

Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Polydispersity Effects on Polymer-Polymer Welding. ANNA BARNETTE, RICHARD WOOL, IAN MCANINCH, Dept Chemical Engineering, Univ Delaware — During polymer-polymer welding, it is generally accepted that molecular weight distribution $\phi(M)$ and its polydispersity (PD) affects the weld strength and required welding times. However, current welding models do not adequately address the role of PD coupled with interdiffusion Reptation dynamics, entanglement connectivity and relations between the fractal interface structure and strength, which would allow the optimal selection of the molecular weight distribution $\phi(M)$. A computer simulation was developed to predict the microscopic effects of PD on welding and the results are compared with experiments on model blends of monodisperse polystyrenes (PS). The validity of the model was tested using Double Cantilever Beam PS samples that were first wetted below, and then welded for various times t , above the glass transition temperature. Wedge cleavage fracture testing determined that the weld strength G_{1c} reached the maximum strength G^* at an interfacial penetration contour length of 240 kDa corresponding to $M^* = 8 M_c$. The simulations and experiments for monodisperse interfaces yielded $G_{1c}(t) = G^*[t/\tau]^{1/2}$ where the welding time behaved as $\tau \sim M$, and τ was less than the Reptation time $T_r \sim M^3$. For polydisperse samples, the time exponent of $1/2$ decreased empirically with increasing PDI and the welding times were related to various moments of $\phi(M)$ and increased with increasing PDI until a PDI of approximately 12 was reached. The welding times for strength development are much shorter than the welding times for maximum fatigue resistance.

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Date submitted: 30 Nov 2005

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