

CLAIMS

1. Imaging device for locating structures (2, 3) through the surface of an object (20) such as a wafer, in order to position a measuring sensor (45, 46, 47) relative to said structures (2, 3), comprising:

- an imaging sensor (22),
- optical imaging means (34) capable of producing, on said imaging sensor (22), an image of the object (20) in a field of view,
- illuminating means (23, 27) for generating illuminating beams (25, 30) and lighting said field of view in reflection,

characterized in that the illuminating means (23, 27):

- are capable of generating illuminating beams (25, 30) the spectral content of which is suited to the nature of the object (20), so that the light of said illuminating beams (25, 30) is capable of penetrating into said object (20),
- are capable of producing a lighting of the "dark field" type with an illuminating beam (30) which is incident in the field of view along an axis of illumination forming with the optical axis (49) of the imaging device an angle greater than the angle (35) defining the numerical aperture of said imaging device, in such a way that only the light diffused on or in the object (20) in direction of the imaging device contributes to the image.

2. The device of claim 1, in which the illuminating means (23, 27) comprise a spectral filter (26, 29) capable of limiting the spectrum of the illuminating beam to wavelengths which are capable essentially of penetrating into the object (20).

3. The device of claim 2, in which the spectral filter (26, 29) comprises a plate made of a material identical or similar to a material of the object (20).

4. The device of one of claims 2 or 3, in which the spectral filter (26, 29) comprises a silicon plate.

5. The device of one of claims 2 to 4, in which the illuminating means (23, 27) also comprise:

- a light source (24, 28) capable of emitting light with a spectrum comprising first wavelengths capable essentially of being reflected by the surface of the object (20) and second wavelengths capable essentially of penetrating into the object (20), and

- switching means for inserting the spectral filter (26, 29) into, or withdrawing it from, the illuminating beam.

6. The device of claim 1, in which the illuminating means (23, 27) comprise a light source capable of emitting a light the spectrum of which is limited to wavelengths capable essentially of penetrating into the object (20).

7. The device of claim 6, in which the illuminating means (23, 27) also comprise a second light source capable of emitting a light the spectrum of which is limited to wavelengths capable essentially of being reflected by the surface of the object (20).

8. The device of one of the preceding claims, which further comprises an illuminating beam (25) incident in the field of view along an axis of illumination substantially parallel to the optical axis (49) of the imaging system.

9. The device of one of the preceding claims, which also comprises a source of light in transmission (32) arranged so as to illuminate the field of view in transmission, through the object (20).

10. The device of one of the preceding claims, in which the imaging sensor (22) comprises a CCD- or CMOS-type sensor on a silicon substrate.

11. System for carrying out dimensional measurements on an object (20) such as a wafer, characterized in that it comprises at least one optical sensor for measuring thickness and/or distance (45, 46, 47), and an imaging device according to any one of the preceding claims.

12. The system of claim 11, which also comprises at least one optical sensor for measuring thickness and/or distance (46) based on a principle of time-domain low-coherence interferometry.

13. The system of one of claims 11 or 12, which also comprises at least one optical sensor for measuring thickness and/or distance (45) based on a principle of spectral-domain low-coherence interferometry, or optical frequency scanning interferometry.

14. The system of one of claims 11 to 13, which comprises at least one optical sensor for measuring thickness and/or distance (45, 46) with a measurement beam passing through the distal objective (36) of the optical imaging means.

15. The system of one of claims 11 to 14, which also comprises at least one optical sensor for measuring thickness and/or distance (47), of the chromatic confocal type.

16. The system of one of claims 11 to 15, which comprises at least two optical sensors for measuring thickness and/or distance (45, 46, 47) arranged respectively, one on a surface of the object on the side of the optical imaging means and the other on a surface opposite said object (20).

17. Method for measuring the residual thickness of material (9) between a surface of a wafer (20) and structures (3) such as vias, characterized in that it comprises steps of:

- locating said structures (3) through said surface of the wafer (20) by means of an imaging device according to one of claims 1 to 11,
- positioning an optical sensor for measuring thickness and/or distance (45, 46, 47) opposite said structure (3), and
- measuring the residual thickness of material (9).

CLAIMS

1. Imaging device for locating structures (2, 3) through the surface of an object (20) such as a wafer, in order to position a measuring sensor (45, 46, 5 47) relative to said structures (2, 3), comprising:
- an imaging sensor (22),
 - optical imaging means (34) capable of producing, on said imaging sensor (22), an image of the object (20) in a field of view,
 - illuminating means (23, 27) for generating illuminating beam(s) (25, 10 30) and lighting said field of view in reflection, characterized in that the illuminating means (23, 27):
 - are capable of generating illuminating beam(s) (25, 30) the spectral content of which is suited to the nature of the object (20), so that the light of said illuminating beam(s) (25, 30) is capable of penetrating into said object 15 (20),
 - are capable of producing a lighting of the "dark field" type with an illuminating beam (30) which is incident in the field of view along an axis of illumination forming with the optical axis (49) of the imaging device an angle greater than the angle (35) defining the numerical aperture of said imaging 20 device, in such a way that only the light diffused on or in the object (20) in direction of the imaging device contributes to the image.
2. The device of claim 1, in which the illuminating means (23, 27) comprise a spectral filter (26, 29) capable of limiting the spectrum of the 25 illuminating beam to wavelengths which are capable of penetrating into the object (20).
3. The device of claim 2, in which the spectral filter (26, 29) comprises a plate made of a material identical or similar to a material of the object (20). 30
4. The device of one of claims 2 or 3, in which the spectral filter (26, 29) comprises a silicon plate.
5. The device of one of claims 2 to 4, in which the illuminating means 35 (23, 27) also comprise:

- a light source (24, 28) capable of emitting light with a spectrum comprising first wavelengths capable of being reflected by the surface of the object (20) and second wavelengths capable of penetrating into the object (20), and

5 - switching means for inserting the spectral filter (26, 29) into, or withdrawing it from, the illuminating beam.

6. The device of claim 1, in which the illuminating means (23, 27) comprise a light source capable of emitting a light the spectrum of which is
10 limited to wavelengths capable of penetrating into the object (20).

7. The device of claim 6, in which the illuminating means (23, 27) also comprise a second light source capable of emitting a light the spectrum of which is limited to wavelengths capable of being reflected by the surface of
15 the object (20).

8. The device of one of the preceding claims, which further comprises an illuminating beam (25) incident in the field of view along an axis of illumination substantially parallel to the optical axis (49) of the imaging
20 system.

9. The device of one of the preceding claims, which also comprises a source of light in transmission (32) arranged so as to illuminate the field of view in transmission, through the object (20).
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10. The device of one of the preceding claims, in which the imaging sensor (22) comprises a CCD- or CMOS-type sensor on a silicon substrate.

11. System for carrying out dimensional measurements on an object
30 (20) such as a wafer, characterized in that it comprises at least one optical sensor for measuring thickness and/or distance (45, 46, 47), and an imaging device according to any one of the preceding claims.

12. The system of claim 11, which also comprises at least one optical sensor for measuring thickness and/or distance (46) based on a principle of time-domain low-coherence interferometry.

5 **13.** The system of one of claims 11 or 12, which also comprises at least one optical sensor for measuring thickness and/or distance (45) based on a principle of spectral-domain low-coherence interferometry, or optical frequency scanning interferometry.

10 **14.** The system of one of claims 11 to 13, which comprises at least one optical sensor for measuring thickness and/or distance (45, 46) with a measurement beam passing through the distal objective (36) of the optical imaging means.

15 **15.** The system of one of claims 11 to 14, which also comprises at least one optical sensor for measuring thickness and/or distance (47), of the chromatic confocal type.

20 **16.** The system of one of claims 11 to 15, which comprises at least two optical sensors for measuring thickness and/or distance (45, 46, 47) arranged respectively, one on a surface of the object on the side of the optical imaging means and the other on a surface opposite said object (20).

25 **17.** Method for measuring the residual thickness of material (9) between a surface of a wafer (20) and structures (3) such as vias, characterized in that it comprises steps of:

- locating said structures (3) through said surface of the wafer (20) by means of an imaging device according to one of claims 1 to 11,
- positioning an optical sensor for measuring thickness and/or distance (45, 46, 47) opposite said structure (3), and
- 30 - measuring the residual thickness of material (9).