Project Title: 3D Printing of Polymer Nanofiber Networks

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Project Description:
Fiber networks or networks of interconnected fibers are an important component of composite materials. Fabrication of fiber networks with micro/nanometer scale fibers presents challenges with controlling network structure and design. Solution electrospinning is a way to produce polymer nanofibers with a wide diameter range. However, the technique presents challenges to control the precise alignment of fibers in a pre-defined structure because of the highly dynamic and random nature of fiber deposition. In contrast, melt electrospinning is compatible with additive manufacturing principles with precise control over the positioning of fibers and network architecture because of the higher viscosity and lower conductivity of the polymer melt (Fig. 1). 3D printing of carbon fiber-epoxy composites is another area of great potential and interest, especially in the aerospace industry, where micrometer scale polymer fibers embedded with nanoscale short carbon fibers can be used to fabricate scaffolds with control over the composite structure. The aim of this project is to build a 3D printer capable of producing networks of micro and nanofibers with different architectures. This research opportunity will provide the student with a unique experience to work in the field of additive manufacturing, also utilizing concepts from controls and robotics.

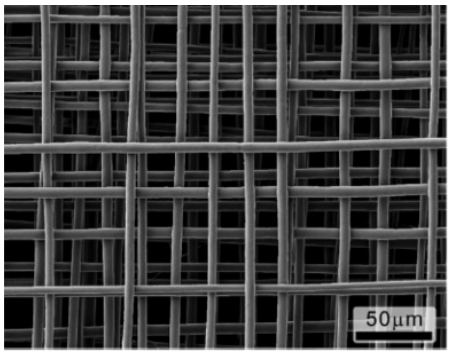

Figure 1. 3D printed network of microfibers fabricated by direct write using melt electrospinning [Dalton et al., *Biomat. Sci.*, 1, 2013]. The scale bar is equal to the radius of the human hair.

Student background and expected research activities:
We are looking for enthusiastic and ambitious students who are interested in materials, controls/robotics, and experimental lab research. Basic LabVIEW, Arduino, and Simulink skills will be beneficial.

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