United States Court of Appeals for the Federal Circuit

00-1375

SEMITOOL, INC.,

Plaintiff-Appellant,

v.

NOVELLUS SYSTEMS, INC.,

Defendant-Appellee.

DECIDED: July 23, 2002

Before MICHEL, LOURIE, and RADER, Circuit Judges.

LOURIE, Circuit Judge.

DECISION

This case is back in this court on remand from the Supreme Court of the United States for further consideration in light of Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki, Co., 122 S. Ct. 1831 (2002). The Court had granted a petition for certiorari following our earlier decision in this case, vacated our decision, and remanded following its decision in Festo. Semitool, Inc. v. Novellus Sys., Inc., 122 S. Ct. 2323 (2002). Because there are other grounds upon which to affirm the decision of the district court in this case that do not implicate the Court's decision in Festo, we affirm.

DISCUSSION

A. Background

This is an appeal brought by Semitool, Inc. from the decision of the United States District Court for the Northern District of California granting Novellus Systems, Inc.'s motion for summary judgment that Novellus's SABRE and SABRE xT semiconductor wafer processing devices do not infringe Semitool's U.S. Patents 5,222,310 and 5,337,708. Semitool, Inc. v. Novellus Sys., Inc., No. C-98-3089 (N.D. Cal. May 10, 2000). Semitool is the assignee of the '310 and '708 patents, which relate to an automated semiconductor wafer processing tool in which various chemical and electrochemical processes can be performed on a single wafer. Semitool, Inc. v. Novellus Sys., Inc., No. C-98-3089, slip op. at 2 (N.D. Cal. Mar. 17, 2000) (order) ("Semitool II"). Wafer processing generally refers to the application of chemical substances to a silicon substrate to alter its surface properties. Typically, the surface of a semiconductor wafer is first oxidized to create an insulated layer of silicon dioxide. Id. Next, an etchant-resistant coating is applied to the surface of the wafer. A chemical etchant is then applied to the wafer to remove portions of the wafer not protected by the etchant-resistant coating, leaving a patterned layer of exposed silicon. Id. Finally, the exposed silicon layer is doped with another chemical substance that affects the electrical characteristics of the silicon, which enables thin layers of a conducting metal to be electrochemically deposited (a process known as "plating") to establish electrical connections between various areas of the semiconductor. Id. These interconnections allow various transistors and other microelectronic devices located on the semiconductor to operate together, forming an integrated circuit. Although the claims of the patents at issue are not limited to any particular

semiconductor processing operation, both patents principally focus on the chemical etching phase of wafer processing.

The wafer processing tool claimed in the '310 and '708 patents primarily comprises a movable head that is capable of "mating" with a processing base or bowl, which contains the chemical etchant used in processing the wafer. Id. at 3. The '310 patent contemplates the use of both liquid and gas chemical etchants, see, e.g., '310 patent, col. 7, ll. 3-42, while the '708 patent focuses exclusively on the use of the vapor phase of processing chemicals (particularly aqueous hydrofluoric acid), see, e.g., '708 patent, col. 3, l. 49 to col. 4, l. 6. The movable head contains a structure for holding the wafer (the "wafer support" in the '708 patent) such that the wafer to be processed is positioned facing downward towards the bowl. Semitool II at 3. The processing device also has a pneumatic cylinder, which is used to raise and lower the processing head over the processing bowl such that wafers may be inserted and removed after processing. Id. at 4. The entire processing unit, consisting of the head, the bowl, and the pneumatic cylinder, is mounted inside a cabinet, which is designed to prevent contaminants from adversely affecting processing. Id.

Claims 1 and 3-5 of the '310 patent and claims 25, 32-37, 50, 55, and 56 of the '708 patent are at issue on appeal. Claim 1 of the '310 patent, which is representative of the claims of that patent and contains two limitations relevant to this appeal, reads as follows:

1. A wafer processing apparatus, comprising:

a stationary frame;

at least one processing base and a complementary processing head mounted to the frame, the processing base and complementary processing head being moveable relative to one another between a closed relative position forming a substantially enclosed processing space for containing processing fluids between the processing base and the processing head and an open relative position allowing transfer of wafers to and from the processing head;

means for moving the processing base and complementary processing head relative to one another; and

wafer transfer means on the frame for directing individual wafers between the processing head and one or more wafer carriers.

'310 patent, col. 10, ll. 10-27 (emphases added). The '708 patent, which is a continuation-in-part of the application from which the '310 patent issued, is similar to the '310 patent.[1] However, the claims of the '708 patent do not contain the term "complementary," and include an additional limitation relevant to this appeal. That limitation reads as follows:

> [A]t least one wafer support for detachably supporting wafers thereon; said at least one wafer support allowing controlled motion of the wafer support and any wafer held therein, at least when the processing head is in said at least one processing position[.]

'708 patent, col. 27, ll. 63-68 (emphasis added).

Novellus manufactures and sells two wafer processing tools, the SABRE and the SABRE xT systems (collectively, "the SABRE systems"). Semitool II at 11. Both machines perform the electrochemical deposition or plating processing step, in which a thin film of pure copper metal is applied onto the wafers during the manufacture of integrated circuits. Id. The electrochemical deposition occurs in a plating cell (characterized by Semitool as the "processing base" or "bowl"), which is comprised of a splash shield, an anode chamber, an exhaust tube inlet, and three concentric plating tanks. Id. The silicon wafers to be plated are held by a "clamshell" (characterized by Semitool as the "wafer support" in the '708 patent), which is attached by a shaft to a drive assembly (characterized by Semitool as the "head"). Id. The clamshell and the drive assembly are moved up and down over the plating cell to facilitate the loading and unloading of the silicon wafers to be processed. Id. Wafers are loaded into the plating cell through a "mail slot" on the side of the splash shield. Id. at 11-12. After loading, the clamshell and drive assembly are lowered into a closed position until the wafer to be plated comes into contact with the liquid plating solution in the inner plating tank. Id. at 12. The drive assembly then spins the clamshell and wafer together at the surface of the plating solution. Id. Plating occurs when an electrical current travels through the plating solution and the wafer, thereby depositing copper ions in the plating solution onto the surface of the wafer in the form of pure copper metal. Id.

When the SABRE systems are in the closed position, there is no direct contact between the outer wall of the drive assembly and the interior walls of the plating cell. Id. Instead, an annular gap exists

between the outer wall of the drive assembly and the interior wall of the plating cell, which is 0.25 inches wide in the SABRE machine and 0.815 inches wide in the SABRE xT machine. Id. Furthermore, the mail slot remains open throughout the plating process. The combined area of the annular gap and the mail slot opening amounts to 19.2 square inches in the SABRE machine and 38.6 square inches in the SABRE xT machine. Id. at 13.

Semitool sued Novellus in the district court alleging that Novellus's SABRE systems infringed the '310 and '708 patents. Id. at 1. After conducting a Markman hearing, the district court interpreted the "substantially enclosed processing space" limitation of both patents to require a "seal" created by the head and the bowl that is "sufficiently closed to permit the effective gas processing of a wafer using the gas phase of a processing chemical known in the art, regardless of whether the chemical to be used is in a gas or liquid state." Semitool, Inc. v. Novellus Sys., Inc., No. C-98-3089, slip op. at 19 (N.D. Cal. Sept. 24, 1999) (order) ("Semitool I"). Given its construction of the "substantially enclosed" limitation, the court construed the "complementary processing head" limitation in the '310 patent to require that "the head and bowl form a single component when in the closed position." Id. at 20. Finally, the court interpreted the phrase "wafer support for detachably supporting wafers thereon" in the claims of the '708 patent to be a means-plus-function limitation under 35 U.S.C. § 112, ¶ 6, and thus limited to the corresponding structure disclosed in the specification (viz., a plate having a plurality of fingers that grip the wafer at its peripheral edge) and any equivalents thereof. Id. at 24.

Based on its claim construction, the court granted Novellus's motion for summary judgment of noninfringement of both the '310 and '708 patents. Semitool II at 23. The court determined that the opening defined by the mail slot and the annular gap between the drive assembly and the plating cell in the SABRE systems precludes a finding that those devices have a "seal" that literally satisfies the "substantially enclosed processing space" limitation. Id. at 14-15. The court also determined that Novellus does not infringe as a matter of law because Semitool failed to establish a genuine issue of material fact that the SABRE systems are capable of effective gas processing. Id. at 21. Finally, the court found that prosecution history estoppel precluded Semitool from arguing that the air flow in the SABRE systems is equivalent to the "seal" required by both patents. Id. at 22-23.

B. Standards of Review

Summary judgment is appropriate "if the pleadings, depositions, answers to interrogatories, and admissions on file, together with the affidavits, if any, show that there is no genuine issue as to any material fact and that the moving party is entitled to a judgment as a matter of law." Fed. R. Civ. P. 56 (c). "The evidence of the nonmovant is to be believed, and all justifiable inferences are to be drawn in his favor." Anderson v. Liberty Lobby, Inc., 477 U.S. 242, 255 (1986). We review a district court's grant of a motion for summary judgment de novo. Ethicon Endo-Surgery, Inc. v. United States Surgical Corp., 149 F.3d 1309, 1315, 47 USPQ2d 1272, 1275 (Fed. Cir. 1998).

A determination of infringement requires a two-step analysis. "First, the court determines the scope and meaning of the patent claims asserted . . . and then the properly construed claims are compared to the allegedly infringing device." Cybor Corp. v. FAS Techs., Inc., 138 F.3d 1448, 1454, 46 USPQ2d 1169, 1172 (Fed. Cir. 1998) (en banc) (citations omitted). Claim construction is an issue of law, Markman v. Westview Instruments, Inc., 52 F.3d 967, 970-71, 34 USPQ2d 1321, 1322 (Fed. Cir. 1995) (en banc), aff'd, 517 U.S. 370 (1996), which we review de novo, Cybor, 138 F.3d at 1456, 46 USPQ2d at 1172. "Whether certain claim language invokes 35 U.S.C. § 112, ¶ 6 is an exercise of claim construction and is therefore a question of law, reviewable de novo by this court." Personalized Media Communications v. Int'l Trade Comm'n, 161 F.3d 696, 702, 48 USPQ2d 1880, 1886 (Fed. Cir. 1998). Determination of infringement, whether literal or under the doctrine of equivalents, is a question of fact. SRI Int'l v. Matsushita Elec. Corp. of Am., 775 F.2d 1107, 1125, 227 USPQ 577, 589 (Fed. Cir. 1985) (en banc).

C. Claim Construction

1. The "Substantially Enclosed" Limitation

Semitool argues that the phrase "substantially enclosed" simply refers to the ability to contain processing fluids within the head and the bowl depending upon the processing fluid used, and that it distinguished the prior art (i.e., the Aigo reference) on that ground during prosecution. Semitool

contends that the district court erred by requiring that the head and the bowl form a "seal," as the specification of the '708 demonstrates that a seal is required only in a preferred embodiment of the invention.

Novellus responds that the only embodiment of the claimed wafer processing tool set forth in both patents has a processing chamber that is sufficiently sealed to allow pressurization and to prevent ambient air flow into the chamber, and that the phrase "substantially enclosed processing space" must therefore be limited to that embodiment. Novellus also argues that Semitool limited its claims during prosecution to require that the wafer processing tool be sufficiently "sealed" to enable effective gas processing. Finally, Novellus contends that Semitool's process-dependent interpretation of the "substantially enclosed" limitation relies entirely on extrinsic evidence and has no support in the intrinsic record.

In interpreting claims, a court "should look first to the intrinsic evidence of record, i.e., the patent itself, including the claims, the specification, and, if in evidence, the prosecution history." Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1243, 1249, 39 USPQ2d 1573, 1577 (Fed. Cir. 1996). When the meaning of a term used in a claim is sufficiently clear from its definition in the patent specification, that meaning shall apply. Multiform Desiccants, Inc. v. Medzam, Ltd., 133 F.3d 1473, 1477, 45 USPQ2d 1429, 1432 (Fed. Cir. 1998); Intellicall, Inc. v. Phonometrics, Inc., 952 F.2d 1384, 1388, 21 USPQ2d 1383, 1387 (Fed. Cir. 1992). Furthermore, "[t]he prosecution history limits the interpretation of claim terms so as to exclude any interpretation that was disclaimed during prosecution." Southwall Techs., Inc. v. Cardinal IG Co., 54 F.3d 1570, 1576, 34 USPQ2d 1673, 1676 (Fed. Cir. 1995) (citations omitted).

We agree with Novellus that the district court properly construed the "substantially enclosed processing space" limitation to require a "seal" created by the head and the bowl that is sufficiently closed to permit the effective gas processing of a wafer using the gas phase of a processing fluid. Nothing in the plain language of the claims sheds any light on the meaning of the phrase "substantially enclosed." However, during the prosecution of the '310 patent, Semitool explained the significance of

the "substantially enclosed" limitation when it distinguished the Aigo prior art reference, stating that:

> [Claim 1] has been amended to recite that the complementary processing head and processing base define a substantially enclosed processing space when in the closed relative position. This allows the processing space to contain the gaseous or liquid processing chemicals. The Aigo reference has no ability to enclose the wafer and cannot process effectively using gases."

'310 patent file history, Paper No. 8 at 5 (emphasis added). Although Semitool argues that it only disclaimed coverage for wafer processing tools that process wafers outside of the region defined by the head and the bowl, that interpretation would require us to ignore its statement requiring the tool to be capable of effective gas processing — a statement that is divorced from any concept of "containing" the wafer and processing chemical in any particular processing space. We therefore find that Semitool expressly disclaimed coverage under the '308 patent of any wafer processing tool that cannot effectively utilize the gas phase of a processing chemical. See Southwall, 54 F.3d at 1576, 34 USPQ2d at 1676.

We reach the same conclusion with respect to the "substantially enclosed" limitation in the '708 patent. "When multiple patents derive from the same initial application, the prosecution history regarding a claim limitation in any patent that has issued applies with equal force to subsequently issued patents that contain the same claim limitation." Elkay Mfg. Co. v. Ebco Mfg. Co., 192 F.3d 973, 980, 52 USPQ2d 1109, 1114 (Fed. Cir. 1999) (citing Jonsson v. The Stanley Works, 903 F.2d 812, 817-18, 14 USPQ2d 1863, 1863-69 (Fed. Cir. 1990)). Thus, Semitool's relinquishment of subject matter during prosecution of the '310 patent applies with equal force to the '708 patent.

Moreover, the specification of the '708 patent expressly defines the "substantially enclosed" limitation as follows:

> The head **12** is loaded with wafer **20** which is held in position by the wafer holder. The head is positioned in sealing relationship with the bowl **14** or otherwise suitably adjusted to confine the processing chamber against drafts and other substantial leakages which might affect the homogeneous vapor phase which is being presented for contacting and etching the processed surface of the wafer **20**.

'708 patent, col. 9, ll. 32-39 (emphasis added). We have repeatedly stated that "claims must be read in view of the specification . . . . Usually, it is dispositive; it is the single best guide to the meaning of a claim term." Vitronics, 90 F.3d at 1582, 39 USPQ2d at 1577. Thus, although the claims of the '708 patent do not require an air-tight seal, the specification makes clear that they require a "seal" that is sufficient to prevent "drafts and substantial leakages" that might affect the ability of the processing chemical to operate in the gas phase. We therefore conclude that the district court correctly interpreted the "substantially enclosed" limitation in the '310 and '708 patents to require a "seal" created by the head and the bowl that is sufficiently closed to permit the effective gas processing of a wafer using the gas phase of a processing fluid, regardless whether the chemical to be used is in a gas or liquid state.

2. The "Complementary Processing Head" Limitation

Semitool also argues that the district court erred by construing the "complementary base head" limitation in the '310 patent to require that the head and the bowl form a single unitary structure when in the closed position because neither the ordinary meaning of the word "complementary," the specification, nor the prosecution history supports that interpretation. Novellus responds that Semitool did not raise this argument before the district court and therefore waived it on appeal.

Even assuming that Semitool failed to argue the meaning of the "complementary processing head" limitation to the district court, the court did construe that limitation, and in light of the continued vitality of the patent and the public interest in clarifying the scope of the claims, we exercise our discretion to review the district court's construction of that limitation. We agree with Semitool that the district court erred in its interpretation. It is undisputed, and in fact was so determined by the district court, that the head and the bowl in both patents do not form a "gas-tight" seal. Semitool I at 19. Thus, the head and the bowl cannot be said to form a "single component" when in the closed position. Rather, as taught in the '310 and '708 patents, the head is only "complementary" to the extent that, when lowered into the closed position, it forms a seal with the bowl that is sufficiently closed to permit effective gas processing. We therefore interpret the "complementary processing head" limitation to be synonymous with the "substantially closed" limitation, which does not require the head and the bowl to

form a single component when in the closed position.

3. The "Wafer Support" Limitation

Finally, Semitool argues that the district court erred by construing the phrase "wafer support for detachably supporting wafers thereon" in the '708 patent to be a means-plus-function limitation under 35 U.S.C. § 112, ¶ 6 because that phrase is a generic expression for a variety of well-known physical devices used to hold or grasp a wafer and release it. Novellus responds that the phrase is purely functional, and that because the claims do not recite any specific structure for performing that function, the district court properly construed that term to be a means-plus-function limitation.

The failure to use the word "means" creates a presumption that § 112, ¶ 6 does not apply, which can be rebutted by both intrinsic evidence and any relevant extrinsic evidence. Personalized Media, 161 F.3d at 703, 48 USPQ2d at 1886 (citing Mas-Hamilton Group v. LaGard, Inc., 156 F.3d 1206, 1213, 48 USPQ2d 1010, 1016 (Fed. Cir. 1998)). "In deciding whether [the] presumption has been rebutted, the focus remains on whether the claim as properly construed recites sufficiently definite structure to avoid the ambit of § 112, ¶ 6." Id. (citing Sage Prods., Inc. v. Devon Indus., Inc., 126 F.3d 1420, 1427-28, 44 USPQ2d 1103, 1109 (Fed. Cir. 1997)).

We agree with Semitool that the district court erred in construing the phrase "wafer support for detachably supporting wafers thereon" to be a means-plus-function limitation. The "wafer support" limitation does not use the word "means," and therefore this limitation is presumed not to invoke § 112, ¶ 6. Id. Furthermore, none of the intrinsic or extrinsic evidence rebuts this presumption because the term "support" is a sufficient recitation of structure. The word "support" is a well-known term in the mechanical arts for a number of objects capable of providing some type of foundation for another object. See Knight's American Mechanical Dictionary 2455 (1876) (defining "support" as "[a] term of very general import. A stand, frame, or bed for an . . . apparatus, implement, tool"). The fact that the term "support" does not specifically evoke a particular structure does not change the fact that it does connote structure. See Greenberg v. Ethicon Endo-Surgery, 91 F.3d 1580, 1583, 39 USPQ2d 1783, 1786 (Fed. Cir. 1996) (stating that a claim term "need not call to mind a single well-defined structure" to

fall within the ambit of § 112, ¶ 6, and that the relevant inquiry is whether the claim term "has a reasonably well understood meaning in the art"). We conclude that the "wafer support" limitation conveys sufficient structure to preclude the application of § 112, ¶ 6, and therefore interpret that limitation to mean any device capable of both holding or grasping a semiconductor wafer and releasing it at some later time.

D. Infringement

With respect to infringement, Semitool argues that even under the district court's claim construction, its grant of summary judgment of noninfringement cannot stand. Semitool contends that the air being drawn into the plating cell through the annular gap in the SABRE systems forms a fluid "seal" that satisfies the "substantially enclosed" limitation. Semitool also argues that the all-limitations rule does not preclude a finding of infringement under the doctrine of equivalents because the claims do not require that a mechanical "seal" provide the "substantially enclosed processing space" in which to process wafers. Finally, Semitool argues that tests performed by its experts created a factual dispute as to whether the SABRE systems can effectively process wafers using the vapor phase of a processing chemical.

Novellus responds that the air flow in the SABRE systems cannot satisfy the "substantially enclosed" limitation under the all-limitations rule because the plain language of the claims requires that structure, viz., the head and the bowl, form the "seal" in the processing chamber. Novellus also contends that prosecution history estoppel precludes a finding that the air flow in its SABRE systems infringes under the doctrine of equivalents. Finally, Novellus argues that Semitool did not establish a genuine issue of material fact as to whether the SABRE systems are capable of effective gas processing because it failed to present adequate evidence regarding repeatability, uniformity, and low contamination — qualities of wafer processing that its patents taught were crucial.

We agree with Novellus that the district court properly granted summary judgment of noninfringement. The relevant claims at issue require that "the processing base and the complimentary processing head . . . form[] a substantially enclosed processing space." '310 patent, col. 10, ll. 13-17; see also '708 patent, col. 27, ll. 56-58. The structure most closely corresponding to the head and the bowl in the SABRE systems is the plating cell and the drive assembly, and therefore it is these components, and not air flow, that must form the required "seal" in order to literally satisfy the "substantially enclosed" limitation. Consequently, the air flow in the accused devices cannot literally satisfy that limitation.

Furthermore, Novellus's accused devices do not satisfy that limitation under the doctrine of equivalents. An equivalence analysis must proceed on a limitation-by-limitation basis, as the doctrine of equivalents cannot be "allowed such broad play as to effectively eliminate that element in its entirety." See Warner Jenkinson Co. v. Hilton Davis Chem. Co., 520 U.S. 17, 29 (1997). Contrary to Semitool's "mechanical

seal" argument, the "substantially enclosed processing space" limitation expressly requires that structural components, viz., the head and the base or bowl, act to "form[] . . . a substantially enclosed processing space." Because the air flow in the SABRE systems does not constitute structure, equating that air flow with the structural components set forth in the "substantially enclosed processing space" limitation would entirely vitiate that limitation. Accordingly, application of the all-limitations rule precludes Semitool from establishing infringement by equivalence of the claims of both the '310 and '708 patents as a matter of law.

Moreover, as discussed above, Semitool made clear in its prosecution that the "substantially enclosed" limitation requires a "seal" created by the head and the bowl that is sufficiently closed to permit effective gas processing. In that regard, Semitool expressly defined effective gas processing in the specification of the '708 patent as entailing four elements: (1) a high etch rate; (2) uniformity; (3) repeatability; and (4) low contamination. '708 patent, col. 4, ll. 1-6.[2] As noted by the district court, the tests performed by Semitool's experts only establish a genuine issue of material fact that one of these elements, high etch rates, could be achieved in the SABRE systems when using the gas phase of a processing fluid. Semitool II at 22. The district court determined that Semitool only offered speculative evidence of uniformity, and that it presented no evidence whatsoever regarding repeatability and contamination. Id. We find no error in the court's determination that Semitool failed to establish a genuine issue of material fact concerning whether the SABRE systems are capable of effective gas processing, and therefore conclude that those devices do not satisfy the "substantially enclosed" limitation of both patents as a matter of law.

Given our affirmance of the district court's grant of summary judgment of noninfringement on the basis that Novellus's SABRE systems do not satisfy the "substantially enclosed" limitation of either patent at issue, we need not address whether those devices satisfy the "complementary processing head" and "wafer support" limitations of the '708 patent under their proper constructions set forth above.

We have considered Semitool's remaining arguments and find them to be unpersuasive.

CONCLUSION

Because the district court did not err in granting summary judgment that the '310 and '708 patents were not infringed, we affirm.

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[1] The claims of the '708 patent use the phrase "substantially enclosed processing chamber." However, neither party has argued that this phrase is different from the "substantially enclosed processing space" language in the claims of the '310 patent. We therefore interpret these limitations identically, and refer only to the latter phrase throughout this opinion.

[2] With respect to the '310 patent, because that patent has the same parent as the '708 patent and the parties have not argued that any meaningful difference exists between the "substantially

enclosed" limitations in those patents, the same infringement analysis applies to both patents.