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Effect of Microstructure on the Dynamic Behavior of UHMWPE Composites JASON PARKER, KT RAMESH, Johns Hopkins University — Ultra-High Molecular Weight Polyethylene (UHMWPE) fiber-reinforced composites are commonly used as a protective material against fragments and projectiles, in part due to the high specific toughness and high longitudinal wave speed of their constituent fibers. UHMWPE composites are inherently difficult to process due to the high viscosity of the thermoplastic matrix and demonstrate a strong sensitivity to processing conditions. The low volume fraction and high viscosity of the matrix can lead to significant porosity. Understanding how porosity affects the dynamic response of these composites and evolves during deformation is important in an effort to model this material. In this study we use a Kolsky bar to dynamically load the composites in out-of-plane compression while simultaneously capturing the deformation history with high speed video. By analyzing the high-speed video, we obtain the complete deformation gradient. Using a finite deformation formulation, we determine how porosity evolves in these composites during loading at several strain-rates and compare our results with post-mortem micro-CT measurements. This work will be used in the development of a constitutive model of the material incorporating microstructure through internal variables.

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