Method for treating millimetre and/or micrometre and/or nanometre structures on a surface of a substrate

Description

Countless methods for treating the surface of substrates, in particular wafers, exist in the prior art. A very important aspect of the processing of substrates is constituted by processing on both sides. With processing on both sides, both sides of the substrate are treated, in particular in succession. Here, it is necessary to suitably protect the fixing side, i.e. the side that is not processed. The protection is necessary so as not to destroy the substrate side as a result of the fixing. In the prior art there exist many materials which are used for the protection of a substrate side during the fixing on a sample holder. These materials are preferably polymers, which, after application to the substrate upper side, are brought into a first state by chemical and/or physical process, which state optimally protects the structures of the fixed substrate side.

The problem with the materials lies in the removal thereof. Most materials are cured, in particular cross-linked, by chemical processes. This results in a certain tendency to adhere to the structures of the substrate surface. Furthermore, removal of the materials from the interstices of the structures becomes more difficult the longer is the polymer chain, the greater is the adhesive strength, and the greater the viscosity of the polymer.

Embodiments of the present invention disclose a method with which the structures on the surface of the substrate can be optimally protected, but at a later moment in time a removal that is as simple as possible can be performed.

According to a first aspect of the present invention, there is provided a method for treating a substrate having a first surface and a second surface, wherein the method includes: providing a substrate having millimetre and/or micrometre and/or nanometre structures on at least the first surface, wherein the structures are produced by an imprinting process, applying at least one protective material to the structures on the first surface, wherein the at least one protective material can be dissolved in a solvent, fixing the first surface having the at least one protective material applied thereto to a sample holder, and processing the second surface while the first surface is fixed to the sample holder.

According to a second aspect of the present invention, there is provided a method for processing a substrate, said method including: delivering a substrate by use of a delivery unit, the substrate having first and second surface, applying and/or arranging millimetre and/or micrometre and/or nanometre structures on at least the first surface of the substrate, wherein the structures are produced by an imprinting process, applying at least one protective material to the structures on the first surface, wherein the at least one protective material can be dissolved in a solvent, fixing the first surface having the at least one protective material applied thereto to a sample holder, and processing the second surface while the first surface is fixed to the sample holder, and receiving the substrate at a storage unit.

According to a third aspect of the present invention, there is provided a facility for processing a substrate, said facility including: a delivery unit for delivering a substrate, the substrate having first and second surface, a processing unit for applying and/or arranging millimetre and/or micrometre and/or nanometre structures on at least the first surface of the substrate, wherein the structures are produced by an imprinting process, an application means for applying at least one protective material to the structures on the first surface, wherein the at least one protective material can be dissolved in a solvent, fixing means for fixing the first surface having the at least one protective material applied thereto to a sample holder, and processing unit for processing the second surface while the first surface is fixed to the sample holder, and a storage unit for receiving the substrate.

According to a fourth aspect of the present invention, there is provided a product including a substrate with millimetre and/or micrometre and/or nanometre structures, at least one protective material on the structures, and a sample holder on the at least one protective material, wherein the product is produced according the above method and/or the above facility.

All combinations of at least two features specified in the description, the claims and/or the drawings also fall within the scope of the invention. Where value ranges are specified, values lying within the specified limits are also disclosed as limit values and can be claimed in any combination.

In accordance with embodiments of the invention, a method for treating a substrate having millimetre and/or micrometre and/or nanometre structures is proposed, wherein at least one protective material is applied to the structures, wherein the at least one protective material can be dissolved in a solvent.

The process according to embodiments of the invention allows the protection of a structured surface, in particular provided by 3D structures. The structured surface has been produced in particular by an imprint process. However, production by hot stamping processes, photolithographic processes, etching processes, etc. are also conceivable.

One or more structures worthy of protection is/are disposed on the substrate surface of the substrate. For the sake of simplicity, reference will usually be made hereinafter to structures in the plural. These structures can be microchips, MEMs, cavities, LEDs, stores, but in particular embossed structures. The structures are coated by a protective material according to embodiments of the invention.

The concept according to embodiments of the invention consists of the use of a protective material-solvent combination. The protective material-solvent combination must be designed such that a solution of the protective material in the solvent is produced in an optimal manner in accordance with the principle “like mixes with like”. Here, the solvent is used as a cleaning agent in order to remove the protective material from a substrate surface after a predefined number of process steps.

The protective material protects the structures from all types of loads which occur on the substrate surface and/or the opposing, second

Claims

1. A method for treating a substrate (2, 2') having a first surface and a second surface, wherein the method comprises:

providing a substrate having millimetre and/or micrometre and/or nanometre structures (3) on at least the first surface, wherein the structures (3) are produced by an imprinting process,

applying at least one protective material (4, 4') to the structures (3) on the first surface, wherein the at least one protective material (4, 4') can be dissolved in a solvent,

fixing the first surface having the at least one protective material (4, 4') applied thereto to a sample holder, and

processing the second surface while the first surface is fixed to the sample holder.

2. The method according to claim 1, wherein the method comprises arranging the at least one protective material (4, 4') as at least one protective layer (4, 4') on the structures (3), wherein the at least one protective material (4, 4') fully covering the structures (3).

3. The method according to claim 1, wherein the at least one protective material (4, 4') is applied by centrifugal coating, spray coating, lamination and/or immersion.

4. The method according to claim 1, wherein the method further comprises:

chemically and/or physically modifying the at least one protective material (4, 4') after applying the at least one protective material (4, 4') to the structures.

5. The method according to claim 4, wherein the chemical and/or physical modification comprises a curing, an increase in viscosity and/or an increase in elasticity of the at least one protective material (4, 4').

6. The method according to claim 1, wherein a first protective material and a second protective material (4') are applied to the structures.

7. The method according to claim 6, wherein the second protective material (4') is different from the first applied protective material (4) (4).

8. The method according to claim 1, wherein a plurality of protective layers (4, 4') are arranged over the structures (3).

9. The method according to claim 8, wherein the plurality of protective layers (4, 4') comprise different protective materials (4, 4').

10. The method according to claim 1, wherein the at least one protective material (4, 4') comprises one of the following substances or a mixture of the following substances:
- paraffins
- polymers.

11. The method according to claim 10, wherein the paraffins comprise petrolatum.

12. The method according to claim 11, wherein the petrolatum comprises wax.

13. The method according to claim 12, wherein the wax comprises ceresin.

14. The method according to claim 10, wherein the polymer is selected from the group consisting of photoresists in general, poly(methyl methacrylates), poly(methyl glutarimides), phenol formaldehyde resins, epoxies, polyimides, polyamides, silanes, silicons, PDMS (protective film and removal material), PFPE or acrylates.

15. The method according to claim 14, wherein the phenol formaldehyde resins comprise Bakelite.

16. The method according to claim 14, wherein the epoxies comprise SU-8.

17. The method according to claim 1, wherein the at least one protective material (4, 4') comprises one of the following substances or a mixture of the following substances:

- polyvinyl alcohol
- polyethers
- cellulose ethers
- poly(2-ethyl-2-oxazolines)
- alcohols
- sugar
- carboxylic acid compounds in plastics
- benzotriazole.

18. The method according to claim 17, wherein the polyether comprises polyethylene glycol.

19. The method according to claim 17, wherein the alcohol comprises glycerol.

20. The method according to claim 19, wherein the glycerol comprises fats.

21. The method according to claim 20, wherein the fats comprises triacylglycerols.

22. The method according to claim 1, wherein the at least one protective material 4, 4' can be dissolved by one of the following solvents or by a solvent mixture of the following solvents:
    - alkanes
    - alkenes
    - alkines
    - aromatics
    - carboxylic acid esters
    - ethers
    - tetramethylsilane
    - tetrahydrogen chloride
    - carbon disulfide
    - benzene
    - chloroform
    - gases.

23. The method according to claim 22, wherein the aromatic comprises benzene.

24. The method according to claim 22, wherein the ether comprises diethylether.

25. The method according to claim 22, wherein the gas comprises carbon monoxide.

26. The method according to claim 1, wherein the at least one protective material 4, 4’ can be dissolved by one of the following solvents or by a solvent mixture of the following solvents:
- water
- alcohols
- ketones
- amines,
- lactones
- lactams
- nitriles
- nitro compounds
- tertiary carboxylic acid amides
- urea derivatives
- sulfoxides
- sulfones
- carbonate esters
- acids
- formic acid, acetic acid
- bases
- gases.

27. The method according to claim 26, wherein the alcohol comprises methanol or ethanol.

28. The method according to claim 26, wherein the ketone comprises acetone.

29. The method according to claim 26, wherein the amine comprises one of primary and secondary amines.

30. The method according to claim 26, wherein the sulfone comprises sulfolane.

31. The method according to claim 26, wherein the carbonate ester comprises dimethyl carbonate or ethylene carbonate.

32. The method according to claim 26, wherein the acid comprises mineral acid or organic acid.

33. The method according to claim 32, wherein the mineral acid comprises sulfuric acid or halogen hydracids.

34. The method according to claim 32, wherein the organic acid comprises carboxylic acid.

35. The method according to claim 34, wherein the carboxylic acid comprises formic acid or acetic acid.

36. The method according to claim 26, wherein the base comprises NaOH or KOH.

37. The method according to claim 26, wherein the gas comprises hydrogen, oxygen or nitrogen.

38. A method for processing a substrate (2, 2'), said method comprising:
    a) delivering a substrate (2, 2’) by use of a delivery unit (9), the substrate having first and second surface,
    b) applying and/or arranging millimetre and/or micrometre and/or nanometre structures (3) on at least the first surface of the substrate (2, 2’), wherein the structures (3) are produced by an imprinting process,
    c) applying at least one protective material (4, 4’) to the structures (3) on the first surface, wherein the at least one protective material (4, 4’) can be dissolved in a solvent,
    d) fixing the first surface having the at least one protective material (4, 4') applied thereto to a sample holder, and
    e) processing the second surface while the first surface is fixed to the sample holder, and
    f) receiving the substrate (2, 2’) at a storage unit (9’’’).

39. The method according to claim 38, wherein the substrate comprises a film.

40. The method according to claim 38, wherein the millimetre and/or micrometre and/or nanometre structures (3) are applied and/or arranged on both sides of the substrate (2, 2’).

41. The method according to claim 38, wherein the at least one protective material (4, 4’) is applied to the structures (3) on both sides of the substrate (2, 2’).

42. A facility (8, 8') for processing a substrate (2, 2'), said facility comprising:

a) a delivery unit (9) for delivering a substrate (2, 2’), the substrate having first and second surface,
b) a processing unit (9’, 9’’) for applying and/or arranging millimetre and/or micrometre and/or nanometre structures (3) on at least the first surface of the substrate (2, 2’), wherein the structures (3) are produced by an imprinting process,
c) an application means (7, 7’) for applying at least one protective material (4, 4’) to the structures (3) on the first surface , wherein the at least one protective material (4, 4’) can be dissolved in a solvent,
d) fixing means for fixing the first surface having the at least one protective material (4, 4') applied thereto to a sample holder, and
e) processing unit for processing the second surface while the first surface is fixed to the sample holder, and
f) a storage unit (9’’’) for receiving the substrate (2, 2’).

43. A product (1, 1', 1'', 1''') comprising a substrate with millimetre and/or micrometre and/or nanometre structures, at least one protective material on the structures, and a sample holder on the at least one protective material, wherein the product is produced using the method according to claims 1-41 and/or the facility according to claim 42.