Tuning shear banding in entangled DNA-PNIPA hybrids

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Shear banding, where a sheared fluid separates into regions of different shear rate or viscosity, is quite ubiquitous in complex fluids. The existence of shear banding makes conventional rheology difficult to interpret. In entangled polymer system, for example, the existence of shear banding would overturn the well-known Tube theory [1]. There is, however, considerable debate over whether shear banding observed in entangled polymers such as Polybutadiene is true or not [2-3].

In order to test which physical parameters determine the stability of the flow, we grafted short PNIPA (Mw=3k) chains on the DNA backbone at a relatively low grafting density. The grafting PNIPA does not change the flow behavior of DNA at temperature lower than its Lower Critical Solution Temperature (LCST), while at higher temperature than LCST the DNA-polymer hybrids become attractive. Thus, we can study the flow behaviour of morphologically identical chains with different interactions.

We report here that the flow behaviour changes from well-defined banded flow with birefringent structure to almost linear flow with no birefringence at all for the same entangled polymer system by tuning the interaction between chains. This transition in flow behaviour with temperature is connected with a pronounced change in the linear and non-linear rheological measurements. These observations would help us understand the mechanism for shear banding in entangle polymer systems on a molecular level.

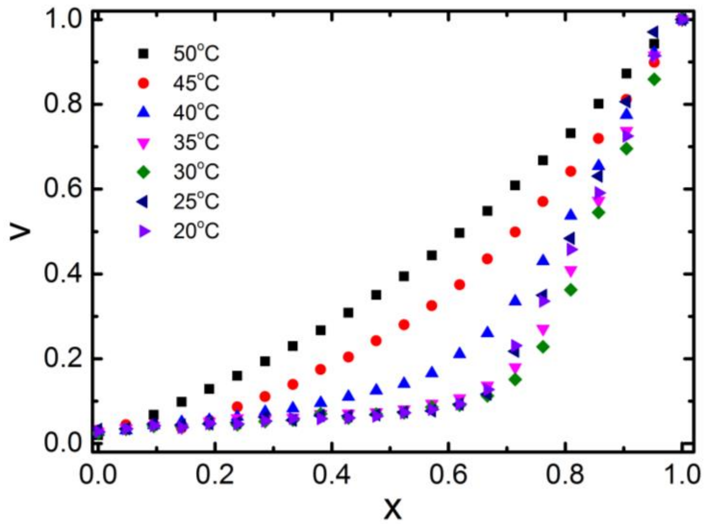

Figure 1 Velocity profiles of PNIPA coated DNA at the same shear rate of $50s^{-1}$ at different temperatures

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[2] K. A. Hayes, M. R. Buckley, I. Cohen, and L. A. Archer, *PRL, 2008,* **101**, 218301.
[3] Y. F. Li and G. B. McKenna, *Rheologica Acta,* 2015, **54**, 77.