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Application News

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Microfocus X-Ray Inspection System

An Example Observation of a Smartphone Using Xslicer SMX-6000

Introduction

As with tablets, smartphones are widely used mobile devices. In these electronic devices, various electronic components are mounted effectively in a limited amount of space in order to achieve high mobility and high performance concurrently. Along with the evolution of such devices, their internal structure is becoming increasingly complex.

Meanwhile, the manufacturing of electronic components involves a certain rate of defect. Defective components not only interrupt the operation of devices but also can cause accidents including fire and explosion. Accordingly, defect inspections of products are extremely important to achieve safe and reliable electronic devices.

One of the methods for such inspections is the internal observation of a device using an X-ray inspection system. X-ray inspections are advantageous because they enable non-destructive internal observation meaning that products can be inspected in the same state as that they are placed on the market.

This article introduces an example observation of a smartphone using the Xslicer SMX-6000 microfocus X-ray inspection system (Fig. 1).

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Fig. 1 Xslicer SMX-6000 Microfocus X-Ray Inspection System

Observation of a Smartphone

Fig. 2 is a fluoroscopic image taken using Xslicer SMX-6000 (using the panorama function). A lithium-ion battery is in the central area and a u-shaped electronic circuit board surrounds the battery. In addition, a camera (A), a USB port (B), and other electronic components are mounted around them. Through fluoroscopic observation of the entire product, the general internal conditions and placements of components can be viewed at a glance.

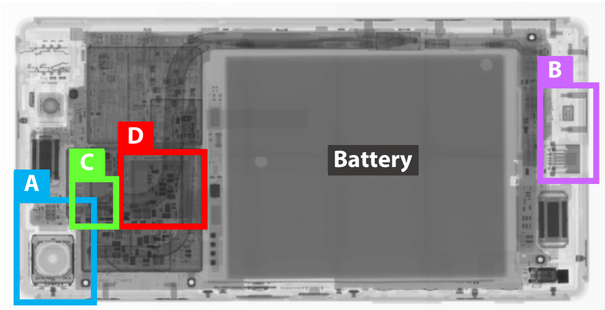


Fig. 2 Fluoroscopic Image of a Smartphone (Taken using the panorama function)

Figs. 3 to 5 are high magnification images of the components A to C in Fig. 2. Each image was taken by changing the observation magnification and angle. Defects can be detected effectively and conveniently since images optimal for inspection items can be obtained easily and quickly. Fig. 5 shows that there are multiple voids in the ball grid array (BGA). However, defects may be difficult to identify when the structure is complex with many layers; for example, components may appear as overlapped in the fluoroscopic images. X-ray computed tomography (CT) imaging is useful in such cases.

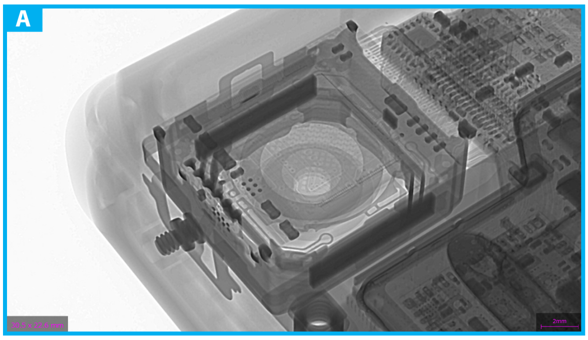


Fig. 3 Fluoroscopic Image of the Camera (A)

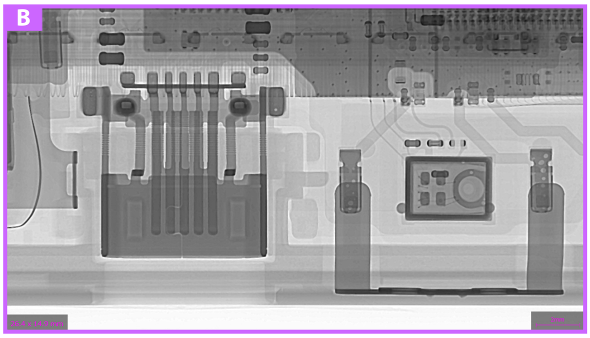


Fig. 4 Fluoroscopic Image of the USB Port (B)

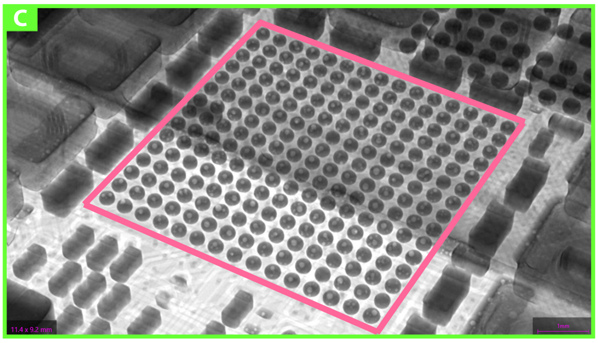


Fig. 5 Fluoroscopic Image of a BGA (C)

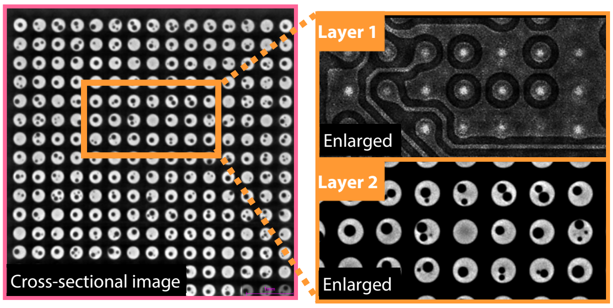
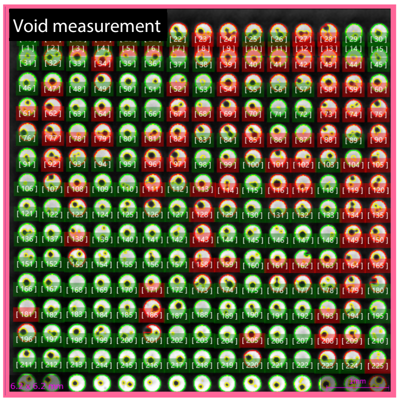


Fig. 6 Cross-Sectional Images of a BGA (C)



BGA Measurement Result
Total BGA : 225
OK (Green) : 138
NG (Red) : 87

NG Judgement Criteria
Total Void Ratio : 50.0 %
Max Void Ratio : 40.0 %

Fig. 7 Measurement of BGA (C) Voids

Fig. 6 shows images of the same section as Fig. 5 acquired by CT imaging at low and high magnifications. Layer 1 and Layer 2 are images of the data of two different layers obtained from the same imaging data. Layer 1 can be used to ensure that there is no disconnection in the electronic circuit pattern and that the solder bumps are properly bonded. Layer 2 can be used to check the void distribution at an arbitrary height. Various data can be obtained from a single observation point by changing the size of the field of view for image acquisition or by extracting the data of different layers.

Fig. 7 presents the results of the void ratio calculation obtained from the cross-sectional images in Fig. 6 using the BGA measurement function. With this inspection system, measurements can be performed easily without the need for complex parameter settings. Furthermore, defective sections can be identified at a glance by setting arbitrary pass/fail criteria. (Sections that pass (OK) are shown in green and sections that fail (NG) are shown in red.) In addition to pass/fail evaluations based on void ratios as presented in Fig. 7, evaluations can also be based on bump diameters or bump roundness.

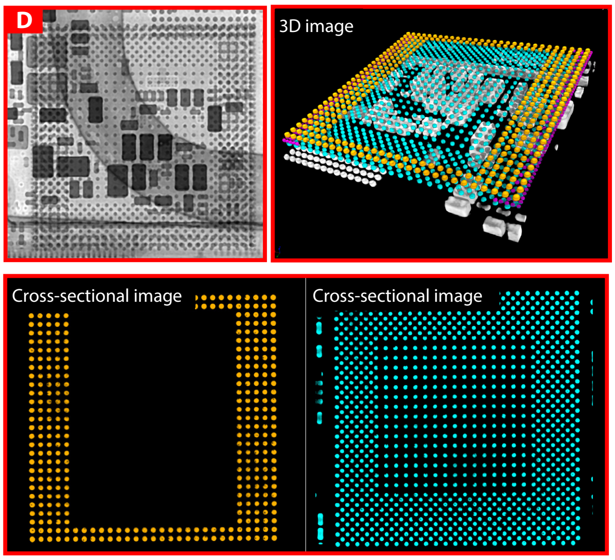


Fig. 8 Fluoroscopic Image, Cross-Sectional Images, and 3D Image of a BGA (D)

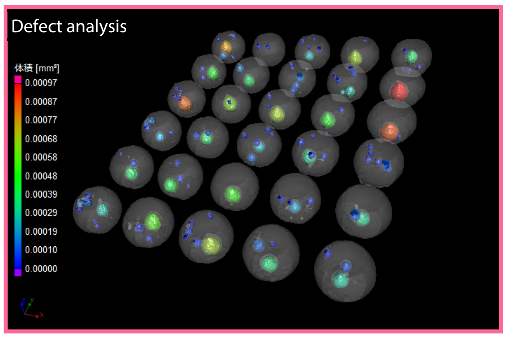


Fig. 9 Defect Analysis of a BGA (C)

Fig. 8 shows a fluoroscopic image and cross-sectional images of a BGA (D in Fig. 2) and a three-dimensional (3D) image of the same BGA generated from the CT imaging data. It is extremely difficult to grasp the structure of this BGA by fluoroscopic observation because it consists of multiple layers and resistors are arranged above and below the layers. In such cases, cross-sectional images and 3D images generated from the CT imaging data are useful.

Fig. 9 is an image of a defect analysis obtained using a 3D image processing software based on the CT imaging data of a BGA (C). The results are visualized by displaying only the voids in color and making the solder bumps semi-transparent.

The analysis result data such as the volume, diameter, and position of the voids can be converted into graphs or tables as a CSV file.

Conclusion

Xslicer SMX-6000 can be used for a wide range of observations and analyses in accordance with the inspection purpose and the samples to be observed. Since the observations and analyses introduced in this article can be performed easily and immediately by anyone, the Xslicer SMX-6000 is an extremely useful tool for the inspections of electric/electronic devices whose structures are becoming increasingly complex.

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