MACRO-MODELING OF ENTANGLEMENTS

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We constructed a macroscopic model of entanglements in polymer melts and studied their behavior at high deformation rates hoping to understand the cause of non-linearity in the rheological behavior of monodisperse macromolecule melts. A model consists in flexible elastic strips, which are tied in a knot (modeling entanglements). It was demonstrated that the behavior of knots is different at low and high rates of deformation. In the preceding case knots disentangle as predicted by the "tube" model, elastic strips slip out of a knot and this is a simulation of the flow. In the latter case, knots tighten up and extension leads to the increase of stresses and ends with break-up of samples. This effect imitates the transition from the flow to the rubbery-like behavior of a polymer melt, when flow is impossible due to the existence of quasi-permanent entanglements with the definite life-time. The stored elastic energy in this case prevails over energy of the Brownian movement. The general dimensionless dependence describing a process under discussion has been proposed.