Resolving tension on the surface of polymer mixes

October 11 2017

Better than playing with Legos, throwing polymer chains of different lengths into a mix can yield surprising results. In a new study published in *EPJ E*, physicists focus on how a mixture of chemically identical chains into a melt produces unique effects on their surface. That's because of the way short and long polymer chains interact with each other. In these kinds of melts, polymer chain ends have, over time, a preference for the surface.

Now, Pendar Mahmoudi and Mark Matsen from the University of Waterloo, Ontario, Canada, have studied the effects of enriching long-chain polymer melts with short-chain polymers. They performed numerical simulations to explain the decreased tension on the surface of the melt, due to short chains segregating at the surface over time as disorder grows in the melt. They found an elegant formula to calculate the surface tension of such melts, connected to the relative weight of their components.

In this study, the authors model individual polymers as a bead-spring model linking a series of monomers connected by freely-jointed bonds. They then use a theory, called self-consistent field theory (SCFT), which helps to model what happens on the surface of the polymer melt. They also model the excess concentration of short polymers combined with the effect on the surface tension in terms of disorder energy. They find that there are universal dependences on the molecular-weight distribution of polymers.

The authors then compare their simulation with approximated equations. They deduct a simple mathematical formula describing the interfacial tension between immiscible short- and long-chain polymers as a function of the molecular weight of the polymers in the mix. What is more, they find that the molecular weight also affects the level of segregation between short- and long-chain polymers.

More information: P. Mahmoudi et al, Entropic segregation of short polymers to the surface of a polydisperse melt, *The European Physical Journal E* (2017). DOI: 10.1140/epje/i2017-11575-7

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