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Yield Stress Enhancement in Glassy-Polyethylene Block Copolymers. WILLIAM MULHEARN, RICHARD REGISTER, Princeton University — Polyethylene (PE) has the highest annual production volume of all synthetic polymers worldwide, and is valuable across many applications due to its low cost, toughness, processability, and chemical resistance. However, PE is not well suited to certain applications due to its modest yield stress and Young's modulus (approximately 30 MPa and 1 GPa, respectively for linear, high-density PE). Irreversible deformation of PE results from dislocation of crystal stems and eventual crystal fragmentation under applied stress. The liquid-like amorphous fraction provides no useful mechanical support to the crystal fold surface in a PE homopolymer, so the only method to enhance the force required for crystal slip, and hence the yield stress, is crystal thickening via thermal treatment. An alternative route towards modifying the mechanical properties of PE involves copolymerization of a minority high-glass transition temperature block into a majority-PE block copolymer. In this work, we investigate a system of glassy/linear-PE block copolymers prepared via ring-opening metathesis polymerization of cyclopentene and substituted norbornene monomers followed by hydrogenation. We demonstrate that a large change in mechanical properties can be achieved with the addition of a short glassy block (e.g. a doubling of the yield stress and Young's modulus versus PE homopolymer with the addition of 25 percent glassy block). Furthermore, owing to the low interaction energy between PE and the substituted polynorbornene blocks employed, these high-yield PE block copolymers can exhibit single-phase melts for ease of processability.

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