

# Particle analysis with the Phenom ParticleX AM Desktop SEM

## A multiscale desktop SEM solution for additive manufacturing

Timely and accurate quality control is a prerequisite for modern additive manufacturing, as excessive or unknown variation in the metal feed powder can lead to non-uniform layering, increased defects, poor surface finish and even catastrophic failures. The Phenom ParticleX AM Desktop SEM is a versatile solution for high-quality analysis, giving you the ability to carry out quick verification and classification of materials. With the ParticleX AM Desktop SEM, your production is supported with fast, accurate and trusted data.

### Phenom ParticleX AM Desktop SEM

The Thermo Scientific™ Phenom™ ParticleX AM Desktop Scanning Electron Microscope (SEM) pushes the boundaries of desktop electron microscopy while retaining the proven ease-of-use and fast time-to-image of the Phenom product line. The system is simple to operate and fast to learn, allowing a wide range of users to do particle and material analysis in-house. This effectively eliminates the need for outsourcing, giving you the answers you need in as little as a day. With less wait time, you can improve your production yield and bring your products to market faster.

### Key Benefits

Small footprint: desktop instrument needs little space, no specialized facilities required

Large sample chamber for the analysis of specimens up to 100 mm x 100 mm in size

Compact motorized stage lets users scan the full sample area

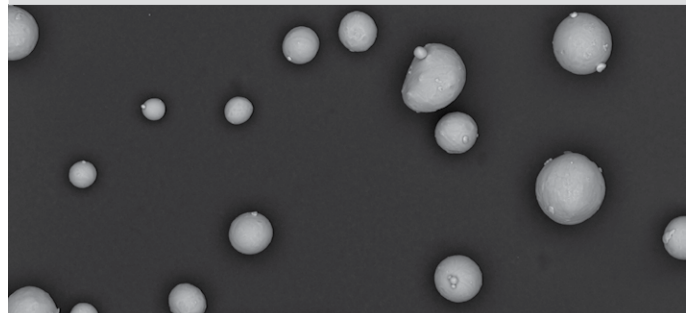
Proprietary venting/loading mechanism enables fastest vent/load cycle in the world

Integrated single shot optical navigation camera provides overview of sample enabling user to locate features of interest and capture SEM image within seconds

Four-segment backscattered electron detector (BSD) generates sharp images with chemical contrast information and a fully integrated energy dispersive spectroscopy (EDX) system for elemental analysis

Optional secondary electron detector (SED) for surface sensitive imaging

Reliable CeB<sub>6</sub> electron source



Additive manufacturing powder sample prepared with Nebula particle dispenser.

The Phenom ParticleX AM Desktop SEM provides not only high-quality SEM analysis but also features automated morphological and chemical characterization of metal powder particles.

### Morphological analysis of metal powder

While SEM can gather size-distribution data consistent with laser diffraction, the power of EM analysis is the additional information collected beyond average diameter. For example, the variety of morphological data acquired by the Phenom ParticleX AM Desktop SEM allows classification and sorting of individual particles. As seen in Figure 1, feed powder particles were categorized as either spherical particles, particles with satellite(s) or deformed/agglomerated particles. These classification rules were then used to sort between the three types of morphologies during automated runs.

The particle types were distinguished using the following morphological filters:

- Spherical particles:
  - Aspect ratio  $<1.1$  and roundness  $\geq 0.9$
  - $(0.6 \leq \text{average diameter} \leq 5.5)$  and aspect ratio  $<1.4$
- Particles with satellite(s):
  - Aspect ratio  $<1.4$ , roundness  $>0.6$ , area/hull area  $\geq 0.95$  and void count less than 1
- Deformed/agglomerated particles:
  - All other particles



Phenom ParticleX AM Desktop SEM

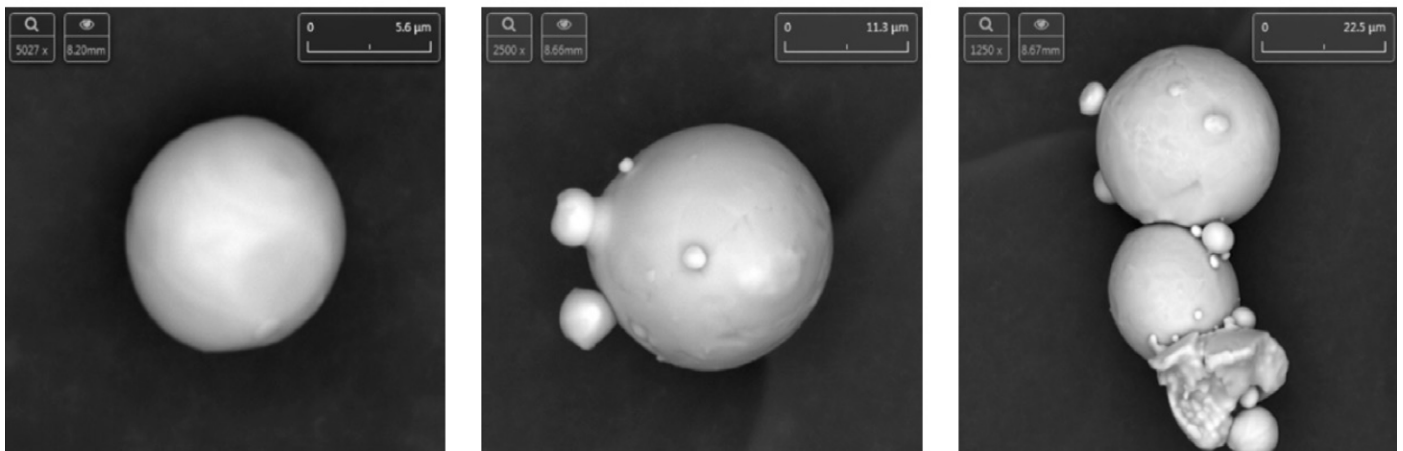


Figure 1. Spherical, satellite and deformed metal powder particles.

In this example, two separate morphological rules were used for spherical particles. With these rules, the volume-size distribution for each morphology type can be separated (Figure 2).

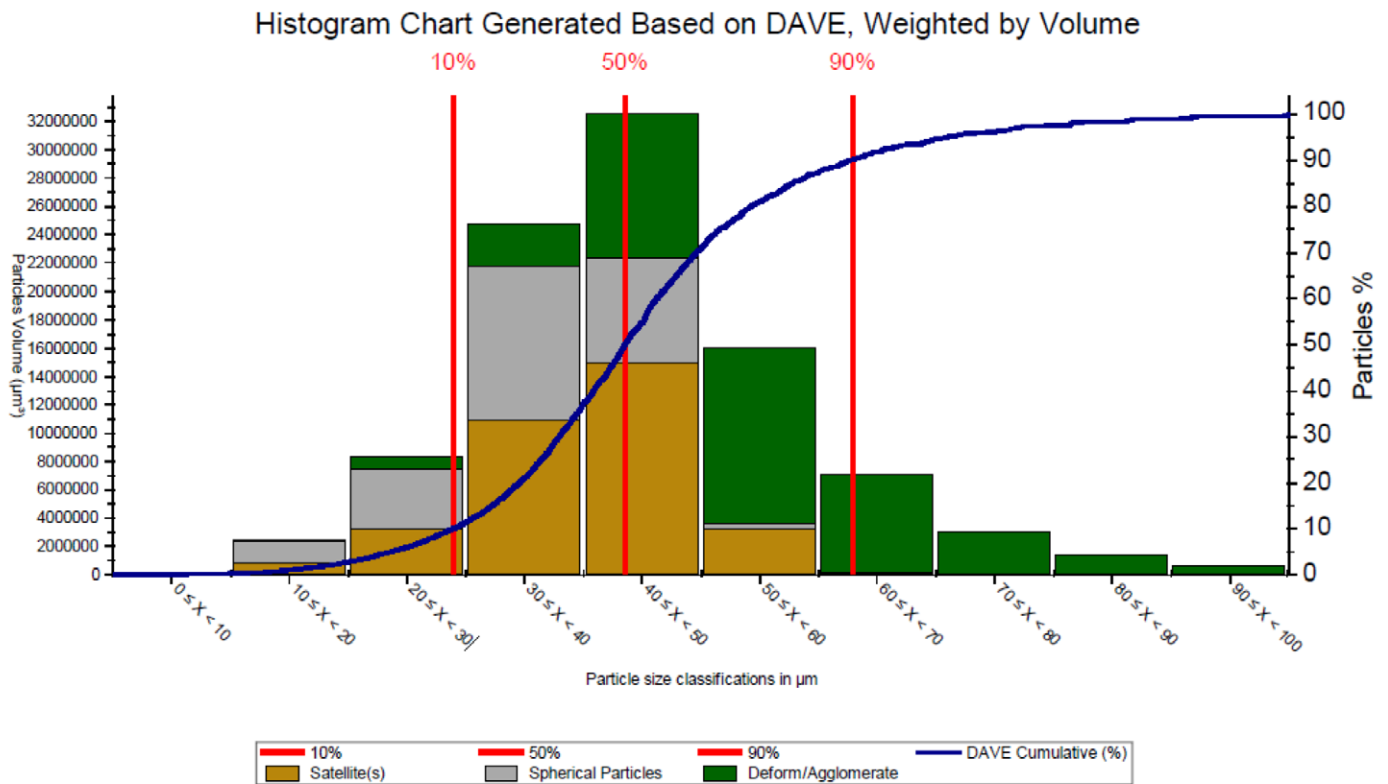


Figure 2. Histogram of particle size classified by average diameter ( $D_{AVE}$ ).

### Chemical analysis of metal powder

Historically, SEM/EDX analysis has been critical for providing the chemical composition of undesired particles, but has been a time-consuming, manual process. Built on more than 30 years of experience in automation, the Phenom ParticleX AM Desktop SEM can automatically identify impurities, obtain their basic characteristics, and log their location (Figure 3).

With integrated particle inspector software, users can relocate particles of interest, capture additional detail, and create reports containing images, parameters and the composition of individual particles. This powerful program also provides an offline tabulated view of every particle, freeing up the instrument for continued testing.

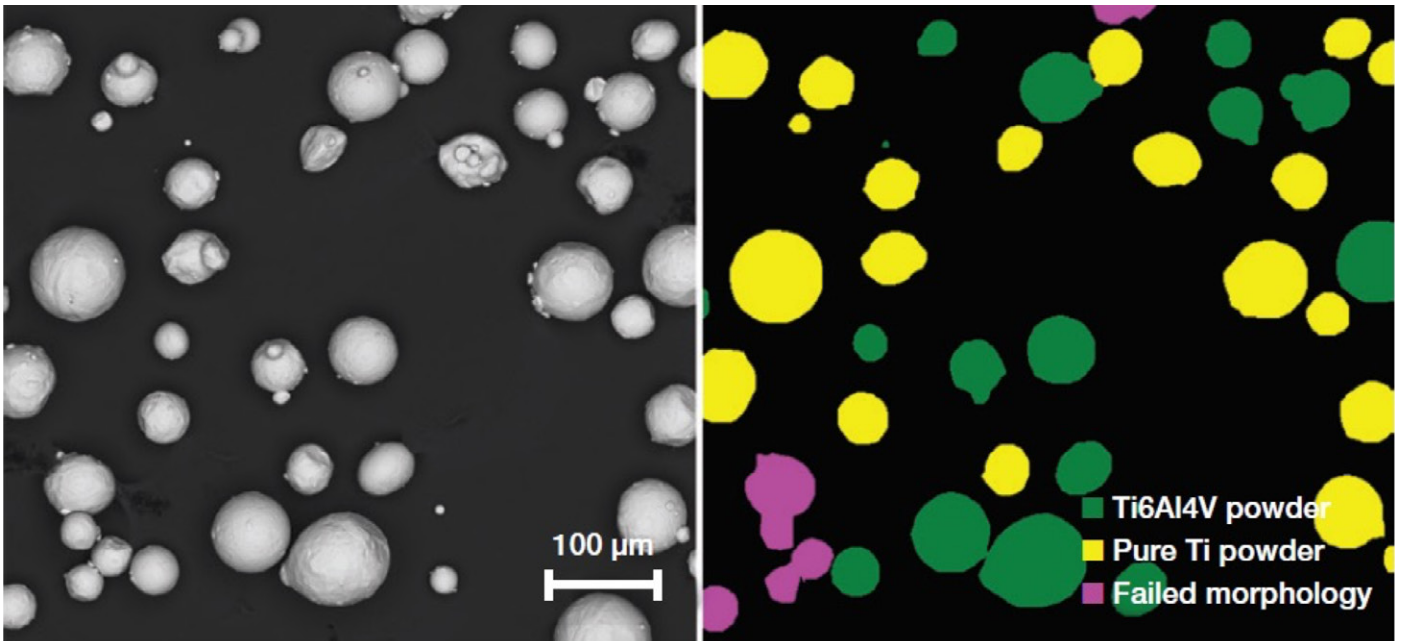


Figure 3. Morphological classification was first used to separate out agglomerates (purple) and subsequent chemical analysis sorted the remaining particles (yellow, green).

### Conclusions

The Phenom ParticleX AM Desktop SEM puts increased productivity and quality control directly in your hands. As a multi-purpose desktop SEM solution, it is designed to deliver automated and accurate analysis on feed powders, identifying potential problems before a single component is created. Experience the power, insight and reliability of cutting-edge SEM/EDX analysis from the surface of your desktop.

Find out more at [thermofisher.com/phenom-particle-x-am](https://thermofisher.com/phenom-particle-x-am)