Application Example

Automated particle analysis of air filters

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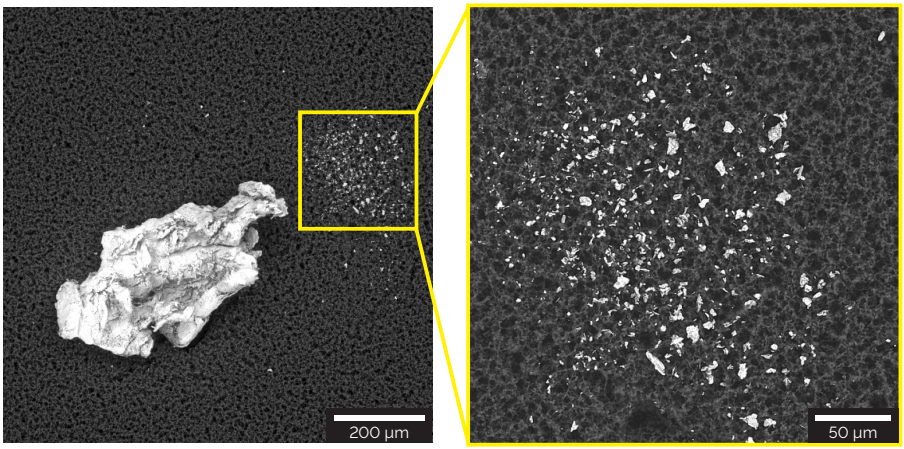
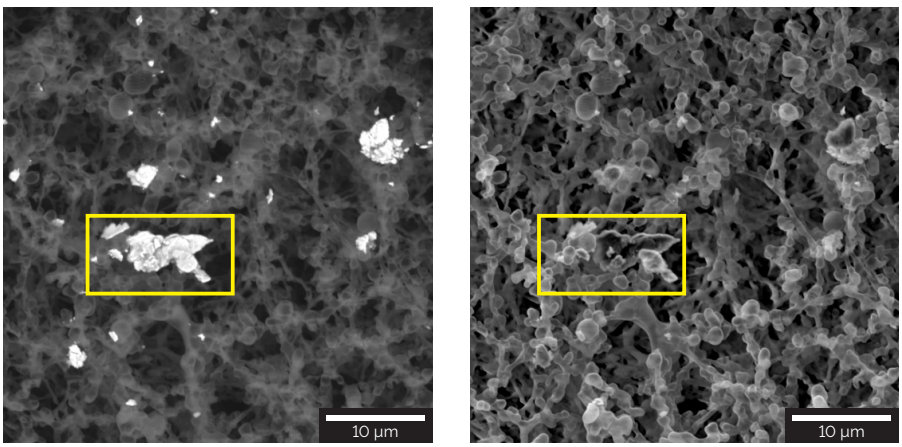
Quality control is a very important industrial process. Quality control includes analysis of particles on air filters, which is nowadays a standard process in many production lines. Particle analysis of air filters can be achieved by means of optical microscopy; however, scanning electron microscopy (SEM) can offer extended analytical possibilities with the advantage that the analysis can be completely automated. The SEM analysis is based on the principles of different grey levels between substrates and metallic particles.

The TESCAN Particles Basic and Particles Advanced are software modules that enable automated detection of particles according to grey level, and, several different samples can be automatically analysed. Such analysis provides information on the location and size of particles. On the other hand, the TESCAN Integrated Mineral Analyser with EDAX EDS detectors (TIMA-X) provides a solution for automated chemical particle analysis. This SEM-based system enables distinguishing particles from the background based on grey levels, see Figs. 1 and 2. Compositional analysis of such particles can be subsequently performed by means of EDS. For particle analysis, TIMA-X combines size-by-size and particle-by-particle measurements and EDS analysis. The particles can then be sorted in different classes according to their chemical composition or size. TIMA-X provides the user with valuable information of the sample such as phase maps, elemental maps, EDS spectra, and particle classification, Fig 3.

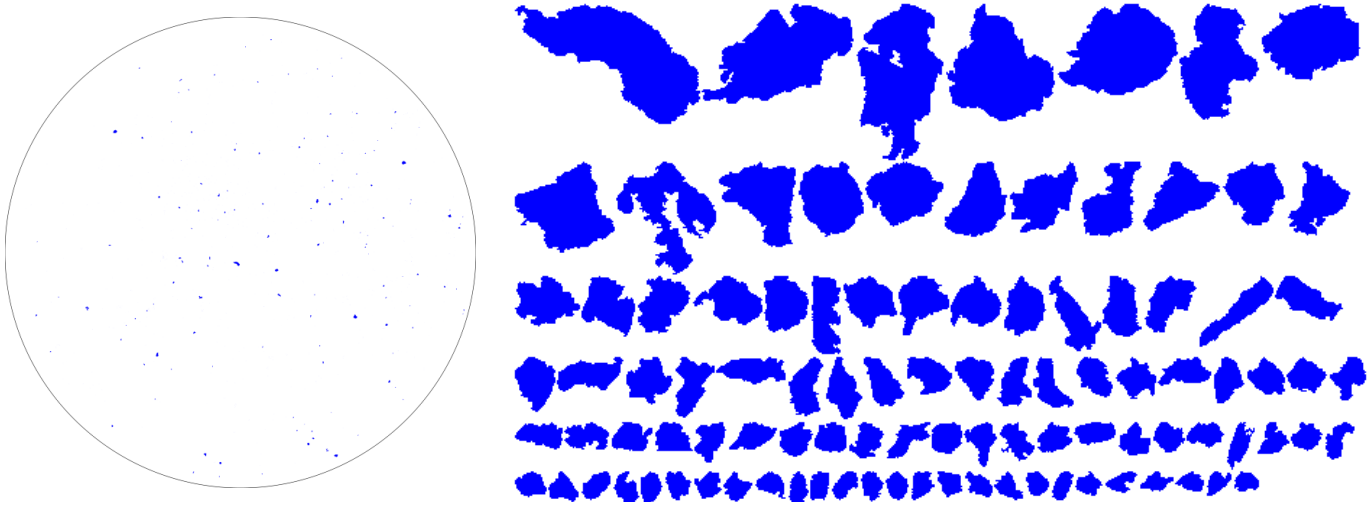


▲ **Fig 1:** Large and small metallic particles imaged with the BSE detector at 15 keV. The image on the right is a magnified image of the small particles in the square. The sample was imaged uncoated at low vacuum conditions.

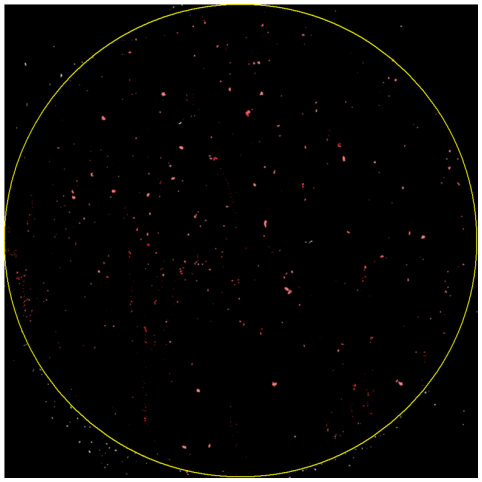


▲ **Fig 2:** BSE (left) and SE (right) images of metallic particles on the substrate (filter) acquired at 10 keV. The sample was coated with a carbon protective film. The same particle is inside the square.

Both the Particles Basic/Advanced software and TIMA-X can apply filters (Fig. 4-7) in order to only analyse "critical" particles of a given size or chemical composition (among other criteria filters), and, as a result, the whole procedure can be optimised thus dramatically reducing the time of analysis. Furthermore, the analysis can be stopped once a certain number of particles is detected on the sample. This approach can be used for detecting particles on different substrates. Alternative applications such as characterisation of both natural and artificial particles on polished sections, or identification of inclusions in alloys are also possible.

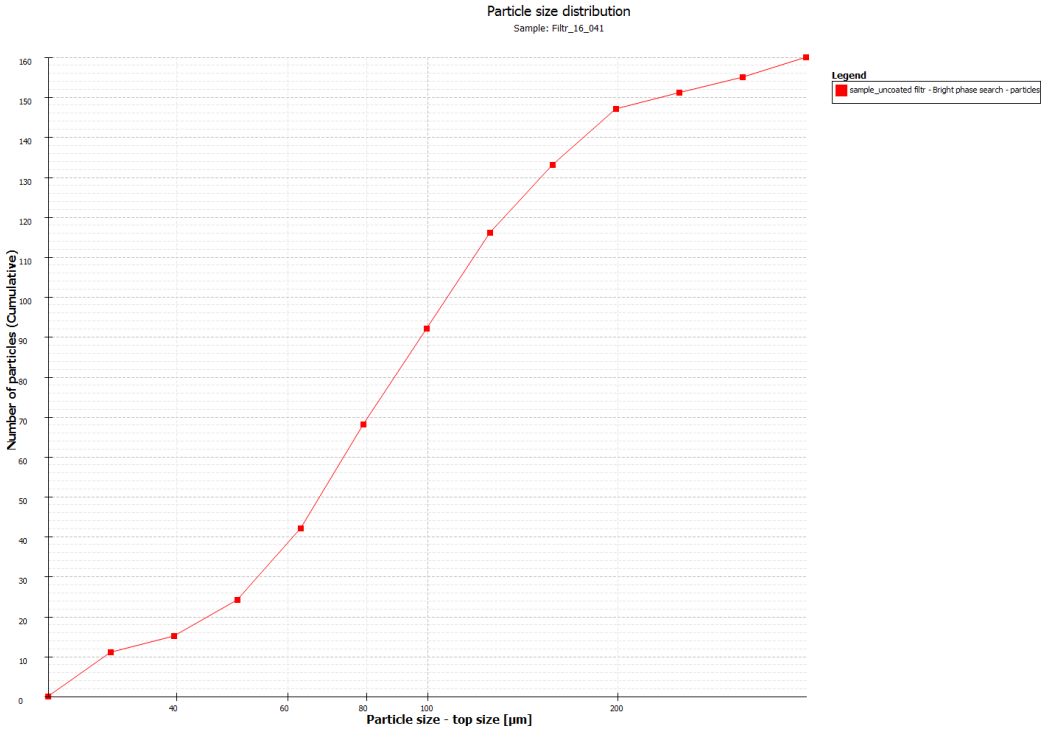


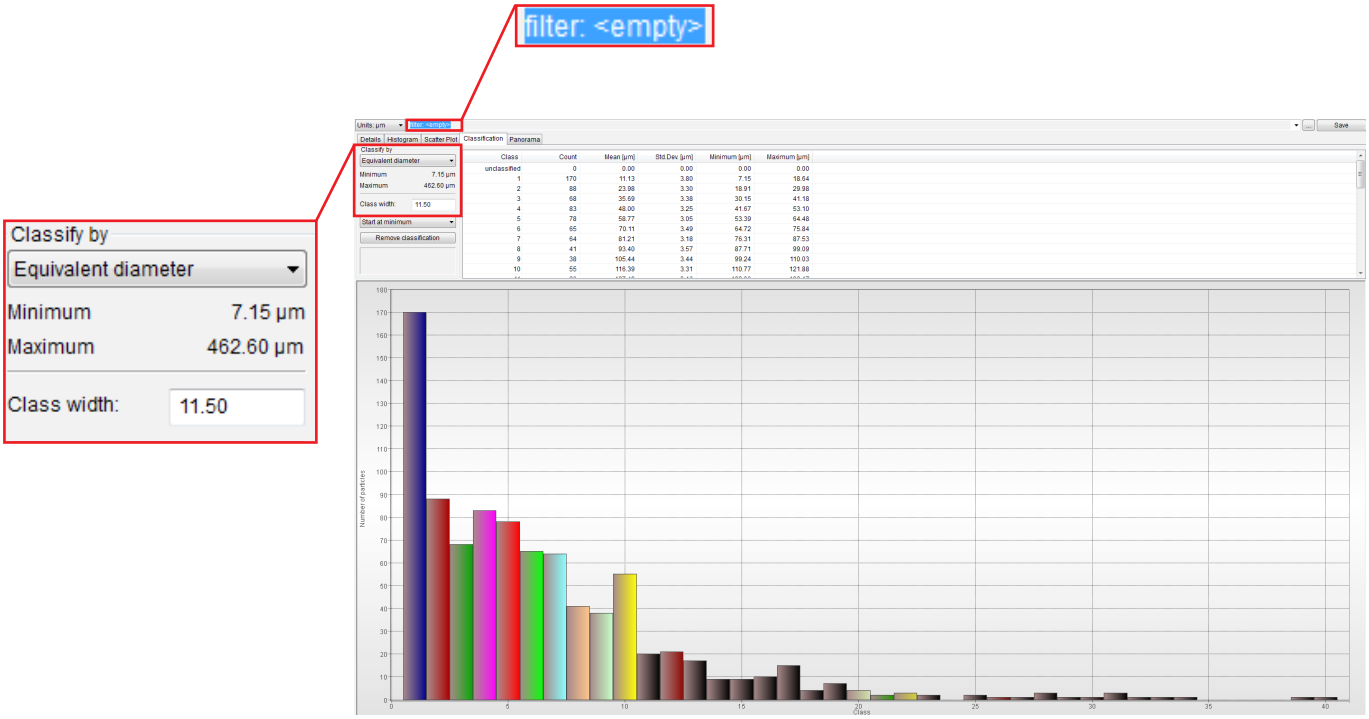
▲ **Fig 3:** TIMA-X particle analysis. (Left) A panoramic phase map of the whole uncoated filter. (right) Sample analysis sorting the particles by size.



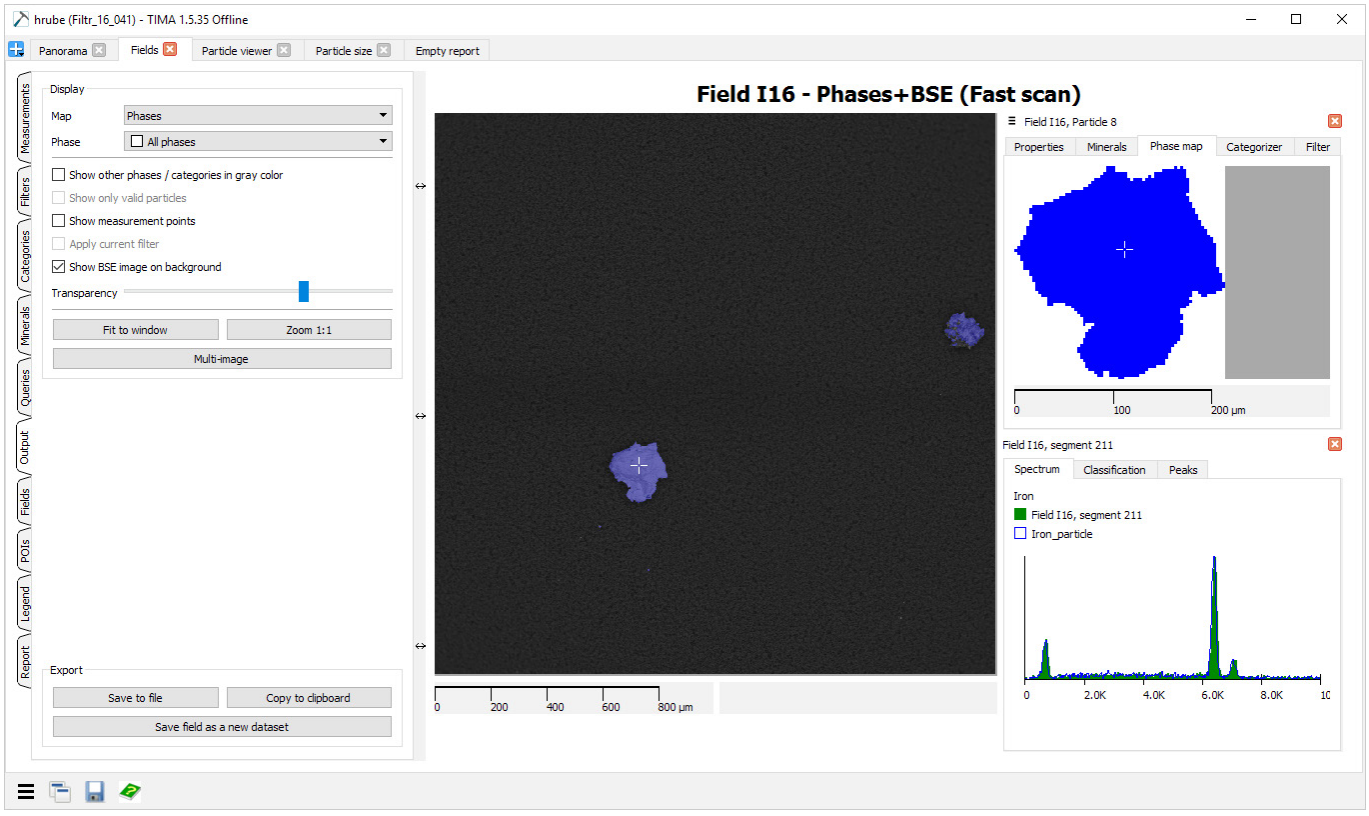
◀ **Fig 4:** The entire surface of the filter was analysed (an image composed of multiple frames) using the Particle Advanced software module.

▼ **Fig 5:** Cumulative particle size distribution as obtained by TIMA-X.





▲ **Fig 6:** Particle Advanced: Histogram of particle number distribution in each class



▲ **Fig 7:** Screenshot of the TIMA-X user interface showing single field and details of selected particle (EDS spectrum and identification).

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