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Application of Stochastic Simulation to Analysis of Elongation Flow and Fiber Spinning

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Abstract: Application of stochastic simulation to a uniaxial elongation flow and fiber spinning of polymer melts were investigated. In the numerical simulation of fiber spinning, a one dimensional approximation was employed. The stochastic simulation was performed based on the stochastic differential equation equivalent to the diffusion equation of a probability density for the Doi-Edwards and the Curtiss-Bird models. The stress field was computed from the results of the stochastic simulation. The computation of velocity field was decoupled with that of the stochastic simulation. It was confirmed that the elongation viscosity predicted by the stochastic simulation coincided with that predicted with the differential-approximated Doi-Edwards model. Furthermore, stress growth and temporal change in orientation vectors were successfully predicted. The numerical simulation indicated that the present approach was applicable to the fiber spinning problems and gave useful information relating fluid microstructures such as polymer orientation.

Key Words: Stochastic simulation, Elongation flow, Fiber spinning, Doi-Edwards model, Curtiss-Bird model

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