High Throughput Nanofiber Production Using Massive Electrospinning Emitter Arrays
Technology #16349

Applications

- Flexible electronics
- Filtration systems
- Tissue engineering
- Ultracapacitors
- Nano-reinforced composites
- 3D printing of parts made of nanoporous materials

Problem Addressed

Electrospinning is a technique which generates nanofibers using strong electric fields applied to high molecular weight, polar polymer solutions. In the procedure, a high electric field deforms the free surface of the liquid into a conical shape. Then, the apex of the cone emits a charged fiber which undergoes a whipping process that stretches the fiber and greatly reduces its diameter. Electrospinning is the only known process that can generate nanofibers of arbitrary length with controlled form, but the practical application of the resulting nanofibers is limited because of the low output of standard electrospinning sources.

Technology

The presented technology overcomes the standard limitations of electrospinning by using arrays of externally-fed batch-microfabricated electrospinning emitters, demonstrating emitter densities as high as 25 emitters per square centimeter, which is two orders of magnitude higher than the state-of-the-art MEMS implementations. Further, the surface of the emitters is patterned to allow delivery of polymer solution without external pumping. The Inventors demonstrated four times more nanofiber mass flux compared to state-of-the-art commercial electrospinning nanofiber sources while operating at 92% less voltage.

Advantages

- Technology drastically increases throughput production of electrospun nanofibers, decreasing their cost of production, and making them more available for low-end applications
- Technology operates with 92% less bias voltage compared to the best commercial electrospinning nanofiber sources because of the microstructured emitter tips
- Technology is modular and lends itself for implementing very large arrays
- Technology is compatible with individual actuation of each emitter, enabling the possibility to use the technology to implement a printing head for high-speed, free-form additive manufacturing of nanoporous parts made of dielectric, semiconductor, and metallic materials
- Technology uses capillary feed of the liquid, removing the need of active pumping and making the devices based on the technology resilient to clogging and with liquid feed redundancy. The
liquids used in producing nanofibers are very viscous; therefore, having capillary feed greatly simplifies the liquid feed and reduces the power it consumes

Categories For This Invention:

Materials
Fabrics, Fibers & Textiles
Micro & Nanotech
MEMS/NEMS (Materials)
Nanomaterials
Nanowires (Micro & Nanotech)

Intellectual Property:

Electrically-driven fluid flow and related systems and methods, including electrospinning and electrospraying systems and methods
Issued US Patent
9,358,556
Electrically-driven fluid flow and related systems and methods, including electrospinning and electrospraying systems and methods
Issued US Patent
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External Links:
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http://www-mtl.mit.edu/wpmu/lfv/about

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