Dynamics of Interface Broadening and Fracture Mechanics of Phase Separated Poly(Urethanes)

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The rate of self-adhesion and interface width development between thin films of Poly(Urethane) (PU) was investigated. The study emphasizes methods to prepare optical quality film specimens which can be used in interface fracture tests to obtain a wide dynamic range of interface strengths. Also, visco-elastic dissipation contributions are low, so true interface strengths are more easily extracted from the peel test data. The time dependence of the peel strengths for self-adhesion between thin films of PU follows a $t^{1/2}$ dependence, as has been predicted and experimentally verified for interdiffusion of linear polymers, suggesting that diffusion of mobile soft blocks is the limiting process, even though center of mass motion of entire PU chains is prohibited by the physical cross-links associated with the hard blocks. The interface widths determined by neutron reflection reach a limiting value of about 70 Å after about 2 days at 22°C, while the interface strength measured by peel tests plateaus at much longer times. Tentative molecular mechanisms will be discussed.