Towards a unified theory for entangled polymers: linear, branched and crosslinked

Prof. Jay D. Schieber
schieber@iit.edu
Department of Chemical Engineering, and
Center of Excellence in Polymer Science and Engineering
Illinois Institute of Technology
10 W. 33rd Street
Chicago, Illinois 60616
http://www.chee.iit.edu/~schieber

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Abstract

Rather than tubes, slip-links are used to model the dynamics of entangled polymers. Slip-links suggest a different variable set that has at least two significant advantages over tubes. First, a strong connection can be made with thermodynamics, allowing a more straightforward generalization to more complex problems, such as mixtures. Second, a single mathematical approach can be used to model linear chain architectures, branched architectures, or even cross-linked systems. We have considered all three such systems, but linear architectures are the most well characterized experimentally, and where we have focused most of our work to date. I will show how slip-links can be used to make predictions of stresses in arbitrary flow fields for linear chains without resorting to adjustable parameters. We will consider nearly all studied homogeneous flow data on monodisperse, linear, entangled polymer liquids. Only uniaxial elongation remains a puzzle, where entangled solutions and entangled melts show large qualitative difference.