Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Simulating the melt blowing of viscoelastic materials CHUNFENG ZHOU, DAWUD H. TAN, SATISH KUMAR, CHRISTOPHER W. MACOSKO, FRANK S. BATES, University of Minnesota — This work is motivated by recent experimental developments in melt blowing that enable the production of nanofibers. In contrast to electrospinning, which is another method for producing nanofibers, melt blowing is potentially faster and environmentally friendlier. Using a slender-jet approximation, we obtain a set of one-dimensional equations governing the fiber area, centerline velocity, and temperature. The upper convected Maxwell (UCM) model and the Phan-Thien and Tanner (PTT) model are used to describe the viscoelastic rheology of the melts. Key to melt blowing is the shear stress on the fiber surface from the external air flow that attenuates the fiber to small diameter. Larger shear stresses or higher air flowrates produce fibers with smaller diameter. Our results show a significant influence of viscoelasticity on melt blowing, especially on fiber diameter. The fiber diameter is found to increase with polymer elasticity, which agrees qualitatively with experimental observations.

Chunfeng Zhou
University of Minnesota

Date submitted: 05 Aug 2010 Electronic form version 1.4