TIP Project Brief – 100030/11H004

Manufacturing
Critical process advance to transform production rates of core-sheath electrospun fibers enables manufacturing of micro- and nanofibrous devices in practical commercial volumes

Develop processes to increase production of drug-filled, hollow fibers to rates necessary to enable commercially viable use of these fibers in devices and products for drug delivery, tissue engineering, nanoscale sensors and other applications.

Sponsor: Arsenal Medical, Inc
480 Arsenal Street
Watertown, MA 02472-2891

- Project Performance Period: 2/1/2011 - 1/31/2014
- Total project (est.): $4,706 K
- Requested TIP funds: $2,279 K

Good things often come in small packages—like the ultrathin core-sheath fibers now being eyed for applications ranging from controlled drug delivery systems and tissue regeneration to self-healing coatings and self-cleaning filters. Core-sheath fibers are fibers with a concentric structure, one material surrounding another. (Think of an insulated copper wire, but much smaller.) Arsenal Medical intends to develop a high-throughput, core-sheath electrospinning technology that greatly increases the rate of producing these slender cylindrical packages. The anticipated jump in processing speed would move promising—but unaffordable—prospective products requiring high-throughput manufacture of core-sheath fibers into the realm of the commercially viable.

Ranging in diameter from about 100 nanometers to 20 micrometers, core-sheath fibers are among the most promising members of a growing family of electrospun materials. In electrospinning, a high-voltage electrical field is used to charge and stretch a droplet of a polymeric solution while on its way to a grounded collector plate or screen. Depending on the composition of the starting materials, operating conditions, and other factors, the process outputs can take the form of a range of shapes and textures including meshes, tubes, or structures that look like yarns.

A major challenge is to develop methods that yield fibers of uniform quality in volumes sufficient for commercial production. This is especially true for core-sheath fibers because of their concentric design, which encapsulates one material within another. Production yields with the current state-of-the-art method—a pump-driven needle with low flow rates—are a fraction of a gram per hour, according to Arsenal Medical.

Extending a newly introduced technology, the company will leverage the physics of electrospinning to devise a process that generates multiple fiber-forming jets composed of two materials in the desired arrangement. In addition to revving up production rates by more than 500-fold, the nascent process does not require multiple nozzles, as would an alternative option. Arsenal Medical says its approach can overcome logistical, quality-control, and cost issues that impede other approaches to scaling up production of core-sheath fibers for marketplace applications.

For project information:
Toby Freyman, Ph.D., (617) 393-4609
tfreyman@arsenalmedical.com