

NANO HIGHLIGHT

Enhancing the Properties of Nanoscale Electrospun Polymer Fibers Through Chemical Architecture, Surface Texturing and Optimization of Processing Protocols

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The University of Delaware's NIRT is using genetically directed synthetic methods to produce a number of unique protein polymers and then electrospin them into nanofibers so as to assess their mechanical integrity and biological activity. Significant progress has been made on the electrospinning of polymer nanofibers¹ as is shown in Fig.1 which contains an FE-SEM micrograph of an electrospun membrane of genetically engineered spider silk (S. Fahnestock – DuPont) with an average fiber diameter of 300 nm. Raman spectroscopy has revealed that, although the as-synthesized spider silk analogue adopts a β -sheet conformation, electrospinning produces nanofibers that adopt predominantly an α -helical structure.

Recently, polysaccharide-derivatized PEG star polymers have been synthesized and are currently being evaluated as a strategy for including functional macromolecules into electrospun fibers. PEG-star polymers have been derivatized with the sulfated, helical polysaccharide heparin, and these molecules have been incorporated into electrospun PEO fibers (Fig. 2). Heparin alone cannot be incorporated into electrospun PEO fibers; attachment of the polysaccharide to a PEG scaffold is required in order to incorporate the biomolecule into the fiber. Alteration of the spinning conditions results in radically different fiber morphologies; the origins of these differences are being explored, along with the potential for orientation of the helical heparin molecules. These preliminary results suggest the utility of copolymers as a means to produce novel functionalized electrospun fibers².

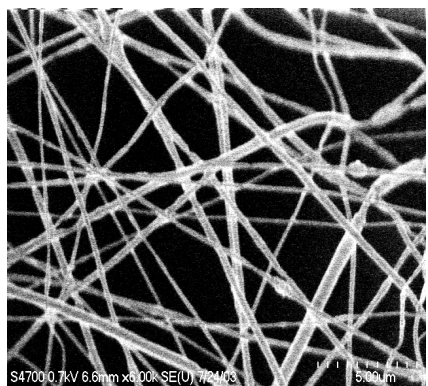


Figure 1. Electrospun nanofibers of genetically engineered spider silk.

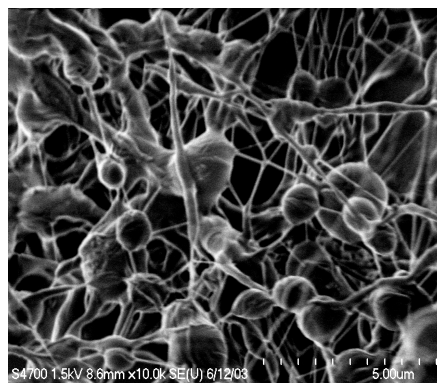


Figure 2. Electrospun fibers of PEO and PEG-heparin star polymers.

References

- [1] Megelski, S.; Stephens, J. S.; Chase, D. B.; Rabolt, J. F., "Arrays of Micro- and Nanopores on Electrospun Polymer Fibers", *Macromolecules* **2002**, 35, 8456
- [2] For further information about this project link to <www.udel.edu/mse/research.htm>