Polymeric Nanofibers, Nanofibrous Layers, Nanofiber Yarns and Nanoparticles

Jitka Färberová, Department of Nonwoven Textiles, Nanoscience Centre, Faculty of Textile Engineering, Technical University of Liberec, Czech Republic

The Department of Nonwovens runs courses in production technology, evaluation of nonwovens, and innovative methods in nonwoven textile production and technical textiles. Research activities involve the testing and analysis of the structure of nonwoven textiles.

Jitka Färberová:
"Working with the Phenom Fibermetric System gives us very fast, accurate and well-presented results."

The Department of Nonwovens 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 nanofibres. Nanofibers are defined as fibers having diameters of the order of 100 nanometers. They can be produced for instance by interfacial polymerization and electrospinning.

We have more than six years' experience with electrospinning and more than 40 years' experience with other nonwoven technologies. We are able to spin several polymeric materials and melts with various structures. Their morphology is analyzed preferently using electron and optical microscopic techniques. One of the microscopes used is the Phenom™ desktop scanning electron microscope.

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 our laboratory 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.

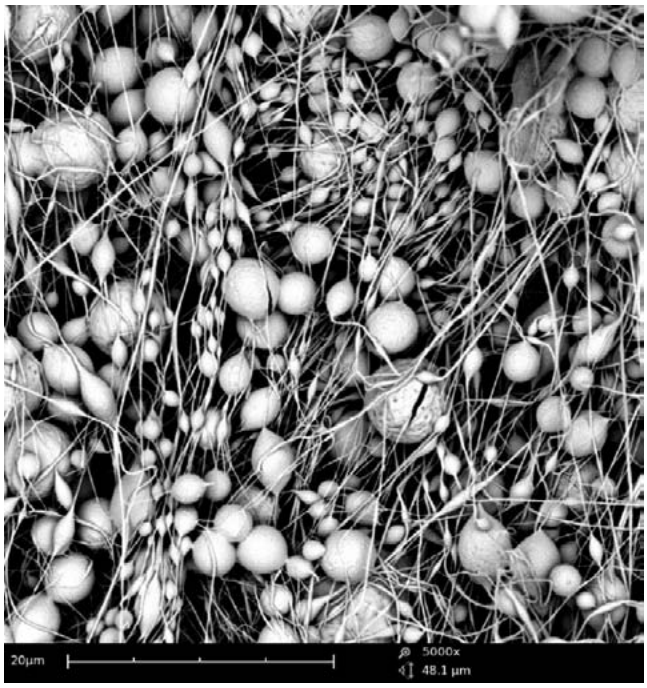
Acoustic applications

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 an extraordinary promising as acoustic barriers in many applications.

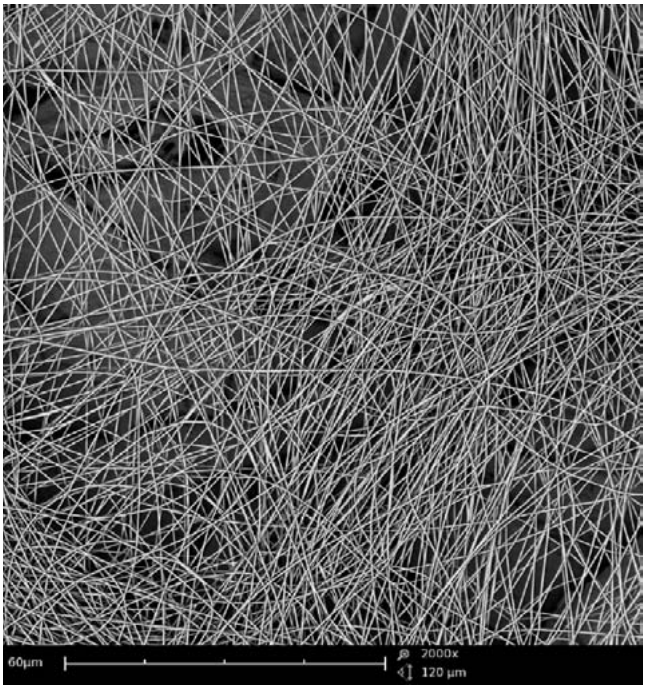
Medical and biological applications

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 quite a promising technique employed to produce core-shell fibers which can be used for drug delivery applications.

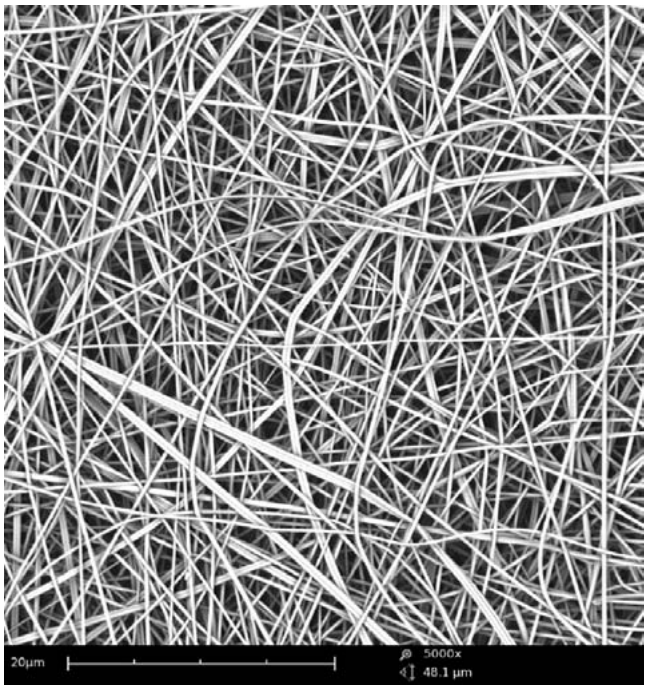
Poly (lactic-co-glycolic acid) nanofibers with beeds



Polycaprolactone nanofibers with beeds



Polyvinyl alcohol nanofiber layer



Polyvinyl alcohol nanofiber layer

Cross-section of 3D nanofiber layer

Cross-section of 3D nanofiber layer

Conclusion

The purchase of the Phenom™ desktop scanning electron microscope has improved our work flow and research programs. Whereas in the past, we had to wait an annoying time for obtaining images from an electron microscope. Microphotographs are now available for us in heretofore unbelievable short time comparable with light microscopy technology. The magnification range of the Phenom desktop scanning electron microscope is very suitable for studying the structure of nanofiber layers and of single fibers. Furthermore, our Phenom is so easy to operate that students can use it without the need of time consuming special training. This was the main reason for choosing the Phenom.

Used in conjunction with the Fibermetric™ System, the Phenom enables fast measurement of nanofiber and pore diameters. Measurement of these parameters is automatic, so it speeds up our work and saves time. Measured values are as accurate as those obtained from manual measurements using special image analysis software. We enjoyed a great advantage having the Phenom and the Fibermetric System together in one place and allows us to obtain complete sample information in the same session. Next advantage is that the Fibermetric System generates statistical data and frequency diagrams of the measured diameters.

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