

## Additive powder quality control with the Phenom ParticleX 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 features

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

Large sample chamber allows loading up to 30 samples for automated analysis

Intuitive user interface simplifies navigation and operation

Unique chamber design enables fast venting and sample loading

Included backscattered electron detector (BSD) and fully integrated energy dispersive spectroscopy detector (EDS) enable fast and reliable particle analysis

Optional secondary electron detector (SED) for surface sensitive imaging

Reliable long-life CeB<sub>6</sub> source

Customized application-specific reporting allows for easy interpretation and extraction of meaningful insights



Phenom ParticleX AM Desktop SEM.

The Phenom ParticleX AM Desktop SEM provides not only highquality 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

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).

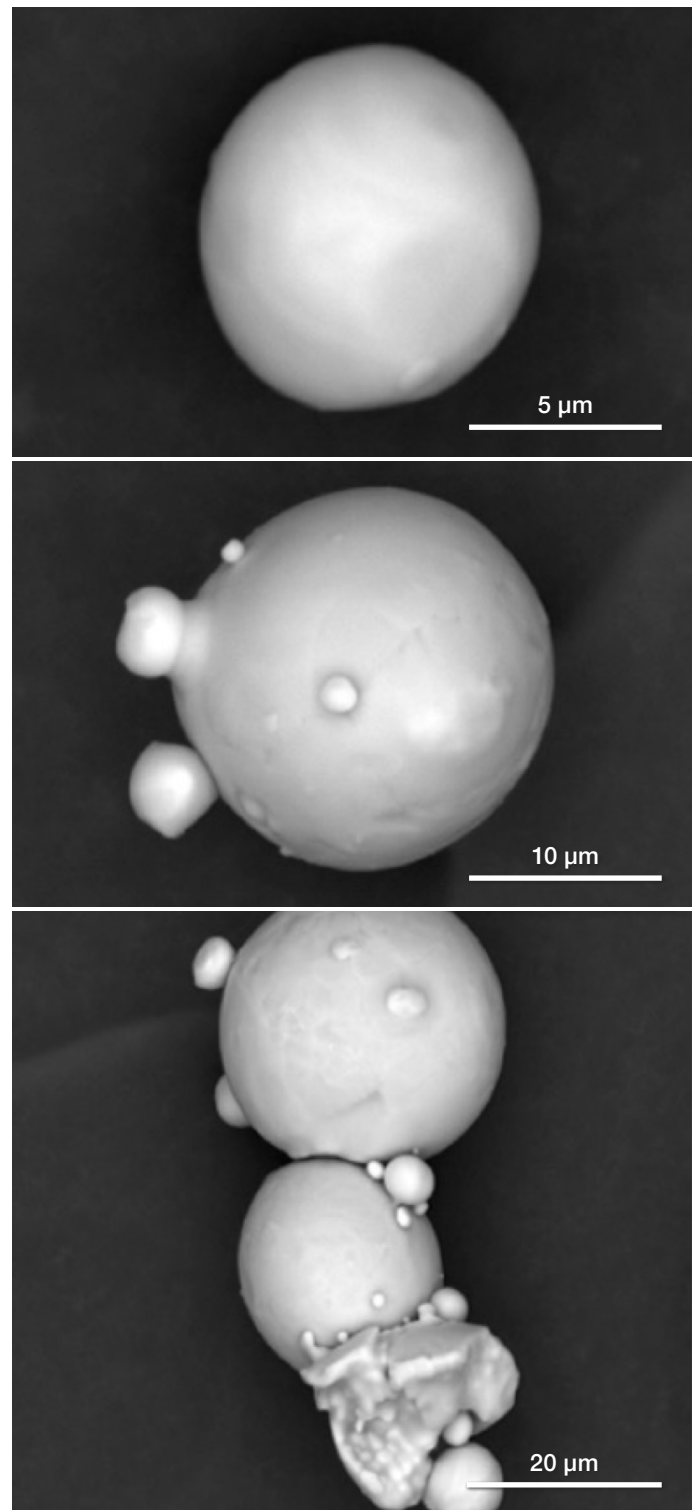


Figure 1. Spherical, satellite and deformed metal powder particles.

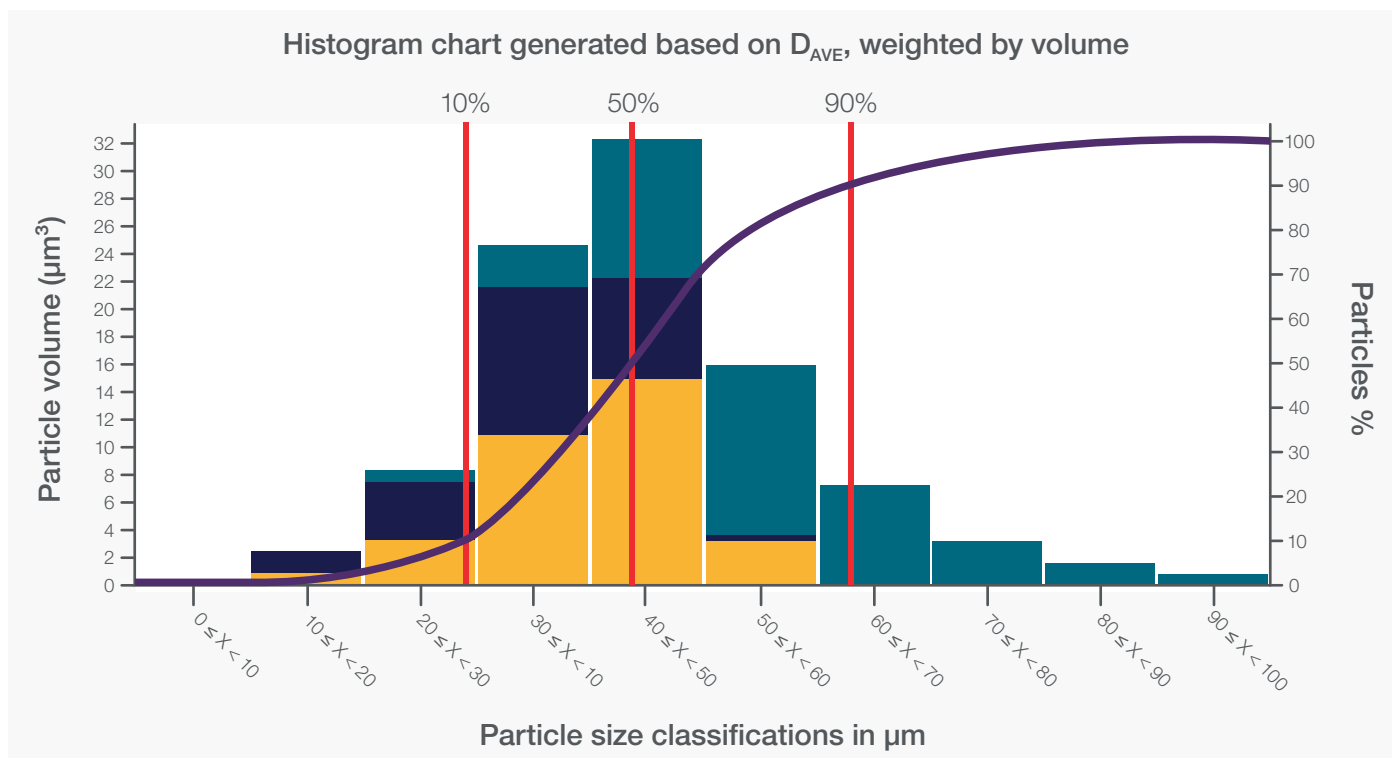


Figure 2. Histogram of particle size classified by average diameter ( $D_{AVE}$ ).

### Chemical analysis of metal powder

Historically, SEM-EDS 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.

### 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-EDS analysis from the surface of your desktop.

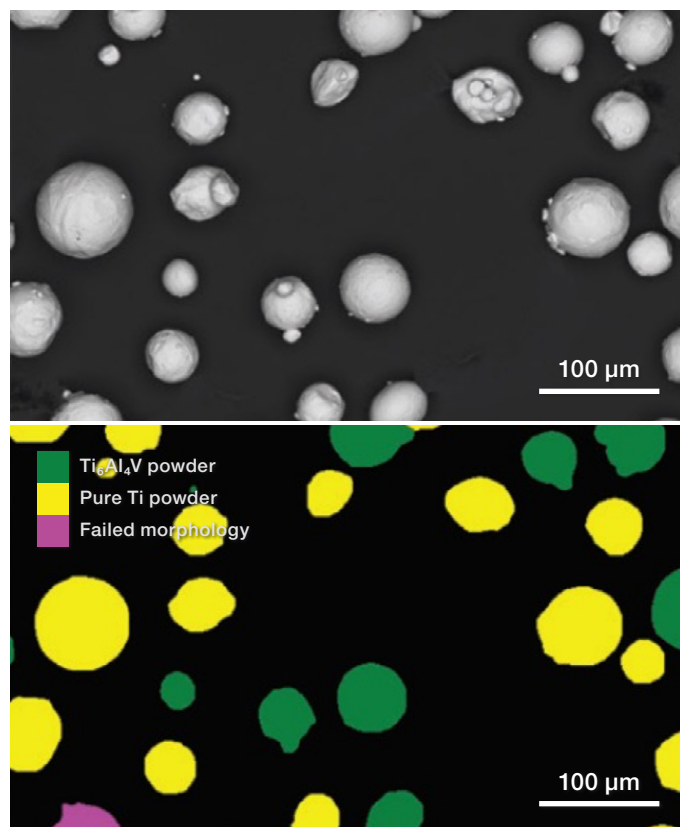


Figure 3. Morphological classification was first used to separate out agglomerates (purple) and subsequent chemical analysis sorted the remaining particles (yellow, green).

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