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Understanding the Evolution in Meso/Nanostructure in UHMWPE Fibers PRESTON MCDANIEL, JOSEPH DEITZEL, JOHN GILLESPIE, Univ of Delaware — Ultra-high-molecular-weight polyethylene (UHMWPE) fibers are increasingly used in composite armor applications. Understanding the complex sub-filament structure which ultimately dictates macroscopic mechanical performance is important as a materials by design approach is taken. In this work, the meso/nanostructure of fibers is studied through a series of atomic force microscopy, X-ray diffraction, and tomography techniques. Fibers with varying thermomechanical processing histories and macroscopic mechanical properties are examined to correlate the evolution of structure with fiber mechanical response in both tension and transverse compression. This work spotlights the sub-filament structural hierarchy in the fiber. The study of nanoscale fibril geometry and crystal structure provides some insight into the load pathways within the fiber, while the identification of a three-dimensional fibrillar network indicates the presence of complex mechanical interactions throughout. The presence and geometry of mesoscale voids in highly drawn fibers is discussed, and tomography results are presented to further understand their distribution throughout the fiber. Finally, the presence of these features are explored in the context of their influence on the energy dissipative capabilities at the fiber level.

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