exhibits the topological interaction. In this study, we have synthesized several high molecular weight ring polystyrenes with high purity. Using the purified rings, chain dimension in dilute solutions and bulk were measured and viscoelastic properties were also discussed.

Experiment

A series of ring polystyrenes were synthesized by anionic polymerization technique and isolated by SEC fractioination[1]. Samples for viscoelastic measurement were further purified using liquid chromatography at the critical condition (LCCC). The purity of the rings was checked by LCCC[2]. It was confirmed that all ring polymers obtained have high purity (<95%), and ring samples for viscoelasticity have higher purity(<99.5%).

Results

The chain dimensions of ring polymers in good solvent, theta solvent and bulk were measured using light scattering and neutron scattering. It was found that R_g of ring polymer were scaled with Mw as $R_g \propto M_w^{0.61}$ in benzene and as $R_g \propto M_w^{0.53}$ in cyclohexane, both exponents being the same as for linear counterparts, while R_g of rings in bulk was scaled $R_g \propto M_w^{0.38}$ as shown in Figure 1.

From the dynamic viscoelastic measurement of the purified rings and the linear counterparts, the data for rings did not show apparent plateau region and had shorter relaxation time than the linear ones.

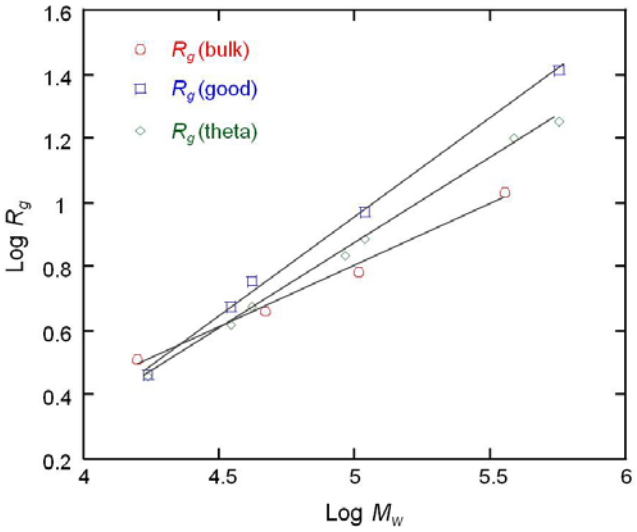

Figure 1. Relationship between molecular weight and radius of gyration of ring polystyrenes.

References

1) D. Cho et al. *Polymer J.* **2005**, 37, 506-511
2) A. Takano et al. *Macromolecules* **2007** *40*, 679- 681