

### The latest trend of quality management of metal powder

We have deployed a high-resolution X-ray CT scan for quality management. There is a new trend to apply X-ray CT for metal powder quality inspection. In this issue, we will introduce the latest powder analysis technology of metal powder by X-ray CT scan.

#### Quality management of metal powder

The receiving inspection of the metal powder is generally deployed particle distribution analyser or SEM-EDX to inspect the powder shape and chemical composition to compare with the MSDS from the supplier. Today, the technology development of metal additive manufacturing (metal AM) is exceptional and in response, the manufacturing technology, such as metal powder production, laser, mechanical systems, furnace and other related technologies are intensively developed. As the quality of metal AM progresses, the metal powder quality control becomes more important since it reveals that the sintered part quality is greatly dependent on the powder quality. In metal AM, metal powder sieved in a narrower size distribution than that of MIM is used and multiple materials and a small lot size production is the advantage of metal AM in powder metallurgy production. Therefore, strict management of materials and production procedure is required, but also the inspection technology of metal powder is also essential.

The material inspection by testing mechanical properties is well standardised, but it is not good at the detection of slight foreign matter and a large amount of the samples are required for the statistical evaluation. Chemical analysis is a widespread measurement method of chemical composition with high accuracy, however, it is impossible to find out where the foreign matter originated due to its procedure. On the other hand, the latest high-resolution X-ray CT scan is capable of setting the focus spot size at small as 3  $\mu\text{m}$ . Therefore, the X-ray CT scan receives more attention as the metal powder quality inspection tool. The result of X-ray analysis is capable of obtaining not only the contamination physical information such as the size, shape and location but also the chemical composition related information since the heavier elements are shown in the brighter shade and the voids and lighter elements are shown in the darker shade in X-ray CT grayscale images.

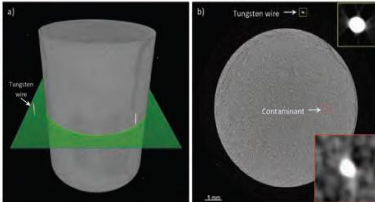


Fig. 1. shows a sample of compacted titanium alloy powder with tungsten wire embedded. The wire appears on the graphic clearly. The lower limit of detection of chemical analysis by the X-ray CT is calculated to 0.005ppmv compared to 100ppm by the ordinarily chemical analysis.

Fig.1 X-ray CT images of tungsten wire ( $\phi 50 \mu\text{m}$ ) in Ti-6Al-4V sample\*

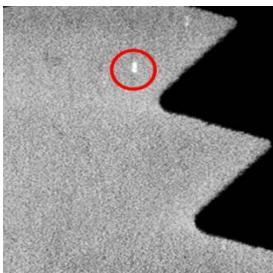
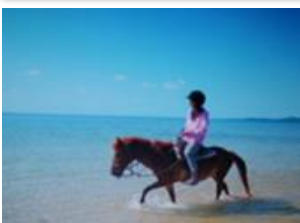


Fig. 2. shows the result of contaminations detection in a stainless steel sample. It shows that detection of the contaminations in heavy specific density is possible through optimisation of observation conditions. We have also experienced detecting light specific density elements contamination in the heavy specific density material. To obtain the chemical composition related information from the X-ray CT scan requires accurate settings of the threshold value of grayscale in every single set of scans. We have deployed a high-resolution X-ray CT for small complicated designed dimensional quality control for more than 10 years while piling up the various experiences of X-ray CT observation. The smaller and more complicated designed serial production will accept more complicated chemical composition alloys to realise the additional functions. We are ready to produce those metal components with our quality certification.

Fig. 2 X-ray CT image of contamination (about 40  $\mu\text{m}$ ) in SUS316L sample

\*Reference; R. Pelletier, F. Bernier, C. Charbonneau, Quantification of contaminants in metal powders for additive manufacturing using micro-focus X-ray tomography, International Journal of Powder Metallurgy, Vol. 56, No. 3, 2020, pp35-42

#### Column



Hello, I am Izumi Kawamoto from the production management section. I have been working here for 9 months. I am in charge of the logistics and delivery date. I check the production progress and check the additional information to improve the accuracy of progress so I am building up a good relationship with other sections. Now I follow the basic routine, but I would like to generate ideas to improve my tasks soon in the future. It is getting colder and colder here in Osaka and I cannot forget the travel experience of the warm winter in Okinawa. My best memory is the horse riding along the seashore.