

THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 32

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte ADRIAAN F.M. LEENAARS,
and JACQUES J. VAN DEKEL

Appeal No. 94-3000
Application 07/914,654¹

ON BRIEF

Before KIMLIN, WEIFFENBACH and PAK, Administrative Patent Judges.

PAK, Administrative Patent Judge.

DECISION ON APPEAL

¹ Application for patent filed July 15, 1992. According to applicants, this application is a continuation of Application 07/701,295, filed May 13, 1991, now abandoned, which is a continuation of Application 07/467,718, filed January 19, 1990, now abandoned.

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Adrian F.M. Leenaars et al. (Appellants) appeal from the examiner's final rejection of claims 17 through 23, 25 and 26, which are all the claims remaining in the application.

The subject matter on appeal is directed to a process for cleaning and drying substrates, such as silicon wafers, and an apparatus for carrying out the process. Claims 21 and 25 are representative of the subject matter on appeal and read as follows:

21. An apparatus for treating substrates comprising

(a) container means for containing a bath of a liquid,

(b) holding means for immersing at least one substrate into said bath,

(c) lifting means for lifting said at least one substrate from said bath at a speed such that substantially all of said liquid remains in said bath, said lifting means including knife-shaped means for pushing said at least one substrate upwardly at a lowest portion of said at least one substrate,

(d) gripping means for gripping dried parts of said at least one substrate above said bath after withdrawal from said bath, and

(e) means having outlet nozzles for passing vapor of an organic solvent directly onto said at least one substrate immediately upon leaving said bath, said vapor being free of condensation of said at least one substrate, said organic solvent being chosen from a group of organic solvents which are miscible with a liquid which is the same as said liquid

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used in said bath, and said organic solvent forming with said liquid a mixture having a surface tension lower than that of said liquid alone,

wherein contaminants and drying marks are substantially eliminated from said at least one substrate.

25. A method of treating substrates comprising the steps of

(a) immersing at least one substrate into a bath of a liquid,

(b) maintaining said at least one substrate in said bath for a given time period,

(c) withdrawing said at least one substrate from said bath at a speed such that substantially all of said liquid remains in said bath, and

(d) directly contacting said at least one substrate with a vapor of an organic solvent immediately upon leaving said bath, said vapor being free of condensation on said at least one substrate upon withdrawing said at least one substrate from said bath, said organic solvent being chosen from a group of organic solvents which are miscible with a liquid which is the same as said liquid used in said bath, and said organic solvent forming with said liquid a mixture having a surface tension lower than that of said liquid alone,

wherein contaminants and drying marks are substantially eliminated from said at least one substrate by said step (d).

The references of record relied upon by the examiner are:

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Steck	4,722,752	Feb. 2, 1988 (Filed June 16, 1986)
Kremer	4,828,751	May 9, 1989 (Filed Aug. 28, 1987)
Kurokawa et al (Kurokawa)	5,105,556	Apr. 21, 1992 (Filed Aug. 9, 1988)

Claims 17 through 23, 25 and 26 stand rejected under 35 U.S.C. § 103 as unpatentable over the combined disclosures of Steck, Kremer and Kurokawa.

We have carefully reviewed the entire record, including each of the arguments and comments advanced by appellants and the examiner in support of their respective positions. This review leads us to conclude that only the examiner's rejection of process claims 17 through 20, 25 and 26 is well-founded. Accordingly, we shall affirm the rejection of process claims 17 through 20, 25 and 26, but reverse the rejection of apparatus claims 21 through 23. Our reasons for these determinations follow.

At the outset, we note appellants' argument that "each of the claims [is] separately patentable over the prior art.." See Brief, page 5. To the extent appellants have argued the limitations of each claim separately consistent with 37 CFR

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§ 1.192 (c)(7)(1993), we shall treat the claims separately.

The examiner has rejected process claims 17 through 20, 25 and 26 under § 103 as unpatentable over the combined disclosures of Steck, Kremer and Kurokawa. As indicated by the examiner at pages 2 and 3 of the answer, the Steck reference discloses a method for rinsing and drying substrates, such as silicon wafers. The silicon wafers are initially submerged in a tank containing high purity, hot deionized water. See Steck, column 2, lines 7-9. The hot deionized water flowing in a laminar flow removes particulate contaminants. See Steck, column 1, lines 54-60 and column 2, lines 9-12. The resulting wafers are efficiently dried by slowly withdrawing them from the tank. See Steck, column 4, lines 4-15 and column 2, lines 19-21.

The examiner, however, recognized that Steck does not disclose directly contacting the withdrawn wafers with a vapor of an organic solvent during the drying step. See answer, page 3. This recognition led to reliance on the Kremer and Kurokawa references. The Kremer reference discloses a conventional wafer drying technique employing vapor dryers utilizing isopropyl alcohol as a drying agent after cleaning

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the wafer with deionized water. See column 1, lines 19-28. This conventional drying technique is said to create "a significant amount of waste over the period of a month, for example, and also a significant fire hazard." See column 1, lines 28-30.

Similarly, the Kurokawa reference discloses three different conventional drying techniques which are known to remove water drops on the wafers. See column 1, lines 22-37. One of the conventional drying techniques involves employing vapor of organic solvent, such as isopropyl alcohol (IPA). See column 1, lines 38-48. According to column 2, lines 6-12 of Kurokawa, "although the IPA vapor drying method is less sensitive to the influence of impurities in the ultra-pure water since the water that is used in the washing is replaced with IPA, it has the problem of adhesion of impurities in the IPA due to the dispersion of IPA mist and the problem of replacement between the IPA and the water."

At issue is, therefore, whether the use of a conventional IPA vapor drying method to dry the water-treated wafers withdrawn from a deionized water containing tank as taught by

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Steck would have been obvious to one of ordinary skill in the art.

We find ourselves in agreement with the examiner that it would have been obvious to one of ordinary skill in the relevant art to employ the conventional vapor drying method in the drying step of Steck with the reasonable expectation of obtaining dried silicon wafers (dried of the water to less than 3 nm) having reduced water spots and drops in an effective manner. In reaching this conclusion, we find that the advantages of employing the conventional vapor drying technique far outweigh the disadvantages of employing the same. As can be seen from the disclosures of both the Kremer and the Kurokawa references, the conventional vapor drying technique is one of the few, which is commercially available for the purpose of drying the wafers after cleaning them with water. It, like the drying technique of Steck (slowly withdrawing wafers from a water tank), is useful for removing water spots and drops from the wafers. When the drying technique of Steck is used in conjunction with this conventional vapor drying technique, one of ordinary skill in the relevant art would have reasonably expected to obtain an

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additive drying effect. That is, one of ordinary skill in the art would have recognized that the reduced amount of the IPA vapor can be employed during the drying step of Steck to obtain the enhanced effect of removing water spots and drops on the wafers, with the minimum negative effect associated with using a large volume of the IPA vapor.

Appellants appear to argue at page 1 of the reply brief that

a vapor of the organic solvent referred to by the Kremer and the Kurokawa references is not free of condensation. We, however, note that the term "vapor" by definition means free of condensation.² Appellants simply have not proffered any objective evidence to demonstrate that the IPA vapor used in the conventional vapor drying technique contains condensation. See In re Greenfield, 571 F.2d 1185, 1189, 197 USPQ 227, 230 (CCPA 1978) (Counsel's arguments and conclusory statements must be supported by objective evidence and cannot take the place of such evidence).

² According to page 617 of Grant & Hackh's Chemical Dictionary, Fifth Edition, 1987 (attached herewith), vapor is "[a] gas, especially from a substance that at ordinary temperature is a solid or liquid".

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Appellants also appear to argue that the IPA (isopropyl alcohol) vapor does not have the claimed properties, including miscibility. Appellants, however, acknowledge that the claimed 2-propanol vapor has such properties. See the dependent claims. It then follows that the isopropyl alcohol vapor (which is otherwise known as 2-propanol vapor) of the Kremer and the Kurokawa references, has the claimed properties.

Further, appellants appear to argue that the preferred embodiments of the Kremer and Kurokawa references are directed to employing solvents having different properties than those claimed for the purposes of cleaning and drying silicon wafers. However, we cannot limit our focus to the preferred embodiments of the prior art references only. We need to consider all the prior art references in their entirety. In re Boe, 355 F.2d 961, 965, 148 USPQ 507, 510 (CCPA 1966) ("we concluded... the claimed invention obvious to those of ordinary skill in the art despite the fact that the art teachings relied upon in all three cases were phrased in terms of a non-preferred embodiment..."). Upon taking into consideration the non-preferred embodiments of the Kremer and

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the Kurokawa references as discussed above, we determine, as indicated supra, that it would have been obvious to employ the conventional IPA vapor drying method in the drying step of Steck.

Moreover, appellants appear to argue that the showing in the Table at page 11 of the specification establishes the criticality of the claimed particular solvents over other solvents. Appellants, however, do not refer to any comparison between the closest prior art, a conventional drying process employing 2-propanol vapor, and the claimed invention. In re Merchant, 575 F.2d 865, 868, 197 USPQ 785, 787 (CCPA 1978). Nor do appellants demonstrate that the showing in the Table is commensurate in scope with the claims to which it pertains. In re Dill, 604 F.2d 1356, 1361, 202 USPQ 805, 808 (CCPA 1979). While the showing is limited to silicon wafers treated with specific steps and solvents under particular conditions, none of the claims is so limited.

Under the circumstances recounted above, it is our determination that the evidence of record for and against obviousness, on balance, weighs most heavily in favor of an obviousness conclusion. Accordingly, we shall sustain the

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examiner's rejection of process claims 17 through 20, 25 and 26.

The rejection of apparatus claims 21 through 23 as being unpatentable over the disclosures of the Steck, Kremer and Kurokawa references, however, is on a different footing. Appellants state that none of the references relied upon by the examiner renders the claimed lifting means obvious or anticipated. The lifting means recited in claim 21 read as follows:

(c) lifting means for lifting said at least one substrate from said bath at a speed such that substantially all of said liquid remains in said bath, said lifting means including knife-shaped means for pushing said at least one substrate upwardly at a lowest portion of said at least one substrate,

We interpret this means-plus-function limitations as the corresponding structure in the specification or equivalents thereof. See, e.g., In re Donaldson Co. Inc., 16 F.3d 1189, 29 USPQ2d 1845 (Fed. Cir. 1994)(in banc); Laitram Corp v. Rexnord, Inc., 939 F.2d 1533, 1536, 19 USPQ2d 1367, 1369 (Fed. Cir. 1991) ("[t]he recitation of some structure in a means plus function element does not preclude the applicability of

section 112(6)"). According to pages 5, 6, 7 and 10 of the specification, the lifting means is described as follows:

The invention further relates to an arrangement for carrying out the method mentioned in the opening paragraph, this arrangement being provided with a lifting member for lifting the substrates above the liquid and with means for gripping the dry substrates above the liquid.

... On the lower side of the substrates, which in the known arrangement are taken from the liquid, a drop of liquid sticks. In order to avoid this, the arrangement according to the invention is provided with a knife-shaped member, which supports the substrates when lifted from the liquid at those parts of the substrates which are the last to leave the liquid. The drops then flow away via the knife-shaped member.

... Further, the arrangement comprises a lifting member 15, which can be moved upwardly by means of shafts 16, passing through the bottom 10 of the bath 2 and which are driven by driving means not shown. Thus, the substrates 1 can be slipped or moved upwardly from the cassette 4 into the auxiliary cassette 11.

... According to the invention, this knife-shaped member 19 forms parts of the lifting member 15 and the substrates are lifted from the liquid by the knife-shaped member 19. The knife-shaped member 19 is made, for example, of quartz glass and has an apical angle of less than 100°. When the substrates are lifted from the liquid 3, the whole quantity of liquid now flows away from the substrate via this knife-shaped member 19.

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Thus, the lifting means is interpreted as including a specifically placed structure consisting of a body connected to shafts and a knife-shaped member made of quartz glass, with an apical angle of less than 100E, or equivalents thereof. However, we observe that the examiner has not explained, much less proven, that such structure is described or would have been suggested by any of the references relied upon by the examiner. Thus, we are constrained to reverse the examiner's rejection of apparatus claims 21 through 23.

The decision of the examiner is affirmed-in-part.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR 1.136(a).

AFFIRMED-IN-PART

EDWARD C. KIMLIN)
Administrative Patent Judge)
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CAMERON WEIFFENBACH) BOARD OF

PATENT

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	Administrative Patent Judge)	APPEALS
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