Microstructures and Mechanical Properties of Electrospun Silk Fibers

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The microstructure of nanofiber electrospun from silk (*Bombyx mori*)/poly(ethylene oxide) (PEO) blend were characterized using birefringence, wide-angle X-ray diffraction, differential scanning calorimetry, and atomic force microscopy (AFM). In the as-spun fibers, silk fibroin is present in a coil conformation due to rapid fiber formation during electrospinning. After treatment with methanol, the silk fibroin was transformed into a beta-sheet-containing structure. Evidence for nanofibrils within the as-spun fibers was observed by AFM, and the PEO phase was dispersed as small, elongated islands within the silk fibroin matrix and oriented along the fiber direction. The mechanical properties of single fibers were characterized by AFM nanoindentation. The results were consistent with uniaxial tensile tests and with the morphological analysis. After methanol treatment and extraction with water, the electrospun silk fiber exhibits a lateral modulus of 8.0 GPa, within a factor of 2 of degummed native silk. The results provide additional insight into the nature of these reconstituted silk fibroin submicron diameter fibers, which have potential utility in a range of materials science and engineering applications.