

CLAIMS

1. A method for optically checking by interferometry the thickness of an object being machined by a machine tool, said thickness extending from an external surface, that cooperates with the machine tool, to an internal surface of discontinuity of the object; the method comprising the steps of:

- 10 - emitting low coherence incident radiations by means of a radiation source;
- focusing by means of at least one optical probe the incident radiations on the object being machined, said at least one optical probe being part of a detection system;
- 15 - receiving and detecting, by means of said detection system, primary reflected radiations generated by a reflection on the external surface of the object, and concurrent reflected radiations;
- 20 - analysing by means of a spectrometer a spectrum of the result of interference between said primary reflected radiations and concurrent reflected radiations; and
- processing on the basis of the analysis of the spectrum of the result of interference between the primary reflected radiations and the concurrent reflected radiations, information about the thickness of the object being machined;

the method comprising a phase of direct checking wherein said concurrent reflected radiations are secondary reflected radiations generated by a reflection on the internal surface of discontinuity of the object; and

wherein the method further comprises a preliminary phase wherein said concurrent reflected radiations are

reference reflected radiations, generated by a reflection of said incident radiations on a reference surface, the reference surface being adapted to define the length of a reference optical path, and to delimit and define, together
5 with said external surface of the object, a virtual thickness related to the thickness of the object;

wherein the step of processing information about the thickness of the object being machined includes checking variations of the virtual thickness; and

10 wherein the direct-checking phase occurs subsequent to the preliminary phase, and wherein the thickness of the object during the preliminary phase is greater than the thickness of the object during the direct-checking phase.

15 2. The method according to claim 1, wherein said reference surface is virtual and defined by an optical system.

20 3. The method according to claim 1, for checking the thickness of an object being machined by a machine tool comprising a tool that cooperates with said external surface of the object and is movable with respect to said detection system along a machining direction, wherein the length of said reference optical path does not change
25 during the machining.

4. The method according to claim 1, wherein said reference surface is in a fixed position with respect to the detection system.

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5. The method according to claim 1, comprising the further step of checking, on the basis of the analysis of the spectrum of the result of interference between the

primary reflected radiations and the concurrent reflected radiations, when the secondary reflected radiations are received and detected by said at least one optical probe.

- 5 6. A method for optically checking by interferometry the thickness of an object being machined by a machine tool, said thickness extending from an external surface, that cooperates with the machine tool, to an internal surface of discontinuity of the object; the method
- 10 comprising the steps of:
- emitting low coherence incident radiations by means of a radiation source;
 - focusing by means of at least one optical probe the incident radiations on the object being machined,
 - 15 said at least one optical probe being part of a detection system;
 - receiving and detecting, by means of said detection system, primary reflected radiations generated by a reflection on the external surface of
 - 20 the object, and concurrent reflected radiations;
 - analyzing by means of a spectrometer a spectrum of the result of interference between said primary reflected radiations and concurrent reflected radiations; and
 - 25 - processing on the basis of the analysis of the spectrum of the result of interference between the primary reflected radiations and the concurrent reflected radiations, information about the thickness of the object being machined;
 - 30 the method comprising a phase of direct checking wherein said concurrent reflected radiations are secondary reflected radiations generated by a reflection on the internal surface of discontinuity of the object; and

wherein the method further comprises a preliminary phase wherein said concurrent reflected radiations are reference reflected radiations, generated by a reflection of said incident radiations on a reference surface, the
5 reference surface being adapted to define the length of a reference optical path, and to delimit and define, together with said external surface of the object, a virtual thickness related to the thickness of the object;

wherein the method further comprises the step of
10 checking, on the basis of the analysis of the spectrum of the result of interference between the primary reflected radiations and the concurrent reflected radiations, when the secondary reflected radiations are received and detected by said at least one optical probe; and

15 wherein the phase of direct checking is started when the secondary reflected radiations are received and detected by said at least one optical probe.

7. The method according to claim 1, wherein, when
20 the phase of direct checking is started, the preliminary phase is stopped.

8. The method according to claim 1, wherein the step of receiving and detecting the primary reflected
25 radiations generated by the reflection on the external surface of the object, and the concurrent reflected radiations, comprises receiving and detecting the reference reflected radiations by means of said at least one optical probe, and receiving and detecting the
30 secondary reflected radiations by means of an additional optical probe, the latter being part of the detection system.

9. The method according to claim 1, for checking the thickness of a slice of semiconductor material while the slice is rotating.

5 10. The method according to claim 1, for checking the thickness of a slice of highly doped silicon.

11. The method according to claim 1, for checking the thickness of an object comprising multiple layers of semiconductor material, said layers being separated by at least one further internal surface of discontinuity of the object, and the reference surface, together with each internal surface of discontinuity, delimiting and defining virtual thicknesses, the method being characterized by the following further steps:

- receiving and detecting, by means of said at least one optical probe, intermediate reflected radiations generated by a reflection on said at least one further internal surface of discontinuity;
- 20 - processing information about each of said virtual thicknesses on the basis of the spectrum of the result of interference between the reference reflected radiations and the intermediate and secondary reflected radiations;
- 25 - processing information about the thickness and the relative location of said layers on the basis of said information about each of said virtual thicknesses.

30 12. An apparatus for optically checking by interferometry the thickness of an object being machined by a machine tool, said thickness extending from an external surface, that cooperates with the machine tool, to an

internal surface of discontinuity of the object, the apparatus comprising:

- a radiation source, adapted to emit low coherence incident radiations;
- 5 - a detection system comprising at least one optical probe, connected to the radiation source and facing the object to be checked to focus the incident radiations emitted by the radiation source on the external surface and adapted to receive and detect
10 primary reflected radiations and secondary reflected radiations respectively generated by a reflection on the external surface and by a reflection on the internal surface of discontinuity of the object;
- a spectrometer, connected to said detection
15 system, adapted to analyse a spectrum of the result of interference between said primary reflected radiations and secondary reflected radiations;
- a processing unit, connected to said
20 spectrometer, adapted to process, on the basis of the analysis of the spectrum of the result of interference between the primary reflected radiations and the secondary reflected radiations, information about the thickness of the object being machined;
- an optical reference with a reference surface
25 adapted to define the length of a reference optical path, and, together with said external surface of the object, to delimit and define a virtual thickness related to the thickness of the object;
- the processing unit being adapted to process
30 information about variations of the virtual thickness, indicative of variations of the thickness of the object being machined, when no secondary reflected

radiations are received and detected by said at least one optical probe.

13. The apparatus according to claim 12, wherein said
5 optical reference comprises an optical system and said reference surface is virtual.

14. The apparatus according to claim 12, wherein the
reference surface is in a fixed position with respect to
10 said detection system and the length of said reference optical path does not change during the machining.

15. The apparatus according to claim 12, wherein the
processing unit is adapted to verify that the secondary
15 reflected radiations are received and detected by means of said at least one optical probe.