Application News

Microfocus X-ray Inspection System Xslicer™ SMX™-1010/1020

Observation of Wireless Earphones Using a Microfocus X-ray Inspection System

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User Benefits

- By taking X-ray fluoroscopic images of wireless earphones, various electronic components inside the product can be observed non-destructively and in a short amount of time.
- Even when electronic components overlap due to multilayered structures, making it difficult to observe defects through X-ray fluoroscopy, it is possible to observe any cross-section by using X-ray CT.

■ Introduction

In recent years, a wide variety of earphones have been sold in the United States, Japan, and China, and the earphone market has experienced remarkable growth. While wired earphones used to be mainstream, the demand for wireless earphones has been increasing due to their convenience, such as cordless use. On the other hand, as the shipment of wireless earphones increases, the number of fire accidents caused by lithium-ion batteries built into the earphones has been increasing year by year. Against this background, quality evaluation is essential in the manufacturing process of wireless earphones, and microfocus X-ray inspection systems are widely used as a means of evaluating the quality.

This paper introduces a case study where the internal structure of wireless earphones was observed using X-ray fluoroscopy and X-ray CT with the microfocus X-ray inspection system Xslicer SMX-1020 (Fig. 1).

Item	Xslicer SMX-1010*1	Xslicer SMX-1020
Detector area size	64×57 mm	114×64 mm
Number of pixels	1.5 million pixels	3.0 million pixels

Fig. 1 Microfocus X-ray Inspection System Xslicer™ SMX™-1020

*1 The detectors (area size and number of pixels) installed are different.

■ Observation of wireless earphones

In this paper, we used a Bluetooth earphone with independent left and right earphone units. The small housing of the earphone contains various electronic components such as a lithium-ion battery, speaker, mounting board (including Bluetooth unit), and charging terminal. Fig. 2 shows the X-ray fluoroscopic image of the wireless earphone. The brighter areas represent regions with low X-ray absorption, which correspond to regions with low density and thickness. On the other hand, the darker areas represent regions with high X-ray absorption, which correspond to regions with high density and thickness. Our proprietary high dynamic range (HDR) processing significantly improves visibility for inspection targets with varying thicknesses and materials compared to conventional X-ray inspection system.

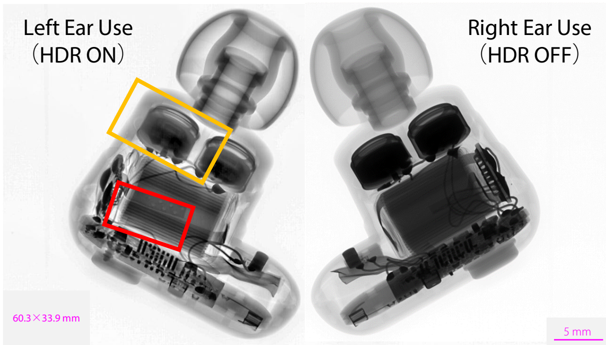

Fig. 2 X-ray Fluoroscopic Image of Wireless Earphones

Fig. 3 and 4 are X-ray fluoroscopic images of the lithium-ion battery and speaker, respectively, taken by enlarging the red and yellow frames in Fig. 2. By obtaining an X-ray fluoroscopic image of the electrodes in the lithium-ion battery, it is possible to observe the position and condition of the positive and negative electrodes, e.g. bending of the negative electrode. Additionally, by focusing on the speaker, it is possible to observe the position of the voice coil and magnet, e.g. the presence or absence of gaps (Fig. 4).

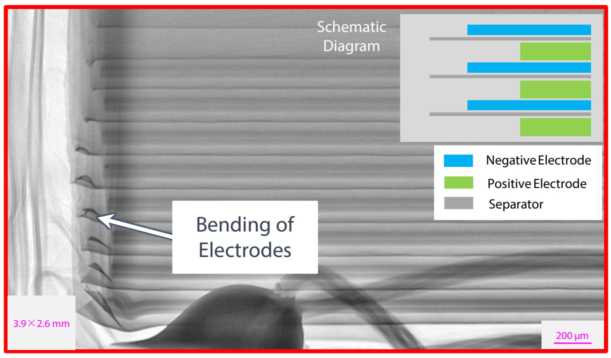

Fig. 3 X-ray Fluoroscopic Image of the Lithium-ion Battery

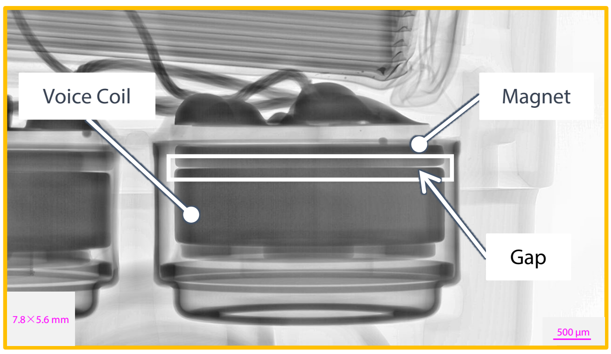

Fig. 4 X-ray Fluoroscopic Image of the Speaker

Fig. 5 shows an X-ray fluoroscopic image of a wireless earphone (left ear). It can be seen that various electronic components are arranged in a limited space. Fig. 6, 7, and 8 are X-ray fluoroscopic images that magnify the orange, green, and purple frames of Fig. 5, respectively. By obtaining X-ray fluoroscopic images of the solder balls of the BGA and the Bluetooth unit, their joint conditions and presence of voids can be observed (Fig. 6). In addition, the bonding wire of the crystal oscillator (Fig. 7) and scattered solder spatter around the charging terminal (Fig. 8) can also be observed.

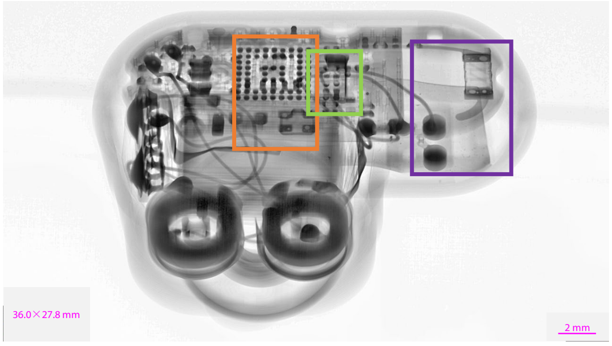

Fig. 5 X-ray Fluoroscopic Image of the Wireless Earphone (Left Ear)

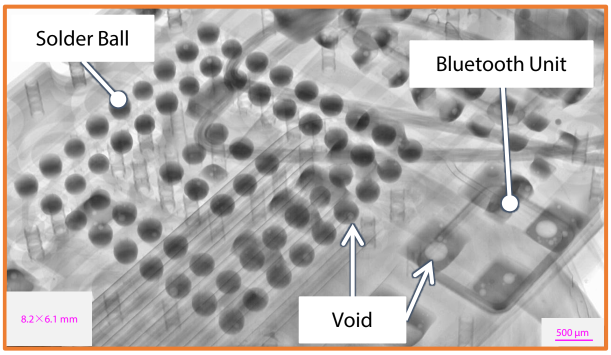

Fig.6 X-ray Fluoroscopic Images of the BGA and Bluetooth Unit

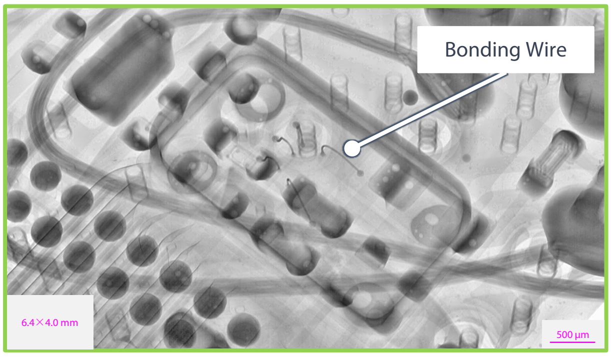

Fig.7 X-ray Fluoroscopic Image of the Crystal Oscillator

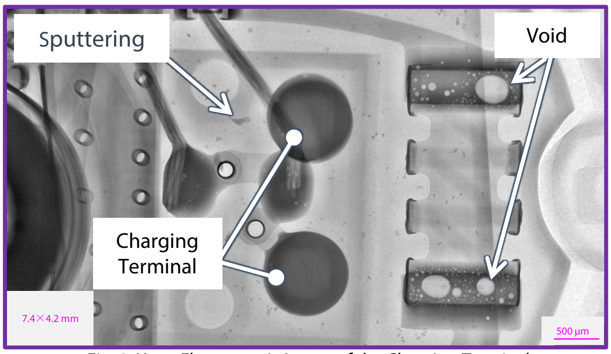

Fig. 8 X-ray Fluoroscopic Image of the Charging Terminal

Fig. 9, 10, and 11 show three-dimensional images*2 and cross-sectional images obtained by CT scanning the BGA in Fig. 6. In cross-sectional images from X-ray CT, the white and black colors are reversed compared to the X-ray fluoroscopic images. The smaller the density or thickness, the darker the cross-sectional image, and the larger the density or thickness, the brighter the cross-sectional image. When electronic components overlap due to multilayering, it can be difficult to observe defects using X-ray fluoroscopy, making X-ray CT useful. By CT scanning, any cross-section of the BGA can be observed, allowing the shape and position of solder balls and voids to be confirmed.

*2 VGSTUDIO software was used as an optional software.

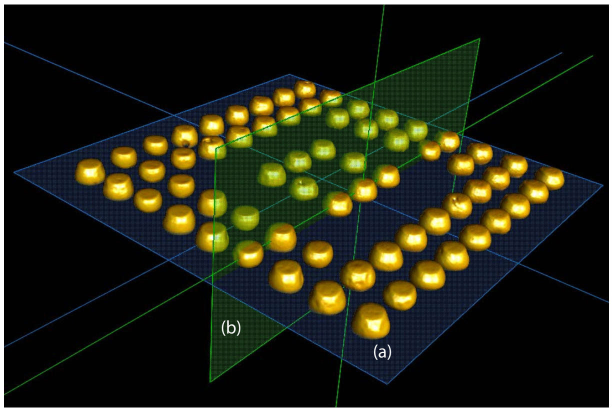

Fig. 9 3D Image of the BGA (Whole)

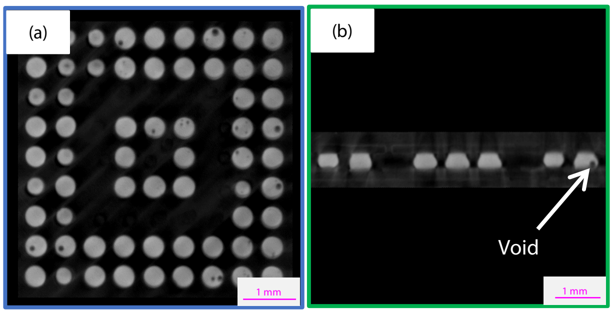

Fig. 10 Cross-Sectional Images of the BGA
(a) Horizontal Cross-Section (Blue Section)
(b) Vertical Cross-Section (Green Section)

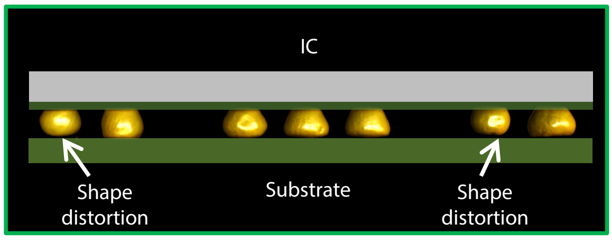

Fig. 11 3D image of the BGA (Green Section)

■ Conclusion

The microfocus X-ray inspection system can non-destructively and quickly observe components such as lithium-ion batteries, speakers, and electronic circuit boards integrated into wireless earphones. In addition to X-ray fluoroscopy, detailed inspections of the shape and position of the inspection target can be performed by X-ray CT. X-ray inspection system can continue to be utilized in any situation related to product quality in the manufacturing industry.

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01-00302-EN First Edition: May. 2023