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Polymer Nanofibers with Applications to Nanosensors, Biological Scaffoldings and Nanoprobes for Electrical Measurements of Neurons

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Abstract

A novel nanorobotic method is proposed for fabricating customized three dimensional (3D) nanoscale polymer fibers of different polymers having diameters less than 200 nanometers and lengths over tens of micrometers using glass micro pipette probe tips. Customized three dimensional fabrication of nanostructures has generated significant interest lately due to its potential applications in diverse fields such as nanoelectronics, nanosensors, biological applications, and smart textiles. The proposed method will allow for multi-length scaling of fibers within the same manufacturing unit, besides providing the ability to fabricate fibers of different polymer blends. Studies of fiber formation at the nanometer scale coupled with their mechanical and electrical characterization along with the estimation of forces generated will allow for potential implementation of these fibers in novel applications such as free standing cantilevers for nanosensors, suspended fibers in biological scaffoldings and conductive probe tips for electrical measurements in biological cells. Analytical models to be developed and corroborated against experimental studies will greatly enhance the understanding of polymer processing in the nanoscale which will in turn enable the design of novel devices and sensors.

The proposed project will demonstrate the proof-of-concept of a novel nanorobotic method of fabricating nanoscale polymer fibers, will train a Ph.D. student, will advance nanoscale science and engineering research in Pennsylvania and will create opportunities for federal funding. Moreover, this nanofiber pulling technology would have wide applications in nanocircuit interconnects by using conductive fibers, prototyping novel nanoscale electronic devices and circuits, 3D fibers used during bone regeneration and development of new nanoprobes for measurement of electrical activities of neurons. These products would have much impact on existing Pennsylvania industries as well as potential for new start-ups.