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# Backbone Stiffness of Cylindrical Brushes Consisting of Rodlike Side Chains. Influence of Side Chain Length on Main Chain Stiffness

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## Introduction

A macromonomer is any polymer or an oligomer with a polymerizable functionality as an end group. Formally, the macromonomer homopolymerizes to afford a star- or comb-shaped polymer and copolymerizes with the conventional monomer to give graft copolymer. Recently, some interesting properties of poly-(macromonomers) have been explored as a simple model of brush polymers. However, most of macromonomer used in these studies is limited to that consisting from the flexible chains.[1,2]

In the present study, we report conformational properties of the polymacromonomers, consisting of a flexible polystyrene chain backbone and rod-like poly(*n*-hexyl isocyanate)(PHIC) side chains by SAXS, light scattering, [η] and AFM measurements in THF.[3-5]

## Experimental

**SAXS Measurements.** SAXS measurements of polymacromonomers were carried out in THF at 25 °C, using BL-10C with a synchrotron orbital radiation as an X-ray source set up in the Photon Factory of the High Energy Accelerator Organization at Tsukuba, Ibaraki, Japan. The wavelength of the X-ray was 1.488 Å. The scattered intensity was recorded by a position-sensitive proportional counter (PSPC) with 512 channels over a scattering vector range from 0.02 to 0.30 $Å^{-1}$. The scattered vector was calibrated using a sixth peak of dry collagen.

## Results and Discussion

Figure 1 shows a double logarithmic plot of cross-sectional radius of gyration, $\langle Rc^2\rangle_o^{1/2}$ of poly(VB-HIC-$n_w$) determined by SAXS in THF with weight averaged degree of polymerization of the side chain ($n_w$). The solid curve is a theoretical one given by the equation,

$$\langle R_c^2\rangle_o = \langle Rc^2\rangle_m + (2L_w)^2/12$$

where $\langle Rc^2\rangle_m$ is that of the main chain and $L_w$ is the weight-averaged contour length of a rod. The solid curve quantitatively describes the experimental data, implying the brush-like conformation consisting of the rods as a side chain.

Figure 2 shows a plot of main chain stiffness parameter ($\lambda^{-1}$) with contour length of side chain. It is clearly seen that the main chain stiffness linearly increases with increasing side chain length.

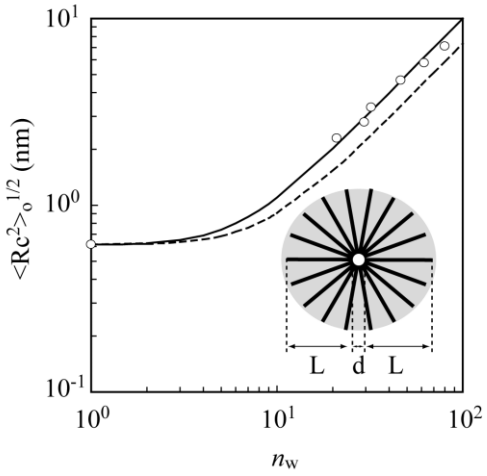


**Figure 1**. Dependence of the measured $\langle Rc\rangle_o^{1/2}$ on degree of polymerization of side chain $n_w$ for poly(VB-HIC-$n_w$) in THF.

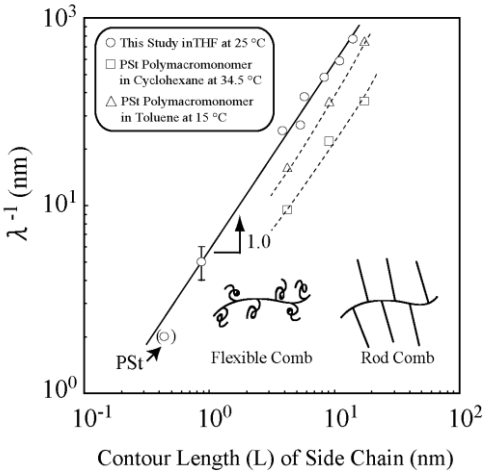


**Figure 2.** Dependence of Kuhn segment length $\lambda^{-1}$ on side chain length L, compared with reference values of polystyrene macromonomer in cyclohexane and toluene.

## References

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