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Slip at Polymer-Polymer Interfaces

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A number of studies have shown that blends of immiscible polymers have anomalously low viscosity at high shear rates (Utracki, 1983). In some blends the viscosity is even lower than either of the components. Slip at the interface between the two polymers has been proposed to explain these results. Interfacial slip has also been identified as the mechanism behind the ability of fluoroelastomer process aids to reduce melt fracture (Migler, 2001). We have found that the apparent shear viscosity of multilayer samples decreases with increasing number of layers. From this viscosity decrease we have calculated slip velocities (Zhao, 2002). The theory of Furukawa (1989) and de Gennes (1992) predicts fewer chain entanglements near the interface of an immiscible polymer pair. Goveas and Fredrickson (1998) have extended the theory to calculate slip velocities. These are greater than we measure and independent of shear stress. We find that slip velocity increases with shear stress. The adhesion between coextruded layers also depends on interfacial entanglements (Cole, 2003) and thus should be related to slip. We find that adhesion decreases with increasing shear stress, but is quickly recovered with annealing for times longer than the reptation time. Reactive coupling between chains in the interface can greatly reduce interfacial slip and increase adhesion. Surprisingly, reaction rates are also accelerated greatly by flow. The addition of premade block copolymer was only effective at reducing slip after static annealing. P.J. Cole, R.F. Cook, and C.W. Macosko, Macromolecules 2003, 36, 2808-2815. R. Zhao and C.W. Macosko, J. Rheol. 2002, 46, 145-167.