Claims

~~1.~~ 1. An apparatus for defect detection in a work ~~pieces comprises~~piece comprising:

at least one light source for providing ~~an~~ illumination ~~light~~ of a wavelength range ~~at which the work piece is~~ transparent~~;~~

~~a camera with a lens, for imaging light from at least one face of~~ to the work piece ~~on a detector of the camera; and~~

~~a stage for moving the work piece and for imaging the at least one face of the work piece completely.~~

~~2. The apparatus as claimed in claim 1~~, wherein the ~~at least one illumination~~light source is ~~arranged such that~~ configured to direct illumination onto the work piece at a surface of a first face of the work piece and transmit the illumination ~~light is directed to one side face of the work piece and the camera receives the light exiting from a further side face of the work piece.~~

~~3. The apparatus as claimed in claim 2~~through the work piece, wherein ~~the further side face~~at least a portion of the illumination transmitted through the work piece is internally reflected by at least one of a top surface or a bottom surface of the work piece ~~is~~ before exiting the work piece at a surface of a second face of the work piece opposite the ~~side face of the work piece which receives the illumination light in order to obtain back-light~~first face, wherein one or more defects block illumination~~.~~

~~4. The apparatus as claimed in claim 2, wherein the further side face of the work piece is oriented such to the side~~ from exiting the second face of the work piece ~~which receives the illumination light that a dark-field image of the other side face is obtainable.~~;

a camera including a lens and a detector for collecting the illumination transmitted through the work piece and exiting from the surface of the second face of the work piece, wherein the camera is configured to image one or more defects within the work piece based on the collected illumination exited through the surface of the second face of work piece and the illumination blocked by the one or more defects; and

a stage for moving the work piece, wherein the stage and the camera are configured to impart a relative motion between the work piece and the camera to form one or more images from the illumination transmitted through the work piece and exiting

from the surface of the second face of the work piece.

2. The apparatus as claimed in claim 1, wherein the second face of the work piece is oriented to the first face of the work piece such that a dark-field image is obtainable.

~~5.~~ 3. The apparatus as claimed in claim 1, wherein the at least one ~~illumination~~light source is arranged such that the illumination ~~light~~ is directed to a top face of the work piece and the camera receives the ~~light shining out of~~illumination from the top face of the work piece.

~~6.~~ 4. The apparatus as claimed in claim 1, wherein the detector of the camera is a line sensor and the camera is configured as a line scan camera.

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~~7.~~ 5. The apparatus as claimed in claim ~~6~~4, wherein a lens of the camera ~~images~~ is configured to image a line of ~~light~~illumination exiting from a side face of the work piece onto the line sensor, wherein the

illumination exiting ~~light~~from the side face originates from at least one illumination source arranged such that ~~a backlight~~back-light illumination is obtained.

~~8.~~ 6. The apparatus as claimed in claim ~~7~~5, wherein a stage, ~~which~~that holds the work piece, is ~~moved~~configured to move along a scan direction ~~which~~that is perpendicular to the line to be imaged, such that a complete image of ~~at least~~ one ~~of the~~or more side faces of the work piece is generated.

~~9.~~ 7. The apparatus as claimed in claim ~~6~~4, wherein a lens of the camera ~~images~~ is configured to image a line of ~~light~~illumination from at least a portion of a top face of the work piece onto the line sensor, wherein the line of ~~light~~illumination is positioned adjacent to ~~one of the~~a side ~~faces~~face of the work piece and the at least one light source is arranged such that the ~~light~~illumination from the top face is coaxial to the ~~light~~illumination directed onto the top face of the work piece.

~~10.~~ 8. The apparatus as claimed in claim ~~9~~7, wherein a stage, ~~which~~that holds the work piece, is ~~moved~~configured to move along a scan direction, ~~which~~that is perpendicular to the line ~~to be imaged~~, such that a complete image of a portion of the top face, adjacent to at least one ~~of the~~ side ~~faces~~face of the work piece, is generated.

~~11.~~ 9. The apparatus as claimed in claim ~~6~~4, wherein an optical setup is provided to generate simultaneously an image of a line of ~~light~~illumination exiting from a side face of the work piece and an image of a line of ~~light~~illumination from a top face of the work piece, wherein the line of ~~light~~illumination from the top face is positioned adjacent to the line of ~~light~~illumination of the respective side face of the work piece.

~~12.~~ 10. The apparatus as claimed in claim ~~11~~9, wherein a front end of the optical setup carries a top mirror and a first bottom mirror and a second bottom mirror, the top mirror captures an image of the line of ~~light~~illumination from a portion of the top face of the work piece and the first bottom mirror and the second bottom mirror capture an image of a line of ~~light~~illumination exiting from a side face of the work piece.

~~13.~~ 11. The apparatus as claimed in claim ~~11~~9, wherein the optical setup is designed such

that the image of a line of ~~light~~illumination exiting from a side face of the work piece and the image of a line of ~~light~~illumination from a top face of the work piece are simultaneously in focus.

~~14.~~ 12. The apparatus as claimed in claim ~~11~~9, wherein ~~light~~illumination from the at least one light source ~~can be~~is coupled ~~seperately~~separately to ~~one~~a side face of the work piece and the top face of the work piece.

~~15.~~ 13. The apparatus as claimed in claim 1, wherein a light guide is positioned between the at least one light source and at least one of a top face ~~and/~~or a ~~respective~~ side face of the work piece.

~~16.~~ 14. The apparatus as claimed in claim 1, wherein the work piece is a singulated semiconductor device.

~~17.~~ 15. The apparatus as claimed in claim ~~16~~14, wherein the wavelength range of the illumination comprises infrared light ~~is the wavelength range of IR light.~~.

~~A method~~

~~18.~~ 16. An apparatus for defect detection in a work ~~pieces, the method~~piece comprising:

~~illuminating a portion of at least one face of the work piece with illumination light of a wavelength range at which the work piece is transparent;~~

~~imaging light from the portion of the at least one face of work piece on a detector of a camera; and~~

~~carrying out a relative movement of a stage, which holds the work piece and the camera, such that the at least one face of the work piece is imaged completely by the camera.~~

~~19. Method of claim 18, further comprising:~~

~~directing the illumination light of the at least one light source to one side face of the work piece; and~~

~~imaging with the camera light exiting from a further side face of the work piece.~~

~~20. Method of claim 19, wherein the camera images the light exiting from the further side face of the work piece onto a line sensor by means of a lens.~~

21. Method of claim 18, further comprising:

directing the illumination light of the at least one light source to a top face of the work piece; and

imaging with the camera light shining out of the top face of the work piece.

22. Method of claim 21, wherein the camera images the light exiting from the top face of the work piece onto a line sensor by means of a lens.

23. Method of claim 18, further comprising:

providing the camera with a line sensor; and

generating simultaneously with an optical setup a line image of light exiting from a side face of the work piece and a line image of light from a portion of a top face of the work piece, wherein the portion of the top face is positioned adjacent to the respective side face of the work piece.

24. Method of claim 23, wherein a front end of the optical setup carries a top mirror and two bottom mirrors, the top mirror captures the line image of light from a portion of the top face of the work piece and the two bottom mirrors capture a line image of light exiting from a side face of the work piece.

25. Method of claim 23, wherein the optical setup is designed such that the line image captured from the side face of the work piece and line image of the portion of the top face of the work piece are simultaneously in focus.

26. Method of claim 18, further comprising:

coupling light from at least one light source seperately to one side face of the work piece and the top face of the work piece.

27. Method of claim 18, wherein a light guide is positioned between the at least one light source and a top face and/or a respective side face of the work piece.

28. Method of claim 18, the moving a stage for imaging at least two side faces and the portion of the respective top face further comprising:

a) carrying out a linear, relative movement between the stage with the work piece and the camera so that an image plane of the camera is parallel to one of the side faces;

b) rotating the stage with the work piece; and

c) repeating step a) and b) until all side faces of the work piece are imaged by the camera.

29. Method of claim 28, wherein the linear, relative movement between the stage and the camera is realized by a linear movement of the camera only and the linear movement of the camera is oriented in opposite directions between the rotating steps.

30. Method of claim 18, the moving a stage further comprising: rotating the stage and in parallel carrying out a movement of the stage in the X/Y —plane, such that a focus point of the camera is kept during the rotational movement of the stage on a respective side face.

31. Method of claim 18, wherein the work piece is a semiconductor device.

32. Method of claim 31, wherein the wavelength range of the illumination light is the wavelength range of IR light.

33. An apparatus for defect detection in work pieces comprises:

at least one light source for providing an illumination light of a wavelength range at which the work piece is transparent, wherein the at least one light source is arranged such that the illumination light enters the work piece at one side face;

a camera with a lens, for imaging the light exiting from a further side face of the work piece on a line sensor of the camera;

at least one light source for providing illumination of a wavelength range transparent to the work piece, wherein the at least one light source is configured to direct illumination onto the work piece at a surface of a first face of the workpiece and transmit the illumination through the work piece, wherein at least a portion of the illumination transmitted through the work piece is internally reflected by at least one of a top surface or a bottom surface of the work piece before exiting the work piece at a surface of a second face of the workpiece opposite the first face, wherein the one or more defects block illumination from exiting the second face of the workpiece;

a camera, including a lens and a line sensor, for collecting the illumination transmitted through the work piece and exiting from the surface of the second face of the work piece, wherein the camera is configured to image one or more defects within the workpiece based on the collected illumination exited through the surface of the second face of work piece and the illumination blocked by the one or more defects;

a chuck for holding the work piece;

a stage for carrying the chuck; and

a control connected to a computer for providing a relative movement between the stage with the work piece and the camera ~~for imaging the at least one side face of the work piece completely~~, wherein the stage and the camera are configured to impart a relative motion between the work piece and the camera to form one or more images from the illumination transmitted through the work piece and exiting from the surface of the second face of the work piece.

~~34.~~ 17. The apparatus as claimed in claim ~~33~~16, wherein the stage is ~~moved~~ configured to move such that a focus of the camera is on ~~the~~a respective side face during the entire movement of the stage.

~~35.~~ 18. The apparatus as claimed in claim ~~33~~16, wherein the ~~further side face of the work piece is opposite the side face of the work piece which receives the illumination light in order to obtain back-light illumination.~~

~~36.~~ ~~The apparatus as claimed in claim 33, wherein the further side~~second face of the work piece is oriented ~~such~~ to the ~~side~~first face of the work piece ~~which receives the~~

illumination lightsuch that a dark field image of the further sidesecond face is obtainable.

37. 19. The apparatus as claimed in claim 3316, wherein a light guide is used to guide the illumination light from the at least one light source to thea respective side face of the work piece.

38. 20. The apparatus as claimed in claim 3316, wherein the work piece iscomprises a singulated semiconductor device.

39. 21. The apparatus as claimed in claim 3820, wherein the wavelength range of the illumination light is the wavelength range of IRcomprises infrared light.

40. 22. An apparatus for defect detection in a work pieces comprisespiece comprising:

at least one light source for providing an illumination light of a wavelength range at which the work piece is transparent to the work piece, wherein the at least one light source is arranged such that the illumination light is directed to a top face of the work piece;

a camera with a lens, for imaging the light shining out of the top face of the work piece on a line sensor of the camera;;

41. The apparatus as claimed in claim 40, wherein the at least one light source is arranged such that the light from the top face is coaxialconfigured to the light directed direct illumination onto the top face of the work piece.

42. The apparatus as claimed in claim 40, wherein at a surface of a light guide is used to guidefirst edge of the workpiece and transmit the illumination light from the at least one light source to the respective side face of the through the work piece.

43. The apparatus as claimed in claim 40, wherein the work piece is a singulated semiconductor device.

44. The apparatus as claimed in claim 43, wherein the wavelength range of the illumination light is the wavelength range of IR light.

45. An apparatus for defect detection in a work piece comprises:

at least one light source for providing an illumination light of a wavelength range at which the work piece is transparent, wherein the at least one light source is arranged such that the illumination light enters the work piece at one side face and from a top face;

a camera with a lens, for imaging light exiting from a further side face of the work piece on a line sensor of the camera and/or for imaging light from the top face of the work piece which is coaxial to the light directed onto the top face of the work piece;

an optical setup for simultaneously generating an image of a line of light exiting from the side face of the work piece and an image of a line of light from the top face of the work piece, wherein the line of light from a top face is positioned adjacent to the line of light of the respective side face of the work piece; and

a stage for moving the work piece and for imaging at least a portion of the top face of the work piece and the respective side face completely, wherein a scan direction is perpendicular to the lines to be imaged.

~~46. The apparatus as claimed in claim 45, wherein a light guide is provided to guide the illumination light from the at least one light source to the respective side face of the work piece and to an area of the top face of the work piece, which is adjacent to the respective side face of the work piece.~~

~~47. The apparatus as claimed in claim 45, wherein the wavelength range of the illumination light is the wavelength range of IR light.~~

~~48. The apparatus as claimed in claim 45, wherein the stage is a theta — stage.~~

~~49. A computer program product disposed on a non-transitory computer readable medium for defect detection in work pieces, the product comprising computer executable process steps operable to control a computer to:~~

~~place the work piece on a stage;~~

~~illuminate at least one face of the work piece with illumination light of a wavelength range at which the work piece is transparent;~~

~~direct light,~~illumination transmitted through the work piece is internally reflected by ~~means of an optical setup, from the least one face of the work piece to at least one line sensor of a camera for imaging a line of light of the least one face of the work piece~~at least one of a top surface or a bottom surface of the work piece before exiting the work piece at a surface of a second edge of the workpiece opposite the first edge, wherein one or more defects block illumination from exiting the second edge of the workpiece; and

~~move a stage, which holds the work piece, such that the at least one face of the work piece is imaged completely by the line sensor of the camera and is in focus of the camera during the movement of the stage.~~

~~50. The computer program product of claim 49, wherein the least one face of the work piece is a side face and the movement of the stage is composed of a linear and rotational movement of the stage, conducted one after the other, so that a focus of the camera remains on the side face of the work piece to be imaged.~~

~~51. The computer program product of claim 49, wherein the at least one face of the work piece is a side face and the movement of the stage is composed of a~~

~~simultaneous linear and rotational movement of the stage, so that a focus of the camera remains on the side face of the work piece to be imaged.~~

~~52. The computer program product of claim 49, wherein the at least one face of the work piece is a portion of a top face of the work piece located at an edge of the work piece and the movement of the stage is composed of a linear and a rotational movement of the stage, conducted one after the other, so that a focus of the camera remains on the portion of a top face of the work piece to be imaged.~~

~~53. The computer program product of claim 49, wherein the at least one face of the work piece is a portion of a top face and an adjacent side face of the work piece and the movement of the stage is composed of a linear and a rotational movement of the stage, conducted one after the other, so that a focus of the camera remains on the portion of a top face and the side face of the work piece to be imaged.~~a camera including a lens and a detector for collecting the illumination transmitted through the work piece and exiting from the surface of the second edge of the work piece, wherein the camera is further configured to image one or more defects within the workpiece based on the collected illumination exited through the surface of the second edge of work piece and the illumination blocked by the one or more defects.