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Interfacial Slip between Immiscible Polymer Melts undergoing Capillary Flow

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Slip at the interface between polymer melts remains poorly understood. Studies that use only rheological data to deduce the slip velocity usually involve applying a shear deformation to a stack of parallel multilayers. In order to understand slip in the context of polymer extrusion, we have investigated slip at the interface between two immiscible polymer melts undergoing pressure driven flow through a capillary die. To enable the measurement of slip velocity at the polymer/polymer interface we have adapted the Mooney method, a method usually used to study wall slip. Using the method, we measured the dependence of the interfacial slip velocity on the interfacial shear stress for cylindrical core-sheath samples of Polypropylene and Polystyrene. In agreement with prior work on multilayer sandwiches, we found two distinct power-law regimes in the relationship between the interfacial slip velocity and the interfacial shear stress. The power-law exponent changes from a value of approximately 3 at low shear stress values to approximately 2 at high shear stresses. We then investigated the effect of varying the temperature on the slip velocity and explore the consequences of time-temperature superposition for the two polymers. Finally, we investigated the connection between slip at the interface between the two polymers and the origin of roughness at the interface.