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Customized Three-Dimensional Nano-Fiber Manufacturing by Controlled Pulling of Liquid Polymers using Nanoprobes

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Abstract

Novel manufacturing processes at the micro- and nano-scale are indispensable for mass production of future micro/nano-scale devices, circuits, man-made materials, sensors, etc. One of the main challenges of this technology is three-dimensional (3D) customized manufacturing. We propose manufacturing micro- and nanometer size polymer fibers by active and precise control of the Atomic Force Microscope (AFM) probe tip and polymer solidification. A liquid polymer fiber bridge between the probe tip and a substrate formed when pulling the probe from the surface involves fundamental issues of surface chemistry of the probe, liquid polymer curing, polymer fiber aspect ratio, spatial control of the AFM probe in 3D, and heat transfer at the nanoscale. This project is exploratory since the proposed technique is not tested and feasibility has not been shown for nanoscale polymer pulling yet.

This micro/nano-fiber pulling technology would have wide applications in nano-circuit interconnects by using conductive nano-fibers, prototyping novel nano-electronic devices by using conductive/semiconductor/non-conductive polymer fiber structures, 3D polymer fiber based nano-actuators, photonic devices, novel bio-nano-sensors, smart materials etc.