

Post-synthetic crosslinking of polymer strands with mechanophores

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Fracture and tear performance in commodity polymers is governed by how the network stores and dissipates energy under load. However, improving fracture resistance and tear toughness without compromising elasticity or introducing large hysteresis remains a challenge. Recent work has demonstrated that mechanophore-based crosslinkers can provide a distinct route to toughening, as force-triggered reactions at selected linkages can change energy dissipation during crack propagation.

Building on these advances, there remains a need for general strategies that (i) enable installation of force-responsive mechanophore linkages into existing commodity polymer strands, (ii) are compatible with scalable network formation, and (iii) provide tunable mechanical performance through mechanochemical activation under load. Here, we demonstrate the post-synthetic installation of mechanophore crosslinks via thermal [3+2] cycloaddition with alkenes on or immediately pendant to the backbone of commodity polymers. We find that this strategy enhances mechanical properties relative to controls across a range of common polymeric materials.