MAR08-2007-005003

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Slippage

LILIANE LÉGER, Université Paris Sud-XI

After a brief overview of the usual assumptions made to fix the boundary conditions for the flow velocity at a solid wall, we shall present the early conjecture made by Pierre Gilles de Gennes in 1979, predicting huge slip at the wall for polymer melts flowing against smooth non adsorbing surfaces. We shall then discuss how interplay between theory and experiments has allowed to produce a refined picture of the molecular mechanisms of friction at polymer interfaces, which quantitatively accounts for the three different friction regimes which have been experimentally identified when increasing the shear rate in simple shear experiments of polymer melts. The key idea (Brochard and de Gennes, 1992) focuses on the effect of a few surface anchored chains. If these chains are not rigid, they will deform under the effect of the friction forces resulting from entanglements between surface and bulk chains. When increasing the shear rate, the surface chains are thus progressively stretched, and can disentangle from bulk chains: a dynamic decoupling between surface and bulk polymer occurs. We shall discuss the available sets of experimental data (and the corresponding techniques which have been developed to either directly characterize wall slip or yield friction forces measurements). At present, the low surface density regime is fully understood, while series of data in the case of large grafting densities are available, but still lack of an adequate model. We shall finally draw lines of possible extensions of the ideas to other systems which start to be investigated as regards to friction: polyelectrolytes - grafted polyelectrolyte chains, rigid polymers, other complex fluids. We shall also discuss what is known at present on slip at the wall in the case of simple fluids, a situation which appear much more difficult to model than the polymer case.