

Claims

1. An inspection system (10) for defect analysis of a wire connection (11) between a substrate (13) and a semiconductor component (15, 16) of a product (12), the inspection system comprising a first projection device (24), a line scan camera (28) and a processing device, the first projection device having at least one slit projection means (25, 43), the slit projection means being capable of projecting a light slit (33, 46) onto a wire (21, 22) of the wire connection, light of the light slit reflected by the wire in a detection plane (39) of the line scan camera extending perpendicularly, preferably orthogonally to a substrate surface (14) being detectable by means of the line scan camera, analysis image information of the product being derivable from a plurality of line scan image information of the line scan camera by means of the processing device, the slit projection means is arranged in relation to the line scan camera in such a manner that the light slit can be projected onto the product so as to extend within the detection plane, the inspection system comprising a second projection device (26), the second projection device having at least one illuminating means (27), the illuminating means being capable of projecting diffuse light onto the product, light of the diffuse light reflected by the product in the detection plane being detectable by means of the line scan camera, characterized in that the slit projection means (25) is arranged laterally perpendicularly in relation to the line scan camera (28), the light slit (33) being projectable onto the wire (21, 22), and the semiconductor component (15, 16) being unlit by the light slit.
2. The inspection system according to claim 1, characterized in that the line scan camera (28) is arranged perpendicularly to a direction of movement of a product (12), the detection plane (39) extending parallel or perpendicularly to the wire (21, 22).
3. The inspection system according to claim 1 or 2, characterized in that the slit projection means (43) is arranged parallel in relation to the line scan camera (28) and has a partially transparent mirror (45) arranged within the detection plane (39) between the product (12) and the line scan camera (28), the light slit (46) being deflectable into the detection plane via the partially transparent mirror.
4. The inspection system according to claim 3, characterized in that

the slit projection means (25) has at least one screening shade (34) for blocking the light slit (33) from the semiconductor component (15, 16) and/or from the substrate (13), the light slit being projectable onto the wire (21, 22) at an acute angle α in relation to a surface (14, 20) of the product.

5. The inspection system according to any one of the preceding claims, characterized in that the slit projection means (25, 43) has an assembly of optical elements, an aperture diaphragm and/or a light guide assembly (30), the light slit being a collimated light slit (33, 46).
6. The inspection system according to any one of the preceding claims, characterized in that the illuminating means (27) has an arc-shaped diffuser (36), the arc-shaped diffuser being arranged parallel in relation to the line scan camera (28).
7. The inspection system according to any one of the preceding claims, characterized in that the illuminating means (27) has a plane diffuser, the plane diffuser being arranged parallel in relation to the product (12).
8. The inspection system according to any one of the preceding claims, characterized in that the illuminating means (27) has a light guide assembly or light-emitting diodes in an arc-shaped and/or plane arrangement.
9. The inspection system according to any one of the preceding claims, characterized in that the illuminating means (27) and/or the slit projection means (25, 46) can emit light in the wavelength ranges red, green and blue (ROB), infrared (IR) and/or ultraviolet (UV).
10. The inspection system according to any one of the preceding claims, characterized in that primary colors can be detected by means of the line scan camera (28), information regarding a surface (14, 20) of the product being derivable from a color value of the line scan image information by means of the processing device.
11. The inspection system according to any one of the preceding claims,

characterized in that

the first projection device (24) has a second slit projection means (24, 43), and that the second projection device (26) has a second illuminating means (27), the first and second slit projection means and the first and second illuminating means being arranged coaxially in relation to the line scan camera (28).

12. The inspection system according to any one of the preceding claims, .
characterized in that
the inspection system (10) has another line scan camera, the other line scan camera being arranged parallel to the line scan camera (28).
13. A method for defect analysis of a wire connection (11) between a substrate (13) and a semiconductor component (15, 16) of a product (12), the method using an inspection system (10), the inspection system comprising a first projection device (24), a line scan camera (28) and a processing device, the first projection device having at least one slit projection means (25, 43) arranged laterally perpendicularly in relation to the line scan camera (28), a light slit (33, 46) being projected onto a wire (21, 22) of the wire connection by means of the slit projection means, light of the light slit reflected by the wire in a detection plane (39) of the line scan camera extending perpendicularly, preferably orthogonally to a substrate surface (14) being detected by means of the line scan camera, analysis image information of the product being derived from a plurality of line scan image information of the line scan camera by means of the processing device, and the semiconductor component (15,16) being unlit by the light slit,
wherein
the light slit is projected onto the product so as to extend within the detection plane, the inspection system comprising a second projection device (26), the second projection device having at least one illuminating means (27), diffuse light being projected onto the product by means of the illuminating means, light of the diffuse light reflected by the product in the detection plane being detected by means of the line scan camera.
14. The method according to claim 13,
characterized in that
an offset is superimposed on the plurality of line scan image information of the line scan camera (28) in a direction of movement of the product (12) by means of the processing device, the offset being smaller than a physical image resolution of the line scan camera.
15. The method according to claim 13 or 14,
characterized in that

the product (12) is moved once in the direction of an X-axis and/or a Y-axis of the product in relation to the line scan camera (28) and is optically scanned, analysis image information associated with the projection devices (24, 26) being obtained.

16. The method according to any one of claims 13 to 15,
characterized in that
the product (12) is optically scanned in at least two planes of a Z-axis of the product.
17. The method according to any one of claims 13 to 16,
characterized in that
the light of the projection devices (24, 26) is projected onto the product (12) in a time sequence,
the line scan camera (28) being synchronized with the projection devices.
18. The method according to any one of claims 13 to 17,
characterized in that
height information and/or geometrical information of the wire is obtained by means of the
processing device from a distribution of the light beam reflected by a surface of the wire (21, 22).
19. The method according to any one of claims 13 to 18,
characterized in that
the light of the diffuse light reflected by the product (12) is analyzed by means of the processing
device in terms of hue, brightness and/or saturation.
20. The method according to any one of claims 13 to 19,
characterized in that
analysis image information associated with the projection devices (24, 26) is superimposed and
evaluated by means of the processing device.