

MECHANICAL PROPERTIES OF URETHANE ACRYLATE NETWORKS THROUGH RAFT MEDIATED PHOTOPOLYMERIZATION

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Reversible addition-fragmentation chain transfer (RAFT) in polymer systems has shown great utility as a controlled radical polymerization method. Due to the reversible chain transfer mechanism, RAFT agents have been used to synthesize monodisperse linear polymers and block copolymers in solution or emulsion polymerization. On the other hand, little is known about the effects of RAFT agents on the polymerization kinetics and thermomechanical properties of cross-linked materials. This work investigates the effect of RAFT agents on photopolymerization behavior and ultimate polymer properties in urethane acrylate systems. Our results indicate that RAFT agent addition has a significantly different impact on network development depending on inherent system characteristics, i.e., rubbery and glassy behavior. When polymerizing with RAFT agents, photopolymerization rate decreases and can be tuned using different concentrations of RAFT agent. The final materials also show increased elongation at break with a relatively decreased Young's modulus (Figure 1). Additionally, with RAFT addition, a relative decrease in glass transition temperature (T_g) was observed from glassy polyurethane networks. The tensile toughness was doubled when compared to neat glassy films. On the other hand, although the T_g of RAFT modified rubbery polyurethane networks stayed the same as the control. Toughness enhancements were observed from films with low RAFT concentration while films with high loading of RAFT exhibited diminished overall tensile toughness. These results demonstrate that the polymer networks and thermomechanical properties can be mortified by introducing RAFT agents enabling dynamic polymer chain rearrangements in both rubbery and glassy acrylate network systems.

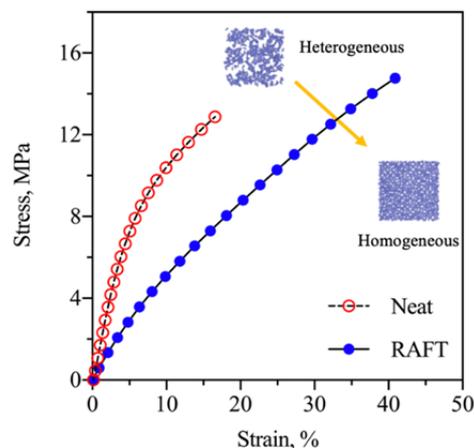


Figure 1. Increased elongation and toughness of poly(urethane) films upon polymerization with RAFT agent.