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Effective Blending of Ultrahigh Molecular Weight Polyethylene with High-Density Polyethylene via Solid-State Shear Pulverization (SSSP) MIRIAN DIOP, JOHN TORKELSON, Northwestern University — Compared with conventional polyolefins, ultrahigh molecular weight polyethylene (UHMWPE) possesses outstanding mechanical properties, including impact strength and crack resistance, that make it it highly desirable for applications ranging from body armor to implants. Unfortunately, UHMWPE has an ultrahigh melt viscosity that renders common melt processes ineffective for making products from UHMWPE. Attempts to overcome this problem by blending UHMWPE with polyethylene (PE) by conventional melt mixing have been unsuccessful because of the enormous viscosity mismatch between blend components and have led to large suspensions of UHMWPE particles within a PE matrix. Here, we show the utility of solid-state shear pulverization (SSSP) in achieving effectively and intimately mixed UHMWPE/PE blends. For blends with up to 50 wt% UHMWPE we observe only slight increases in viscosity (η) at high shear rates but major increases in η with increasing UHMWPE content at low shear rates. Using extensional rheology, we confirm the strain hardening behavior of SSSP blends. Additionally, shear rheology and differential scanning calorimetry data indicate that the degree of mixing between UHMWPE and HDPE domains can be increased dramatically with subsequent passes of SSSP and single screw extrusion. Finally, blends prepared via SSSP show dramatic increases in impact strength; e.g., for a 30/70 wt% UHMWPE/HDPE blend, impact strength increases by about 300 % (relative to the parent neat HDPE).

Jeanette Diop
Northwestern Univ

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