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AMERICAN FILTRATION & SEPARATIONS SOCIETY

Quantitative Inspection of Filtration Media using SEM

Advanced microscopy techniques are imperative to evaluate the performance of a filter. Optical inspection has become insufficient for many applications because fiber dimensions, especially nanofibers, are often below the resolution limit of an optical microscope.

With a higher depth of field and greater image contrast, scanning electron microscopes (SEM) are becoming the new standard for characterizing filtration materials. An SEM image affords a quick and high resolution visualization of filter media. SEM also offers the opportunity to perform elemental analysis via energy dispersive X-ray spectroscopy (EDS), allowing for the identification of elements in the filter materials or contaminants.

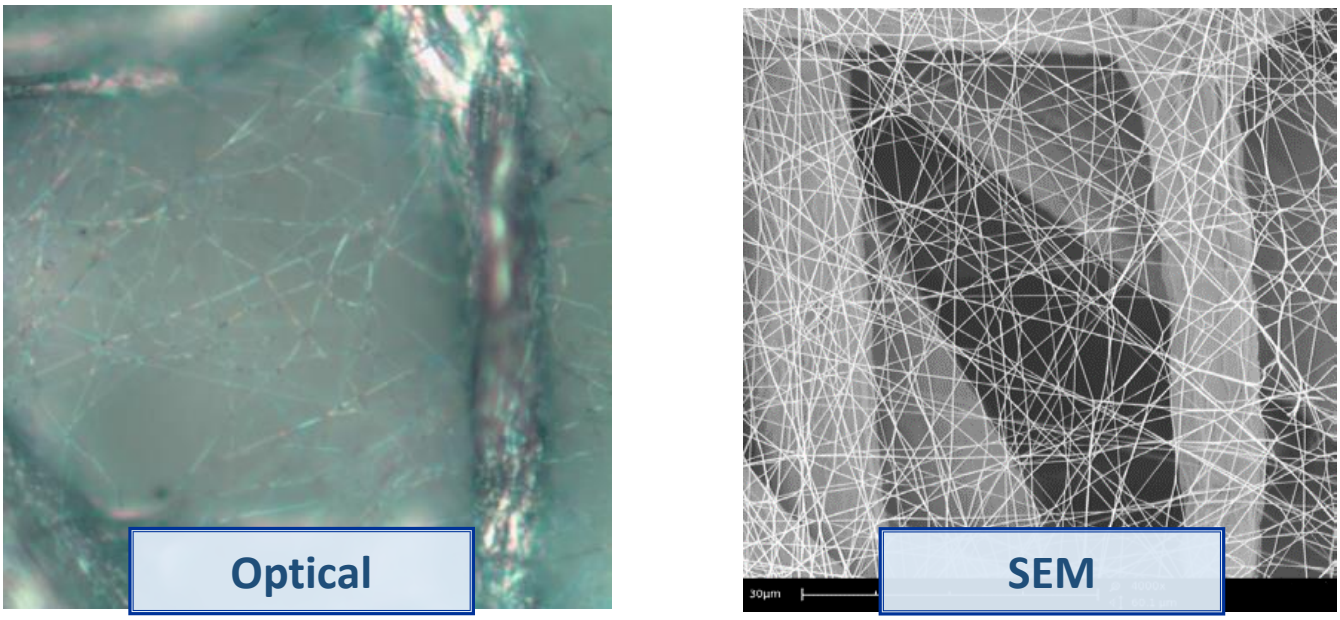

Figure 1 Optical (left) and electron (right) microscope images in same location of nanofiber-based media, showing higher depth of field, greater image contrast and higher resolution in the SEM image

Direct Visual Inspection of Filtration Media

Nanofiber-coated filtration media often encounter quality issues such as membrane deterioration caused by substrate expansion, mechanical processing, pleating or handling. Holes and defects reduce the efficiency and lifetime of these filters. The Phenom SEM is the highest throughput instrument for completing visual inspections and resolving process issues.

The Phenom SEM uses a backscattered electron detector (BSD) and high-brightness electron source that together yield unparalleled SEM images for threshold analysis. This allows for automated determination of fiber diameter and orientation. SEM imaging is the only **non-destructive** and **direct** technology available for the quantification of fiber analysis.

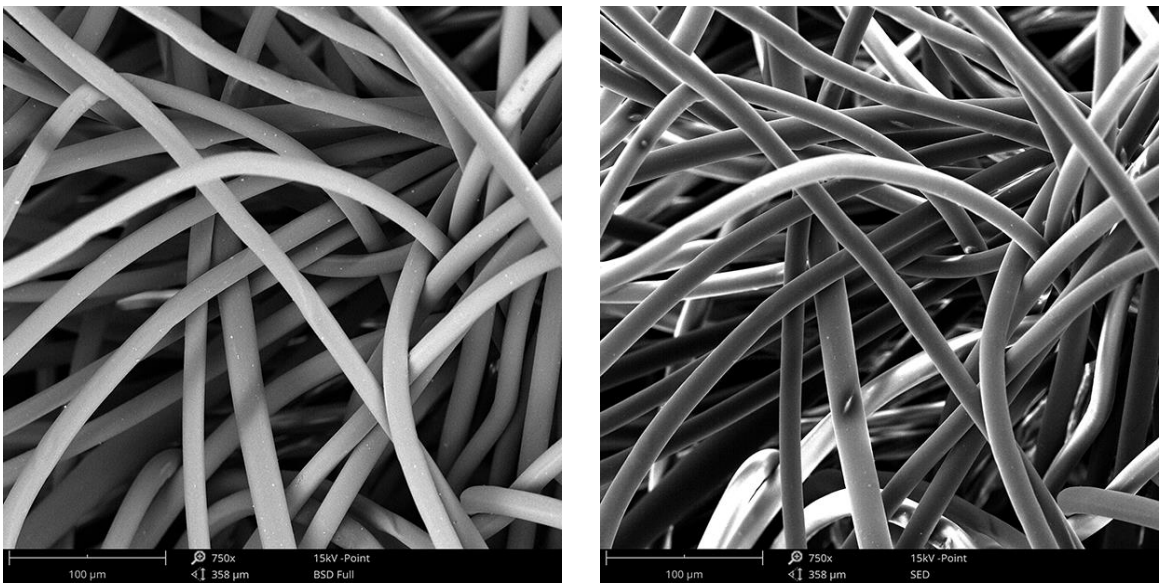

Figure 2 Backscattered electron detector (BSD) image (left) & secondary electron detector (SED) image (right) with orientation-dependent shading observed for SED image preventing simple image threshold analysis

Automated Fiber Analysis

Coupled with FiberMetric automated fiber analysis software for the Phenom SEM, statistical data for

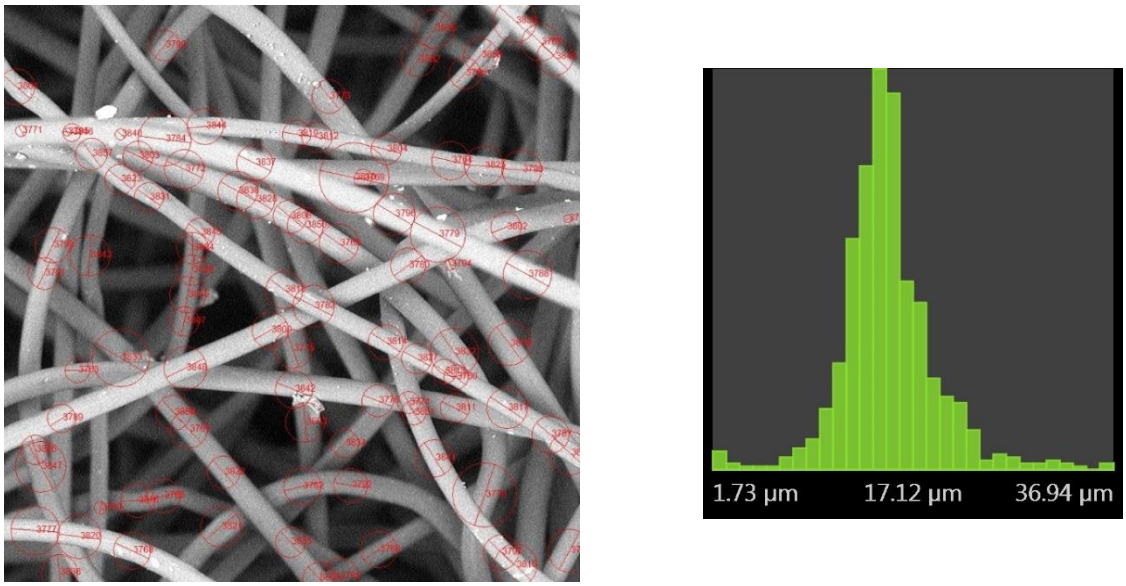

Figure 3 Using FiberMetric with the Phenom SEM, 25 images were tiled to analyze over 750 fibers in 5 minutes

fiber dimensions with **no operator bias** are quickly acquired in minutes.

The automated fiber software for the Phenom SEM provides quantitative image analysis, including fiber diameter, pore size, and fiber orientation.

Conclusions

Scanning electron microscopes (SEM) have become necessary for characterizing filtration materials, offering a higher depth of field and greater image contrast. The Phenom SEM has a high-brightness electron source that is 10x brighter and lasts 30x longer than tungsten sources. Combined with the backscattered electron detector to provide orientation-independent shading, image analysis can be automated for high productivity with no operator bias. FiberMetric analysis software quantitatively measures fiber diameter and orientation distributions.

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