

wire 33b of the defective wire 30b is about 1/2 of g_0 , and is often on the order of 20 to 30 Hz in a general semiconductor apparatus 10.

[0054] The first-stage to fourth-stage wires 31a to 34a of the normally connected wire 30a vibrate in the lateral direction at the natural frequency g_0 of several tens of Hz. The frame rate of the videos is 24 to 60 frames per second. Therefore, for example, the image of the first-stage to fourth-stage wires 31a to 34a in one frame is as indicated by the one-dot chain line on the left side of the center line 39a of the wire 30a in the detail of the part A in FIG. 6, and the image of the previous frame is as indicated by the one-dot chain line on the right side of the center line 39a of the wire 30a in the detail of the part A in FIG. 6.

[0055] In step S104 of FIG. 5, the CPU 51 of the controller 50 compares the image of the first-stage to fourth-stage wires 31a to 34a in one frame shown in the detail of the part A in FIG. 6 with the image of the first-stage to fourth-stage wires 31a to 34a in the previous frame, and calculates a difference Δda therebetween. As shown in the detail of the part A in FIG. 6, this difference Δda is small in the normal wire 30a. This difference Δda is proportional to the amplitudes of the first-stage to fourth-stage wires 31a to 34a.

[0056] On the other hand, the second-stage wire 32b and the third-stage wire 33b of the defective wire 30b, which is not attached to the electrode 26 of the semiconductor chip 22 in the second stage, vibrate greatly in the lateral direction at 20 to 30 Hz. As mentioned earlier, the frame rate of the videos is 24 to 60 frames per second, so for example, the image of the second-stage wire 32b and the third-stage wire 33b in one frame is as indicated by the one-dot chain line on the left side of the center line 39b of the defective wire 30b in the details of the part A and the part B in FIG. 6, and the image of the previous frame is as indicated by the one-dot chain line on the right side of the center line 39b of the wire 30b in the details of the part A and the part B in FIG. 6.

[0057] As in the case of the wire 30a, the CPU 51 of the controller 50 calculates the difference

CLAIMS:

[Claim 1] An ultrasound vibrating-type defect detection apparatus for detecting a defect in an inspection object, the ultrasound vibrating-type defect detection apparatus comprising:

an ultrasound vibrating device ultrasonically vibrating the inspection object;

5 a power supply supplying high-frequency power to the ultrasound vibrating device;

an imaging device imaging the inspection object ultrasonically vibrated; and

a controller adjusting a frequency of the high-frequency power supplied from the power supply to the ultrasound vibrating device, and performing detection of a defect in the inspection object,

10 wherein the controller captures an image of the inspection object with the imaging device while varying the frequency of the high-frequency power supplied from the power supply to the ultrasound vibrating device, and performs detection of a defect in the inspection object based on the image captured,

the inspection object comprises a target portion subjected to detection of a defect, and a non-
15 target portion not subjected to detection of a defect, and

the controller adjusts a voltage of the high-frequency power supplied from the power supply to the ultrasound vibrating device so that a ratio of an amplitude of the target portion detected from the image captured by the imaging device to an amplitude of the non-target portion detected from the image captured by the imaging device is equal to or greater than a predetermined value when
20 varying the frequency of the high-frequency power supplied from the power supply to the ultrasound vibrating device.

[Claim 2] The ultrasound vibrating-type defect detection apparatus according to claim 1, comprising a current sensor detecting a current of the high-frequency power supplied from the power supply to the ultrasound vibrating device,

25 wherein the controller adjusts the voltage of the high-frequency power supplied from the

power supply to the ultrasound vibrating device so that the current detected by the current sensor is within a predetermined range when varying the frequency of the high-frequency power supplied from the power supply to the ultrasound vibrating device.

[Claim 3] The ultrasound vibrating-type defect detection apparatus according to claim 1,
5 wherein the controller comprises a map prescribing a variation of the voltage of the high-frequency power supplied from the power supply to the ultrasound vibrating device with respect to the frequency of the high-frequency power supplied from the power supply to the ultrasound vibrating device so that a current of the high-frequency power supplied from the power supply to the ultrasound vibrating device is within a predetermined range, and

10 adjusts the voltage of the high-frequency power supplied from the power supply to the ultrasound vibrating device based on the map when varying the frequency of the high-frequency power supplied from the power supply to the ultrasound vibrating device.

[Claim 4] The ultrasound vibrating-type defect detection apparatus according to any one of claims 1 to 3, wherein the inspection object is a semiconductor apparatus comprising a substrate,
15 a semiconductor element attached to the substrate, and a wire connecting an electrode of the semiconductor element and an electrode of the substrate, or one electrode of the semiconductor element and another electrode of the semiconductor element, and

the controller adjusts the voltage of the high-frequency power supplied from the power supply to the ultrasound vibrating device so that a ratio of an amplitude of the wire detected from the
20 image captured by the imaging device to amplitudes of the substrate and the semiconductor element detected from the image captured by the imaging device is equal to or greater than a predetermined value when varying the frequency of the high-frequency power supplied from the power supply to the ultrasound vibrating device.

[Claim 5] The ultrasound vibrating-type defect detection apparatus according to claim 4,
25 wherein the controller adjusts the voltage of the high-frequency power supplied from the power

supply to the ultrasound vibrating device so that the amplitude of the wire detected does not exceed a predetermined upper limit amplitude.

[Claim 6] The ultrasound vibrating-type defect detection apparatus according to claim 4 or 5, wherein the controller captures a video of the semiconductor apparatus with the imaging device while varying the frequency of the high-frequency power supplied from the power supply to the ultrasound vibrating device,

calculates a difference between images of the wire in one frame of the video captured and a previous frame before the one frame, and

outputs a defect detection signal of the wire in response to the difference exceeding a predetermined threshold.

[Claim 7] The ultrasound vibrating-type defect detection apparatus according to claim 6, wherein the controller calculates the difference by varying the number of frames between one frame and the previous frame for calculating the difference, or a frame rate of the video.

[Claim 8] The ultrasound vibrating-type defect detection apparatus according to any one of claims 1 to 3, wherein the ultrasound vibrating device is an ultrasound vibrator connected to the inspection object to ultrasonically vibrate the inspection object, or an ultrasound speaker arranged in a periphery of the inspection object.

[Claim 9] A wire defect detection system for detecting a defect in a wire of a semiconductor apparatus, which comprises a substrate, a semiconductor element attached to the substrate, and the wire connecting an electrode of the semiconductor element and an electrode of the substrate, or one electrode of the semiconductor element and another electrode of the semiconductor element, the wire defect detection system comprising:

an ultrasound vibrating device ultrasonically vibrating the semiconductor apparatus;

a power supply supplying high-frequency power to the ultrasound vibrating device;

an imaging device imaging the semiconductor apparatus ultrasonically vibrated;

a display displaying an image captured by the imaging device; and

a controller adjusting a frequency of the high-frequency power supplied from the power supply to the ultrasound vibrating device and performing detection of a defect in the wire,

wherein the controller captures a video of the semiconductor apparatus with the imaging device while varying the frequency of the high-frequency power supplied from the power supply to the ultrasound vibrating device,

calculates a difference between images in one frame of the video captured and a previous frame before the one frame, and

displays a display image of the wire on the display by differentiating the display image from other display images of the wire in response to the difference exceeding a predetermined threshold,

the semiconductor apparatus comprises a target portion subjected to detection of a defect, and a non-target portion not subjected to detection of a defect, and

the controller adjusts a voltage of the high-frequency power supplied from the power supply to the ultrasound vibrating device so that a ratio of an amplitude of the target portion detected from the image captured by the imaging device to an amplitude of the non-target portion detected from the image captured by the imaging device is equal to or greater than a predetermined value when varying the frequency of the high-frequency power supplied from the power supply to the ultrasound vibrating device.