

METHOD FOR REVEALING DEFECTS IN PASSIVE COMPONENTS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to method of identifying defects in passive component. More particularly, this invention relates to a method of inspection all kinds of defects such as surface crack, stains, smear or chip off of a chip by single visual inspection devices.

2. Description of the Related Art

In the field of identifying defects of passive components, several instruments are widely used to identify and analyze passive components' defects. There is vision system used to inspect passive component, such as a chip, prior to mounting the chip onto the circuit board or the like. The vision system, or inspection station, can be used in a system which combines component acquisition, inspection and placement in a highly efficient and effective manner, or can also be used as a stand-alone unit through its dedicated microcomputer.

In identifying defects of passive components, visual inspection of the passive components is done by observing through naked-eye inspection or using a visual inspection device. Visual Inspection is a term used for inspecting passive components under a microscope or the like to determine if the inspected component has defects. During the visual inspection process, the device may show signs of non-conformance or inconsistencies that help determine if the passive component is free from defects. There are so many things to look for during a visual inspection. In general, image captured using visual inspection devices is used to inspect all kind of defects types such as surface crack, stains, smear or chip off.

High reliability software algorithms are used to identify defects of passive components. The reliability is based on very strict parameters such as high quality and quantity of the images that supplied to the software algorithms. High quality images being used will lead to non-defective passive components being identified as defective, and therefore, the result will cause an "over-kill" which reduces production yield. However, if the parameter is set loosely, the inspection will lead to an "under kill" result, where defects are not able to be identified, and thus the method reduces inspection quality.

The drawbacks of currently used method of identifying defects in passive components are time consuming to optimise the conditions and/or the criteria for getting accurate and reliable inspection. In addition, using a single color LED light is difficult to detect accurately in different parts of an object.

U.S. Pat. No. 6,097,784 discloses a method for amplifying defects connected to a top surface of a semiconductor device. A dye is applied to the top surface, and leached into a developing gel. The gel develops defect indications that are more easily visualized than the defects themselves. The dye can be a fluorescent dye.

- 5 U.S. Pat. No. 6,427,544 suggests an environmentally friendly method for detecting defects in parts. The parts are submerged in a mixture of a penetrant dye and supercritical carbon dioxide. The part is removed, and inspected for the presence of dye in any defects. The dye can be a fluorescing penetrant dye that is visualized with UV light.

SUMMARY OF THE INVENTION

- 10 It is a main an main object of the present invention to provide a method for revealing defects in a passive component comprising the steps of

- (i) obtaining images of the passive component captured by a camera which illuminated with red and blue LEDs;
- (ii) implementing a single colour conversion and luminosity method conversion of the
15 images to generate 4 grayscale images;
- (iii) displaying live images of the passive component and all the grayscale images obtained in step (ii) above;
- (iv) selecting an optimal image for each of the passive components to be inspected from a parameter menu; and
- 20 (v) carrying out the inspection of the images with defects

thereby increasing the contrast of the grayscale images, and the defects of the passive component is isolated and is identified.

- A further object of the present invention is to provide a method for revealing defects in a passive component, wherein the inspection process is efficient and accurate to identify defects
25 such as stain, smear, crack, and chip off in the passive component.

It is a further object of the present invention to provide a method for revealing defects in a passive component with accuracy and with flexibility within a minimally operation cost.

Another main object of the present invention is to provide a method for revealing defects in a passive component, wherein a user has option to select the appropriate grayscale image

effectively to reveal defects of the passive component to prevent “overkill” or “underkill” inspection.

A further main object of the present invention is to provide a method employing a software to generate 4 grayscale images (red, green, blue and merge) instead of only a single colour
 5 image, and based on the images generated, the user can set the parameter needed to obtain the most optimal inspection condition and choose a grayscale image use for different types of defect of a passive component.

A further object of the present invention is to provide a method for revealing defects in a passive component, wherein the production yield is increased and any escapees in
 10 production is removed which increases production yield and quality of the production.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features and advantages of example embodiments of inventive concepts will become more apparent by describing in detail preferred examples thereof with reference to the attached drawings in which:

15 FIG. 1 is a flowchart illustrating a method of revealing defects in passive component in accordance with the present invention.

FIG. 2 shows an image of a ceramic capacitor taken under a color camera with blue LED in accordance with the present invention, wherein the image shows a terminal area (28) and a body area (26);

20 FIG. 3 shows an image of a ceramic capacitor taken under a color camera with white LED in accordance with the present invention;

FIG. 4 shows a grayscale image of ceramic capacitor showing red color channel in accordance with the present invention;

25 FIG. 5 is a grayscale image of ceramic capacitor showing blue color channel in accordance with the present invention; and

FIG. 6 is a grayscale image of ceramic capacitor showing green color channel in accordance with the present invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

30 An embodiment according to the present invention will now be described hereinafter with reference to the accompanying drawings.

FIG. 1 is a flowchart illustrating a method of revealing defects in passive components in accordance with the present invention. Based on the preferred embodiment of the present invention, there is provided a method for revealing defects in a passive component comprising the steps of

- 5 (i) obtaining images of the passive component captured by camera which illuminated with red and blue LEDs;
- (ii) implementing a single colour conversion and luminosity method conversion of the images from step (i) to generate 4 grayscale images;
- (iii) displaying live images of passive component and all the grayscale images obtained in
10 step (ii) above;
- (iv) selecting an optimal image for each of the passive components to be inspected from a parameter menu; and
- (v) carrying out the inspection of the images;

thereby increasing the contrast of the grayscale images, the defects of the passive component
15 is isolated and is identified.

FIG. 2 shows an image of a ceramic capacitor taken under a color camera with blue LED in accordance with the present invention, wherein the image shows a terminal area (28) and a body area (26). FIG. 3 shows an image of a ceramic capacitor taken under a color camera with white LED in accordance with the present invention.

20 When the images of FIG. 2 and FIG. 3 are compared, the defects of the passive component can be seen more clearly in the terminal area (28) in the blue LED than the one with white LED. However, the defects on the body (shown on FIG. 3) of the passive component can be seen more clearly in the white LED than in the blue LED. This preferred embodiment of the invention shows that certain defects of the passive component are seen more clearly when
25 the component is under different colour lighting.

Referring again to FIG. 2 and 3, the best case is to have the ceramic capacitor's body of the image with white LED and the terminal area (28) of the blue LED image. Accordingly, this will allow a software to pick out the defects easily in the course of inspection defect process.

FIG. 1 indicates a flowchart illustrating a method of revealing defects in passive components
30 in accordance with the present invention. A computer is equipped with a software which first grabs the images of the object being inspected from the color camera illustrated with red and

blue LEDs together. In order to enhance accuracy and speed in identifying defects in existence in the passive component, color information of the identifying process are extracted from the color images that captured using red, blue LEDs to produce grayscale images. The software of the computer retrieves the size of the captured images to get the total number of pixels, and for every pixel in the images, the software performs two kinds of grayscale conversions, that is, the colour channel conversion and the grayscale conversion.

In the color channel conversion, the software algorithm converts the RGB values from the captured images and set the colour value to be the gray value. In addition to the colour channel conversion, the software algorithm also performs the grayscale conversions using the luminosity method to produce a combined grayscale image.

$$\text{Gray} = (\text{Red} * 0.3 + \text{Green} * 0.59 + \text{Blue} * 0.11)$$

Based on the above equation, four grayscale images will be generated which reflect the level of intensity of Red, Green, Blue, and the combined colors from the original picture. The software of the computer will display these 4 grayscale images along with the original picture.

The grayscale images will be able to accurately show that the defects and the object will have different contrast level. Based on the generated images, a user can set the parameters that required to get the most optimal inspection condition. The user is able to choose which grayscale mages to use for different defect types.

In accordance with the preferred embodiment of the present invention, the software is preprogrammed to contain inspection items which check any defects based on the generated images. The software will focus on the scope of the inspection items and make use of the images chosen to inspect for any defects. Any detected defects shall then be output by the software of the computer.

FIG. 4 shows a grayscale image of ceramic capacitor showing red color channel in accordance with the present invention. In Figure 4, the terminal area (28) shows more "black spots" defects as compared to that shown in FIG. 5 and FIG. 6. FIG. 5 is a grayscale image of ceramic capacitor showing blue color channel in accordance with the present invention; and

FIG. 6 is a grayscale image of ceramic capacitor showing green color channel in accordance with the present invention.

As shown in FIG. 6, the defects shown in the figure are numerous but the image is darker and is not in good quality, for instance, when the user chooses a grayscale image to use for checking of uneven terminal area (28). FIG. 4 is the image being the preferred one to be used for identifying the defects in a passive component.

In accordance with the present invention, the method is able to produce four grayscale images from one color image which cut down on the time to grab the different color images, and by using the grayscale images generated from Red and Blue LEDs, defects can be seen more clearly in some colors than the rest.

- 5 As defects can be seen more prominently under some colour intensity, this allows the user to have a choice to choose which grayscale image to use. Reliability can be ensured by choosing which grayscale images to be used for individual inspection items and customising the parameters to get desired inspection process.

- 10 In accordance with the present invention, the method allows the user to have multiple choices to choose which grayscale image most effectively reveals the defects for the software to use for inspection to reduce/remove overkill which increase production yield or to remove escapees which increase quality of the passive component.

- 15 It is to be understood that the forms of the invention shown and described herein are to be taken as the presently preferred embodiments. Changes may be made without departing from the spirit and scope of the invention as described in the following claims.

CLAIMS:

1. A method for revealing defects in a passive component comprising the steps of
 - (i) obtaining images of the passive component captured by camera which illuminated with red and blue LEDs;
 - 5 (ii) implementing a single colour conversion and luminosity method conversion of the images from step (i) to generate 4 grayscale images;
 - (iii) displaying live images of passive component and all the grayscale images obtained in step (ii) above;
 - (iv) selecting an optimal image for each of the passive components to be inspected from a parameter menu; and
 - 10 (v) carrying out the inspection of the images

thereby increasing the contrast of the grayscale images, the defects of the passive component is isolated and is identified.
- 15 2. The method for revealing defects in a passive component as set forth in Claim 1, wherein the four grayscale images are generated from one colour image.
3. The method for revealing defects in a passive component as set forth in Claim 1, further comprising the step of differentiating defects of the passive component based on the grayscale images.
- 20 4. The method for revealing defects in a passive component as set forth in Claim 1, wherein brightness in grayscale images creates distinction between passive component of similar color, and defects can be seen clearly even if the passive component are of the same color.
5. The method for revealing defects in a passive component as set forth in Claim 1, further comprising the step of providing a software algorithms to identify the defects based on the images.
- 25 6. The method for revealing defects in a passive component as set forth in Claim 5, wherein the software algorithm identifies the defects and reject the passive component to prevent non-defective identified as defective.

7. The method for revealing defects in a passive components as set forth in Claim 5, wherein the software grabs an image of the passive component wherein the image is red and blue LEDs together.
- 5 8. The method for revealing defects in a passive component as set forth in Claim 7, wherein colour information are being extracted from color images captured using red, blue LEDS to produce grayscale images.
9. The method for revealing defects in a passive component as set forth in Claim 5, wherein the software retrieves the size of a captured image to obtain the toal number of pixels of the image.
- 10 10. The method for revealing defects in a passive component as set forth in Claim 9, wherein the software performs two kinds of grayscale conversion for each pixel in the image.
11. The method for revealing defects in a passive component as set forth in Claim 5, wherein the software converts RGB values of the images captured and set the colour value to be a gray value.
- 15 12. The method for revealing defects in a passive component as set forth in Claim 11, wherein the software performs grayscale conversion using luminosity method to produce a combined grayscale image, $\text{gray} = (\text{Red} * 0.3 + \text{Green} * 0.59 + \text{Blue} * 0.11)$.
13. The method for revealing defects in a passive component as set forth in Claim 12, wherein a total of four grayscale images are generated to reflect the level of intensity of red, green, blue and combined color of the original picture.
- 20 14. The method for revealing defects in a passive component as set forth in Claim 13, wherein the grayscale images accurately show the defects by having different contrast level.
- 25 15. The method for revealing defects in a passive component as set forth in Claim 11, wherein the grayscale image is manipulated by increasing contrast of the image to isolate defects of different types.