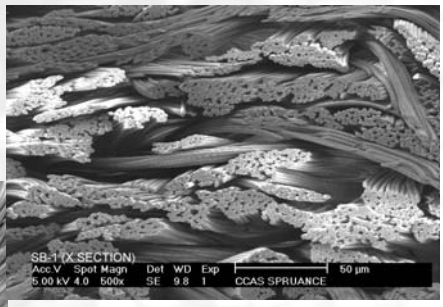
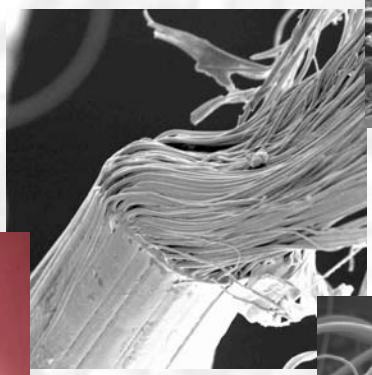
Hills Nano-Technology

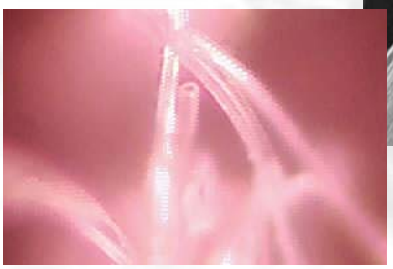
Hills proprietary technology offers the following techniques for development of nano-fibers:

- **Islands-In-A-Sea**- (Fiber within a Fiber)
- **Meltblowing**
- **Nanotubing**

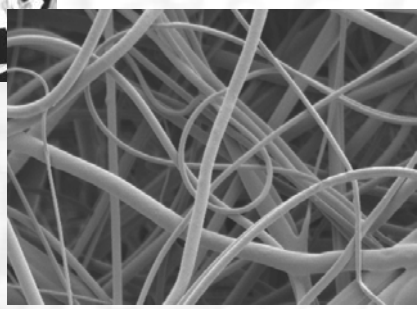


Islands-In-A-Sea
(Fiber within a fiber)





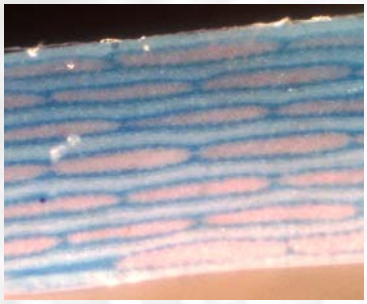
Nano-Tubing



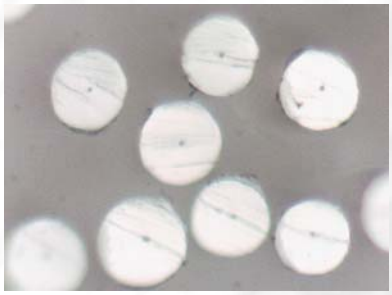
Meltblown

In addition to the above process, Hills' offers the following products in Nano-Technology:

- **MEMS**- (Micro Electro Mechanical System)
- **Metal Fibers**- (Micro Wire)



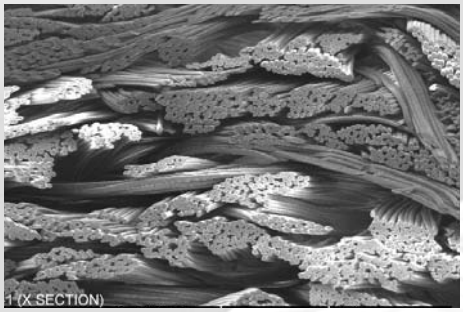
MEMS
(Micro Electro Mechanical System)



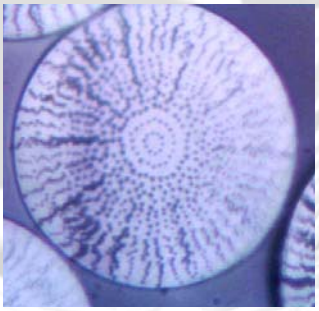
Metal Fibers
(Micro Wire)

Islands-In-The-Sea

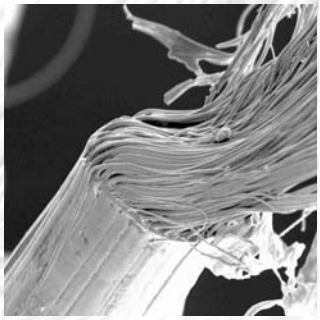
One technique that Hills practices to produce nanofibers is done using the Island-In-The-Sea (fibers within fibers) method. This method, developed using Hills in-house pilot line, has the capability of making a large number of fibers within a fiber. The Hills lab has been able to spin up to 1200 fibers within a single fiber. The Hills' Islands-In-The-Sea process has the potential of producing over 4,000 fibers within a single fiber. Using the same techniques, these filament can be produced as hollow tubes.



Islands-In-The-Sea
Spunbond



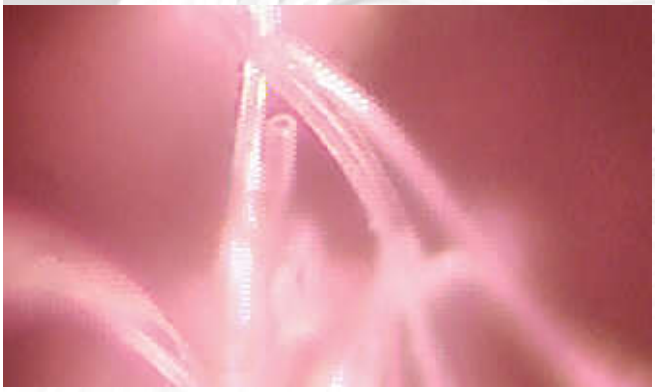
1170 Islands-In-The-Sea
Cross Section



Islands-In-The-Sea
Filament Dissolved

Nanotubing

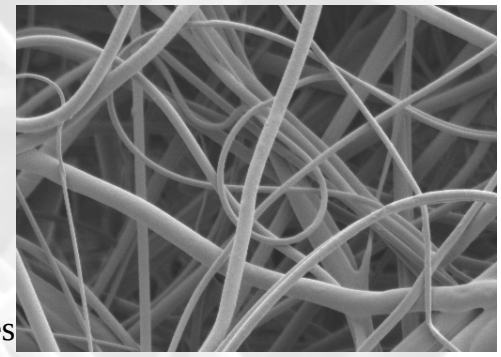
Another form of Nanofibers that Hills has the capability to produce is Nanotubing. The tubing has an outside diameter of 400 nanometers, a wall thickness of 100 nanometers, is made in continuous length bundles of over 100,000 tubes and is relatively in-expensive, per pound to manufacture. Hills, Inc. is a world leader in advanced polymer technology. Two years ago, Hills introduced 400 nanometer diameter fibers. Hills recently invented a process and machine that allows this technology to make tubes instead of just solid fibers. Further advances may allow production of tubes as small as 100 nanometers in diameter. Potential uses of these tubes are filtration, light weight insulating fabrics, and medical devices.

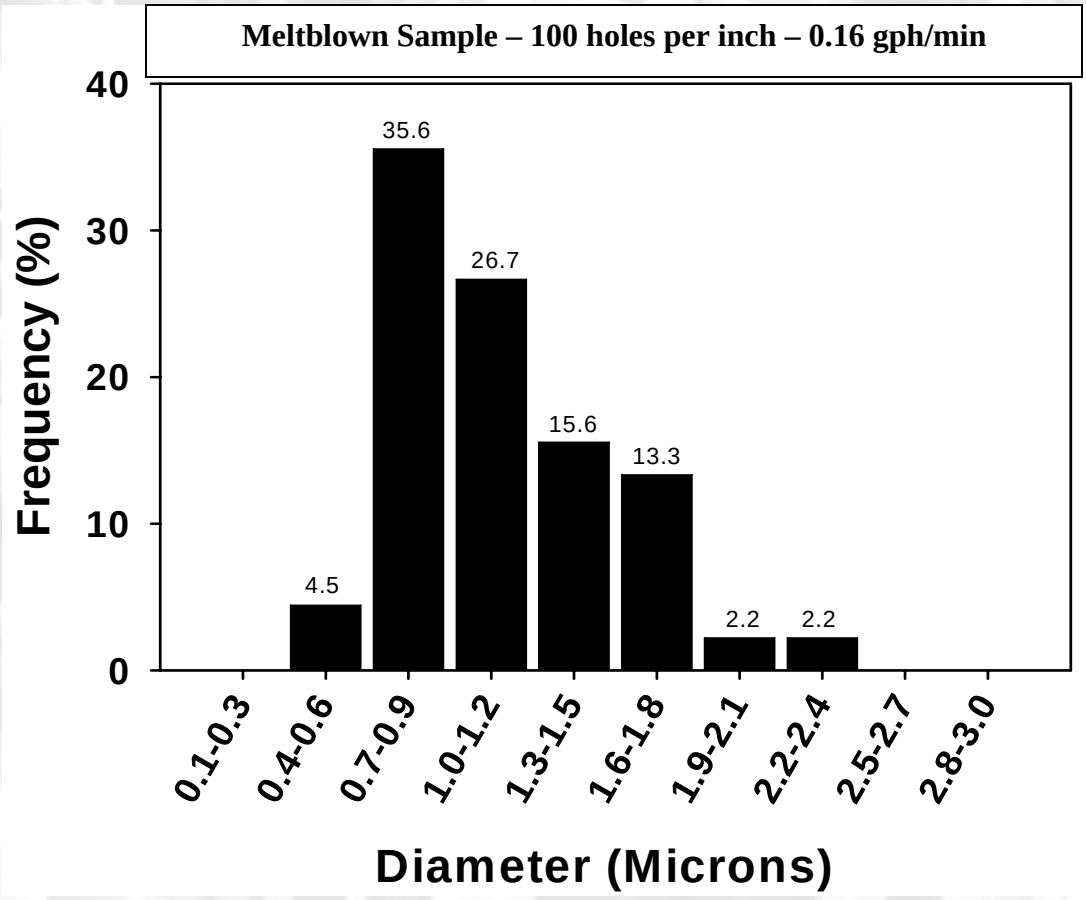


HILLS INC.

Meltblowing

Another method that Hills, Inc. uses to produce nanofibers involves using a meltblowing technique. Hills uses a proprietary design to make die with 100 holes per inch that can be used At 1500 psi. The overall production rate per length of the spin pack is the same as standard meltblowing. With this technology, the L/D of the capillaries is increased to 30, and the resulting pressure drop increases from the standard 40 psi to several hundred psi or greater. As a result, the average melt blown fiber size is greatly reduced and the range of the fiber size is also reduced. In this technique the spin hole diameters are in the range of 0.10 to 0.15 mm; therefore, the polymer must have a MFI of 1000 or greater and be extremely clean.

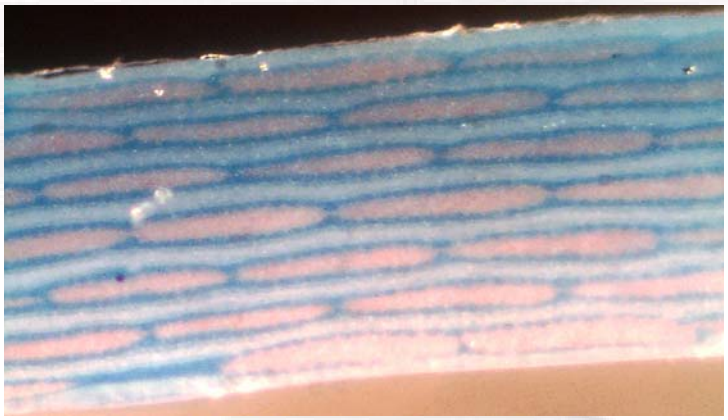




HILLS INC.

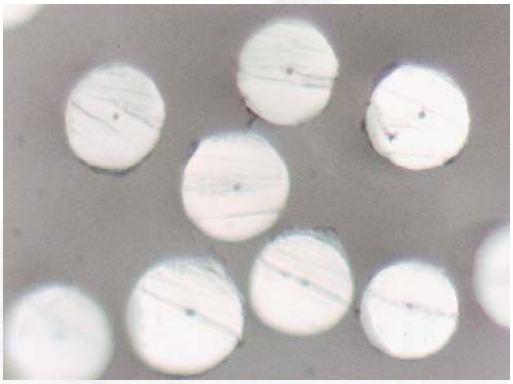
MEMS-(Micro Electro Mechanical System)

Hills, Inc. has the ability to create several nanofiber products. MEMS is one of the nanofiber products that Hills is capable of producing. The patented Hills' process uses micro-precision multi-component polymer extrusion to produce a continuous strand of the MEMS at about 200 meters per minute. The strand can then be cut into individual MEMS, or they can be assembled with other components before cutting. If the desired MEMS is 1 mm long, the production rate is an amazing 200,000 per minute. The Hills process can be used to make practically any cross section making it available for production of a wide variety of MEMS. Because polymers are used and thickness limitations are not a factor, the Hills process can make process can make MEMS that are not possible with existing techniques.



Metal Fibers- (Micro Wire)

A metal core fiber is another product that Hills is capable of producing. The metal core fiber is a regular polymer fiber with a real metal core. Any melt spinnable polymer can be used to make this fiber. The metal content can be as low as 1%. This fiber is spun using a low melt temperature metal alloy that is extruded along with the polymer directly into the core of the fiber. Since the core is real metal it is 1000 times more conductive as standard carbon filled conductive fibers so it is a superior substitute for antistatic applications. Also, the silver color allows it to be used in all colors without causing color pollution. Other applications are RADAR reflective cloth, electronic textiles, micro wiring and micro medical devices.



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