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Title	Shear viscosity of star polymers.
Researchers	Jyun-ichi Takimoto, Hiroyasu Tasaki and Masao Doi
Purpose of this study	Prediction of the shear viscosities of star polymers.
System (Material)	Star polymers and blend of linear and star polymers
Program (including analysis)	PASTA (Smoothing and 2D-plottting programs)
Method & Some important input parameters	(Method) Stochastic simulation based on the slip-link model. It is assumed that the junction point of the arms does not move except moving due to the macroscopic flow of the sample. (Inputs) -Number of entanglements of the arm : $Z_a = M_a$ / Me (M_a : Molecular weight of arms, Me : Entanglement molecular weight) -Number of arms : n_a *Some set of Z_a and n_a is available. -MaxStretchRatio : Extended chain length / Equilibrium chain length
Advance & Problem	(Advance) The shear viscosities of liner and star polymers at high shear rate are similarly independent of the molecular weight. In case of linear polymers, Convective Constraint Release(CCR) is a dominant relaxation mechanism under fast flow. Since the end of an arm is free, it is assumed that the relaxation of star polymers at high shear rate is also governed by CCR of the arms. The rate of CCR is depend on the shear rate, the shear stress of liner and star polymers show good agreement at high shear rate independent of the molecular weight. (Problem) Prediction of the rheological properties of polymers with other type branching structures, such as pom-pom and comb.
References	[Manuscript] Submitted/Accepted(/) [Presentation at conferences (Meetings)] H. Tasaki, J. Takimoto, M. Doi, Proceeding of Materials Science for the 21st Century, Osaka, Japan, **B**, 15 (2001)
KeyWords (in English)	Rheology, slip-link model, entanglement, constraint release, constraint renewal, contour length fluctuation, linear polymer, arm, star polymer, viscoelasticity, shear viscosity, zero shear viscosity, PASTA

Results (Remarks)

[Example of analysis]

In the case of star polymers, it is assumed that the junction point of the arms does not move except moving due to the macroscopic flow of the sample. Under this assumption, each arm of a star polymer can be dealt with independently. Of course, an entanglement between each arm is taken into consideration. Therefore, each arm can carry out a simulation like a linear polymer except for the point of not performing reptation. However, the Rouse relaxation time of an arm whose molecular weight is Z_a(Accurately, $Z_a = M_a / Me$) is given as $\tau_R = 4\tau_e Z_a^2$, that is, it is necessary to use the Rouse relaxation time of the linear chain of a molecular weight Z_a.
In addition, this simulation technique gives the result for which it does not depend on the number of the arm about rheological properties of star polymers.

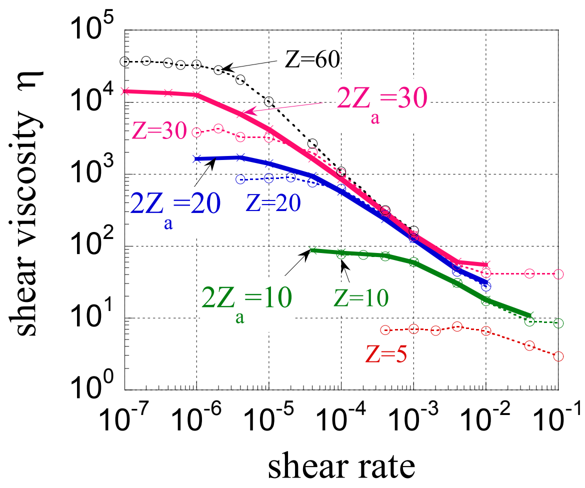

Fig.1 Shear viscosity of the linear and star polymers.
Thick solid lines and thin broken lines with symbols represent the star polymers and linear polymers, respectively.

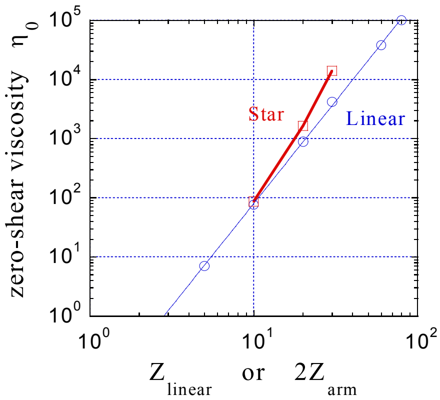

Fig.2 Molecular weight (Z or Za) dependency of the zero shear viscosity.