Application News

No. N141

Microfocus X-ray CT System

# Example of Observation of Food Container (Instant Noodle Container) by inspeXio™ SMX™-225CT FPD HR Plus

## Introduction

Instant noodles are a convenient type of instant food product that can be eaten simply by pouring hot water in the container and waiting several minutes. Instant noodle containers must possess heat resistance and heat insulation properties so that the container can be handled by the consumer even while it is filled with hot water. For this reason, plastics such as styrene foam are used in containers for instant noodles, as they have excellent heat resistance and heat insulation properties. However, in response to the heightened environmental awareness of recent years, paper is now used in food product containers as a biodegradable material with a smaller greenhouse gas (GHG) emission. Beginning in the 2000s, paper containers with high heat resistance and insulating properties were also developed and manufactured for instant noodles, and are distributed in the market only after passing strict inspections.

The microfocus X-ray CT system is a useful tool for development of new containers and inspections for container damage and contamination by foreign matter. Because microfocus X-ray CT systems enable simple nondestructive visualization of the 3-dimensional structure of the observation target, it is possible to grasp the structure of a container by cross-sectional observation without destroying the container.

This article introduces an example of observation of plastic and paper containers for instant noodles using an inspeXio SMX-225CT FPD HR Plus microfocus X-ray CT system (Fig. 1).

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**Fig. 1 inspeXio™ SMX™-225CT FPD HR Plus Microfocus X-ray CT System**

## Observation of Instant Noodle Containers

Fig. 2 shows a 3-dimensional representation and cross-sectional images of an unopened plastic instant noodle container acquired by a CT scan in order to observe the structure of a conventional plastic container. The cross-sectional images taken in planes $\boxed{1}$ and $\boxed{2}$ in Fig. 2 show the entire container, and the images in $\boxed{3}$ and $\boxed{4}$ were generated by enlarging portions of those images. In the cross-sectional images, whiter areas indicate higher density, while blacker areas indicate lower density. From the enlarged images in $\boxed{3}$ and $\boxed{4}$, it can be understood that the interior structure on the inner side of the container includes many voids due to the formation of a 3-dimensional network structure.

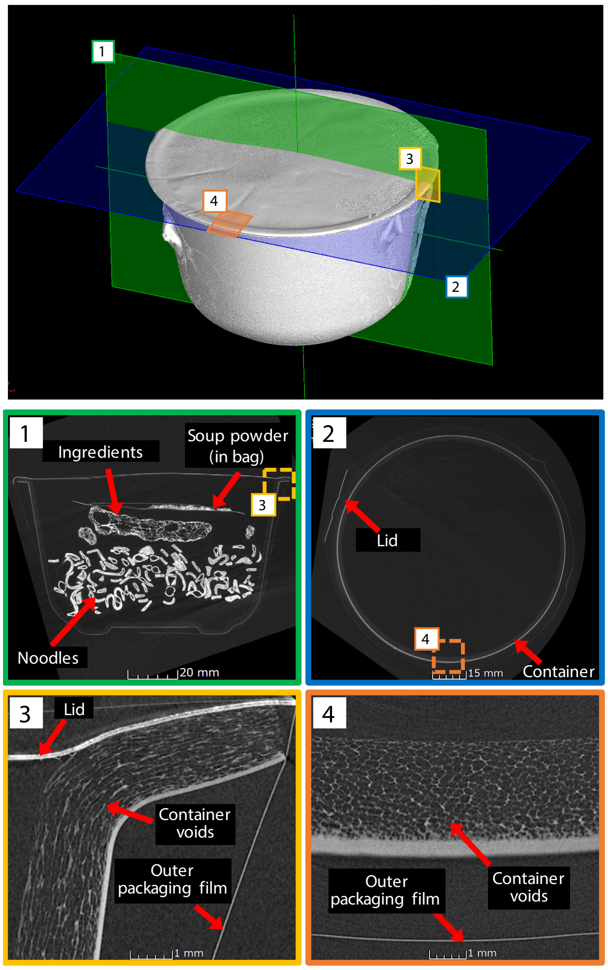


**Fig. 2 3-Dimensional Representation and Cross-Sectional Images of Plastic Instant Noodle Container**

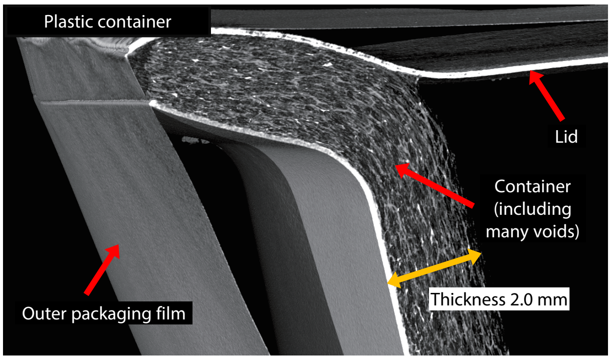


**Fig. 3 3-Dimensional Representation of Plastic Instant Noodle Container**

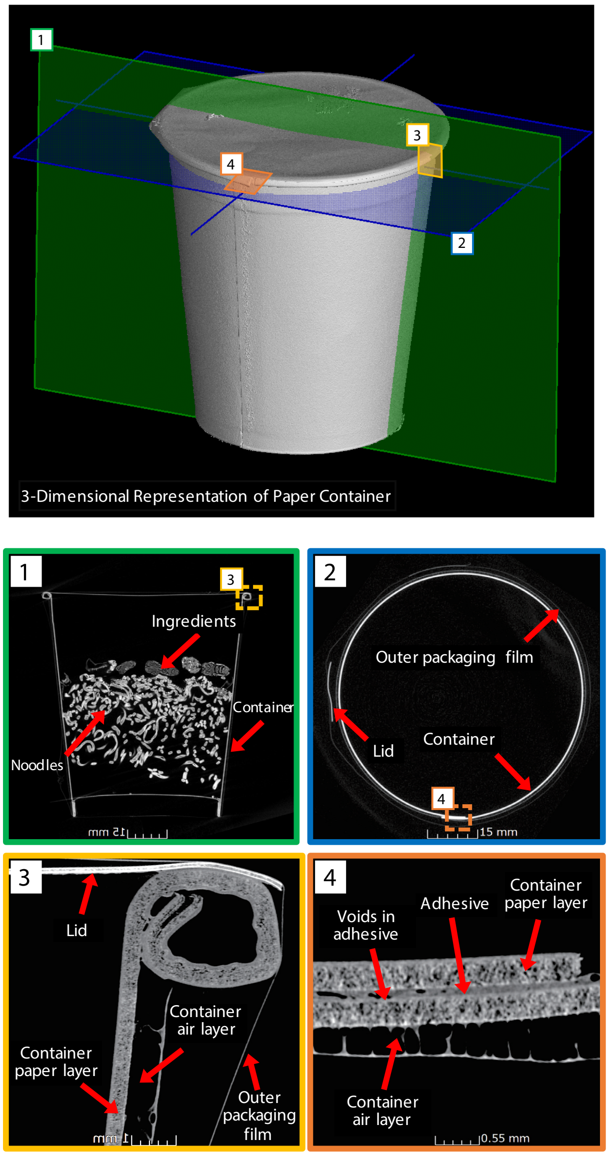


**Fig. 4 3-Dimensional Representation and Cross-Sectional Images of Paper Instant Noodle Container**

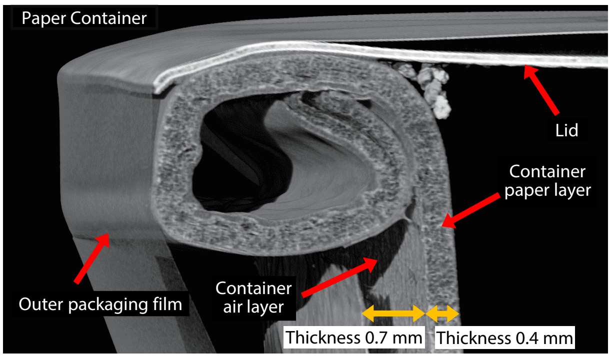


**Fig. 5 3-Dimensional Representation of Paper Instant Noodle Container**

**Table 1 Density of Instant Noodle Containers**

| | Void ratio (%) |
|---|---|
| Plastic container | 77.1 |
| Paper container air layer | 95.1 |
| Paper container paper layer | 43.8 |

For an easier understanding of the 3-dimensional structure of the plastic container, Fig. 3 shows a 3-dimensional representation of the cross section of the container. The container was produced using styrene foam, and its internal structure includes a large number of voids that enhance its heat insulation property. In addition, dimensional measurement is also possible based on this image. The thickness of the container at the measurement point in Fig. 3 is 2.0 mm.

Fig. 4 shows a 3-dimensional representation and cross-sectional images generated by a CT scan of an instant noodle product with a paper container. In the paper container, points where the layers of the container were glued together can be observed. As in Fig. 3, Fig. 5 shows a 3-dimensional representation of the cross section of the paper container for easier understanding of the structure of the paper container. The thickness of the container was also measured, showing that the total thickness of the layers of the paper container, 1.1 mm, is thinner than that of the plastic container, being approximately 1/2 of the 2.0 mm thickness of the plastic container.

Table 1 shows the difference in the void ratios of the respective layers in numerical values calculated from the 3-dimensional representation data. In order from the largest void ratio, the void ratios are air layer of paper container > plastic container > paper layer of paper container. Here, it can be understood that the void ratio of the air layer of the paper container is no less than twice as large as that of the paper layer. It can be estimated that the thickness of the paper layer of the paper container can be reduced to about 1/5 that of the plastic container, as shown in Figs. 3 and 5, because the highly porous air layer plays the role of heat insulation. In addition, conventional plastic containers produced from styrene foam have low resistance against impact during transportation and use, but the multilayered structure of the paper container has good impact resistance and thus reduces the risk of damage during transportation and use.

## Conclusion

As demonstrated in this experiment, the microfocus X-ray CT system enables nondestructive observation of differences in the structures of containers for instant noodles and other food products and makes it possible to quantify the percentage of voids in containers by visualizing their internal structures, and thus is a useful tool for inspections and quality control of commercial products and the development of new products.

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