

Phenom Desktop SEM for nanofiber characterization

Structural insight into polymeric nanofibers, nanofibrous layers, nanofiber yarns and nanoparticles

The Department of Nonwovens and Nanofibrous Materials at the Technical University of Liberec, Czech Republic runs courses in production technology, evaluation and innovative methods in nonwoven textile production and technical textiles. Research activities involve the testing and analysis of nonwoven textile structures, including electrospinning products consisting of nanofibers. These are characterized as fibers having a diameter of ~100 nanometers, which are typically produced via interfacial polymerization or electrospinning.

The department has more than six years' experience with electrospinning and more than 40 years' experience with other nonwoven technologies. They are able to spin several polymeric materials and melts with various structures, whose morphology is analyzed preferentially using electron and optical microscopy techniques. One of the microscopes used is the Thermo Scientific™ Phenom Desktop Scanning Electron Microscope (SEM).

The main research and scientific activities of the department are focused on:

- Development of electrospinning technology, application of electrospun materials and complex theoretical research in this area
- Interactions between fiber assemblies and liquid phases (filtration, sorption), including computer modeling
- Physiological and thermal properties of textiles
- Compressional properties of textiles
- Technology and devices for highloft perpendicular-laid nonwovens (Struto)
- Melt-blown technology, fabric modifications and electrospinning – the production of nanofibers

Applications of nanofibers - filtration

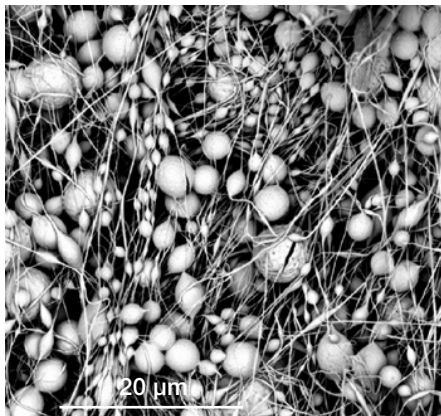
Filtration is one of the most important applications of nanofiber materials. One section of the Department of Nonwovens and Nanofibrous Materials is fully equipped for the detailed testing and analysis of filtration properties of special materials. The department also offers lab and pilot-plant production of small amounts of specialized materials for property testing.

Acoustic applications

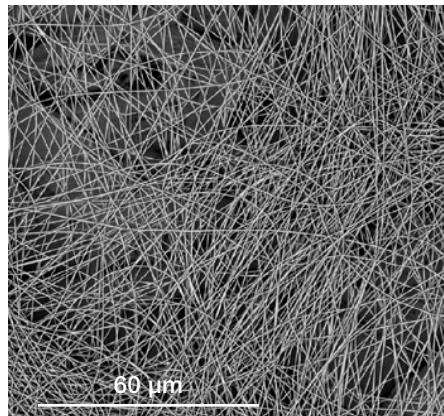
An important property of nanofibrous materials is their high acoustic absorption, especially in the low-frequency range of sound waves, where all other materials either fail or are less effective. Nanofibrous materials seem to be extraordinarily promising as acoustic barriers in many applications.

Medical and biological applications

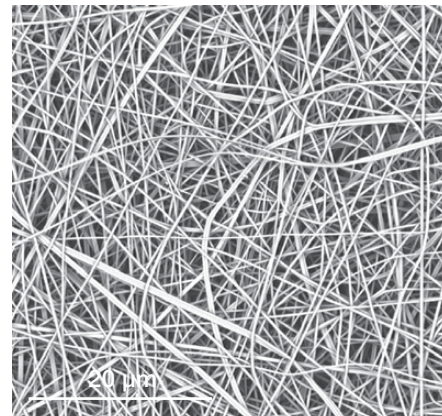
There has been a strong focus over recent decades on the use of nanofibrous materials for medical applications. These materials have ideal properties for tissue engineering. Coaxial electrospinning is also a promising technique employed to produce core-shell fibers which can be used for drug delivery applications.



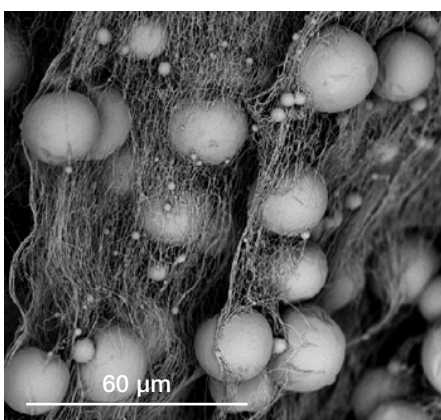
Polycaprolactone nanofibers with beads.



Polyvinyl alcohol nanofiber layer.



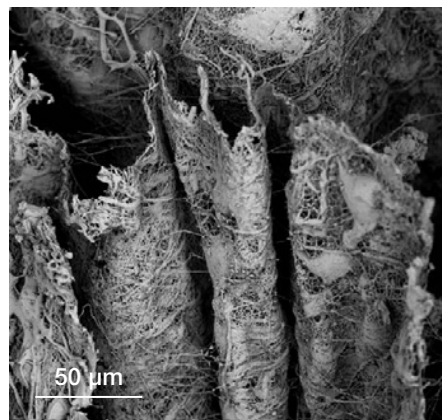
Polyvinyl alcohol nanofiber layer.



Poly(lactic-co-glycolic acid) nanofibers with beads.



Cross-section of 3D nanofiber layer.



Cross-section of 3D nanofiber layer.

Conclusion

“The purchase of the Phenom Desktop SEM has improved our work flow and research programs. Whereas in the past, we had to wait an annoying time to obtain images from an electron microscope, microphotographs are now available to us in a heretofore unbelievably short time compared to light microscopy technology,” says Jitka Färberová of the Department of Nonwovens and Nanofibrous Materials. The magnification range of the Phenom Desktop SEM is particularly suitable for studying the structure of nanofiber layers and of single fibers. Furthermore, Färberová indicated that the Phenom Desktop SEM is so easy to operate that students can use it without the need for time-consuming special training. This was the main reason that the department chose the instrument.

Used in conjunction with the Thermo Scientific FiberMetric Software, the Phenom Desktop SEM enables fast measurement of nanofiber and pore diameters. These measurements are automatic, accelerating throughput and saving time. Not only that, but the measured values are as accurate as those obtained from manual measurements using special image analysis software. The Department of Nonwovens and Nanofibrous Materials enjoyed the great advantage of having the Phenom Desktop SEM and FiberMetric Software together in one place, enabling them to obtain complete sample information in the same session. The FiberMetric Software also generates statistical data and frequency diagrams of the measured diameters.

Jitka Färberová

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