United States Court of Appeals for the Federal Circuit

04-1211

ASM AMERICA, INC.,

Plaintiff/Counterclaim Defendant-Appellant,

and

ARTHUR SHERMAN,

Plaintiff,

and

ASM INTERNATIONAL, N.V.,

Counterclaim Defendant,

v.

GENUS, INC.,

Defendant/Counterclaimant-Appellee.

Henry C. Bunsow, Howrey Simon Arnold & White, LLP, of San Francisco, California, argued for plaintiff/counterclaim defendant-appellant. With him on the brief was Matthew C. Rainey.

Edward R. Reines, Weil, Gotshal & Manges LLP, of Redwood Shores, California, argued for defendant/counterclaimant-appellee.

Appealed from: United States District Court for the Northern District of California

Magistrate Judge Elizabeth D. Laporte

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DECIDED: March 16, 2005

Before NEWMAN, Circuit Judge, FRIEDMAN, Senior Circuit Judge, and BRYSON, Circuit Judge.

BRYSON, Circuit Judge.

This case involves a process known as sequential Atomic Layer Deposition ("ALD"), which is used to deposit extremely thin layers of different materials on the

surface of a substrate, often as part of the process of manufacturing semiconductor devices. The materials, or reactants, are applied to the substrate by sequentially vaporizing each reactant and passing it over the substrate. Each reactant must be removed from the area of the substrate before the substrate is exposed to a new reactant. The removal process can be effected in one of two ways. The first way is to remove the reactant gas by applying a vacuum to the area surrounding the substrate. That process is referred to as "sucking out" the reactant. The second way is to force a continuous stream of inert gas to flow over the substrate and to inject a pulse of the reactant vapor into the flow so that it is carried over the substrate and then is whisked away. That process is referred to as "blowing out" the reactant.

Appellant ASM America, Inc., owns U.S. Patent No. 6,015,590 ("the '590 patent"), which pertains to sequential ALD. In addition, ASM is the exclusive licensee with the right to enforce U.S. Patent No. 5,916,365 ("the '365 patent"), which also relates to sequential ALD. Together with Arthur Sherman, the inventor of the '365 patent, ASM filed suit in United States District Court for the Northern District of California, No. 01-CV-02190, alleging that appellee Genus, Inc., was infringing those two patents. Genus answered and filed counterclaims asserting antitrust violations and seeking a declaratory judgment of invalidity, noninfringement, and unenforceability. By consent of the parties, the case was referred to a magistrate judge pursuant to 28 U.S.C. § 636(c). Genus's antitrust and inequitable conduct claims were subsequently dismissed. After extensive briefing and a hearing, the magistrate judge construed several terms in the '590 and '365 patents. Based on the magistrate judge's claim construction, Genus filed motions for summary judgment of noninfringement with

respect to both patents. In light of the magistrate judge's claim construction, ASM did not oppose Genus's motion with respect to the '365 patent. However, ASM argued that there were still issues of material fact regarding infringement of the '590 patent and opposed summary judgment on that patent. The district court granted summary judgment of noninfringement with respect to both patents. ASM appeals the district court's claim construction and the ensuing grant of summary judgment. We affirm the district court's judgment based on substantially the same reasoning given by the district court.

I

ASM asserts that Genus infringed claim 1 of the '590 patent, which states:

> A method for growing a thin film onto a substrate, in which a substrate is placed in a reaction space and said substrate is subjected to alternately repeated surface reactions of a plurality of vapor phase reactants to form a thin film, said method comprising the steps of:
> feeding said vapor phase reactants into said reaction space in the form of vapor phase pulses repeatedly and alternately, each reactant separately from its own source;
> causing said vapor phase reactants to react with the surface of the substrate to form a thin film compound on said substrate;
> evacuating said reaction space between two successive vapor phase pulses by connecting the reaction space to a pump so that substantially all of said reactants remaining in said reaction space and adsorbed on inner walls of said reaction space are removed to a level of less than 1% prior to the inflow of a second pulse of said two successive vapor phase pulses; and
> feeding an inactive gas into said reaction space simultaneously with said evacuating step.

On appeal, ASM contends that the district court incorrectly construed the terms "evacuating" and "reaction space."

A

The term "reaction space" is expressly defined in the specification. The pertinent portion of the specification provides that

> the term "reaction space" includes both the space in which the substrate is located and in which the vapor-phase reactions are allowed to react with the substrate in order to grow thin films, namely, the reaction chamber, as well as the gas inflow/outflow channels communicating immediately with the reaction chamber . . . . According to the invention, the reaction space is the entire volume to be evacuated between two successive vapor-phase pulses.

'590 patent, col. 4, ll. 29-43. Applying that definition, which explicitly provides that the reaction space includes the entire volume to be evacuated between two successive vapor-phase pulses, the district court ruled that the reaction space constitutes the reaction chamber and the gas inflow/outflow channels that communicate immediately with the reaction chamber. ASM contends that the court's definition is erroneous and that the reaction space need not be restricted to "the entire volume to be evacuated between two successive vapor-phase pulses."

ASM argues that because the dispute between the parties concerns what portions of the device used to perform the claimed process need to be evacuated, defining the "reaction space" as being the portions of the device that need to be evacuated is circular. A fair reading of the specification, however, shows that the district court's definition is not circular at all. The specification makes clear that the "entire volume to be evacuated" includes both the reaction chamber and the inflow and outflow channels that directly communicate with the chamber. As the district court explained, if there was no indication of the extent of the volume designated as the reaction space, it would be unclear how much of those inflow and outflow channels would fall within the

confines of the reaction space, and the reaction space might include the entire device. Such a situation is unacceptable, since the purpose of the invention is to keep the various vapor-phase reactants from being simultaneously present in the reaction space. See '590 patent, col. 3, ll. 25-29. That situation does not arise, however, because the patent makes clear that the reaction space includes only the section of the device that is evacuated between successive vapor-phase pulses.

B

While the specification makes clear exactly which portion of the ALD device must be evacuated, the evidence is more ambiguous as to what the term "evacuation" means. The district court construed the term evacuation as follows:

> Evacuation is accomplished by using a vacuum pump to suck the reactant gases out of the reaction space. Evacuation does not encompass using an inert gas to push the reactant gases out of the reaction space.

ASM contends that this construction of evacuation does not accord with the plain meaning of the term and that it improperly reads limitations from the specification into the claim.

In the first place, ASM asserts, there is no indication in the claim that evacuation requires the use of a vacuum pump. Rather, the claim requires only that the evacuation occur "by connecting the reaction space to a pump"; it does not specify the type of pump used in the evacuation. That argument fails, however, for several reasons. First, it is clear that a person of skill in the art would understand the term "pump" to mean "vacuum pump." ASM's own expert, Alexander Glew, stated that all ALD technology uses a vacuum pump as a necessary component. The specification also supports that interpretation. In describing the invention, the patent discloses a "pump capable of evacuating the reaction space to a vacuum." '590 patent, col. 3, ll. 41-42. Furthermore,

the specification states that the "invention can be implemented using any suitable pump capable of establishing a sufficient vacuum." Id. at col. 5, ll. 44-46. Finally, during prosecution, the patentee used "pump" and "vacuum pump" interchangeably, noting that the patent would allow a user to use "pumps that were smaller and more economical than the pumps employed" in the prior art because the patent required only a "sufficient vacuum," rather than an "ultrahigh vacuum." We conclude, therefore, that the district court correctly construed the term "pump" to be synonymous with "vacuum pump."

ASM's main argument on appeal is that the district court erred in construing the term "evacuation" to mean sucking the reactant gases out of the reaction space, and not to include using an inert gas to push the reactant gases out of the reaction space. In support of its argument that the definition of the term "evacuation" is broader than the definition given by the district court, ASM relies on the definition of "evacuation" given in the specification:

> In the context of the present invention, the term "evacuation" is used generally referring to the removal of reactant residues in the vapor phase. The evacuation of the reaction space can be accomplished by purging the gas volume of the apparatus by means of at least one pumping cycle capable of lowering the internal pressure in the apparatus to a sufficiently high vacuum. When required, the apparatus may be simultaneously filled with an inactive gas which promotes the purging of the reactant residues from the reaction space.

'590 patent, col. 3, line 64, to col. 4, line 5. ASM argues that the quoted portion of the specification establishes that the term evacuation refers to any process that removes reactant gases from the reaction chamber.

When a patentee defines a term in the specification, that definition ordinarily controls. See Renishaw PLC v. Marposs Societa' Per Azioni, 158 F.3d 1243, 1249 (Fed. Cir. 1998); PPG Indus. v. Guardian Indus. Corp., 156 F.3d 1351, 1355 (Fed. Cir.

1998). ASM invokes that principle, but the proposed definition on which it relies does not support its claim construction.

The portion of the specification on which ASM relies states that evacuation can be accomplished by pumping the gas to a "sufficiently high vacuum." The next sentence states that an inactive gas can be used to purge the reactants from the reaction space, but it does not suggest that the purging step is part of the evacuation. Moreover, any doubt on that score is resolved by the language of claim 1, which sets forth evacuation and purging as two distinct steps. For the evacuating step, the claim requires evacuation "by connecting the reaction space to a pump so that substantially all of said reactants remaining in said reaction space and adsorbed on inner walls of said reaction space are removed." The claim then sets forth the purging step as "feeding an inactive gas into said reaction space simultaneously with said evacuating step." The patent clearly requires evacuation through use of a vacuum pump as well as an entirely separate step of feeding an inactive gas into the reaction space.

The distinction between the evacuating step and the purging step is further supported by the prosecution history, which provides a rationale for feeding the inactive gas into the reaction chamber. In distinguishing the invention in the '590 patent over a prior art patent to Nishizawa, the patentee stated that "Nishizawa teaches discharging the reactor by evacuating it to an ultrahigh vacuum. This necessarily indicates that a very low pressure must be maintained in the reaction chamber between successive pulses." The patentee then stated that "[i]n contrast, by using the inactive gas and the evacuation technique taught by the claimed invention, the reactor space is discharged at pressure that is decades above the pressure required by the Nishizawa reference."

Thus, the patentee explained, a cheaper "sufficient" vacuum was all that was needed for the invention, rather than a more expensive "ultrahigh vacuum." See also '590 patent, col. 5, ll. 44-46. That explanation clearly illustrates that the patentee regarded evacuation as encompassing the act of discharging the reactant gas to a vacuum. By contrast, the insertion of inactive gas is intended to increase the internal pressure in the chamber to allow for a weaker pump to perform the evacuation. Thus, the introduction of the inactive gas is not part of the evacuation, but is an additional step that makes the evacuation more efficient.

ASM responds by pointing to the applicant's statement in the prosecution history that "in contrast [with Nishizawa], the claimed invention teaches that by feeding gas into the reactor space between pulses, the inert gas pushes out the previous pulse from the reactor apparatus." ASM argues that this statement bolsters its contention that the introduction of inert gases is part of the evacuation step. Additionally, ASM refers to portions of the specification that, when read alone, give the impression that inserting an inert gas is part of evacuation. For instance, the specification states that "the interval between the successive pulses is kept so long as to permit the evacuation of the reaction space using at least a double or triple purging gas volume." '590 patent, col. 5, ll. 16-18.

These arguments are unavailing, however, because when the specification and the prosecution history are read as a whole, it becomes clear that the insertion of inert gas may help render the process of evacuation more efficient, but is not part of the evacuation itself. For instance, the specification states that "[t]he evacuation steps and possible complementing step of flushing with an inert gas also contribute to the efficient

removal of molecules." '590 patent, col. 8, ll. 12-14. The specification also states that "an inactive gas may advantageously be introduced to the reaction space during the evacuation." Id. at col. 11, ll. 37-39. It is clear that the patent treats evacuation and the introduction of an inert gas as distinct concepts, which is why claim 1 lists evacuation and the introduction of inert gas as discrete steps. See, e.g., id. at col. 4, ll. 6-28 (listing other uses of introducing the inert gas into the chamber for reasons unrelated to evacuation). We therefore agree with the district court's definition of evacuation.

C

In light of the district court's construction of the claim, it is clear that Genus's device does not infringe the '590 patent. That conclusion follows from the fact that Genus's device does not remove the reactant gases from the reaction space with a vacuum pump. Rather, Genus's device inserts pulses of reactant gas into a moving stream of inert gas to be carried over the substrate in the reaction chamber.

Specifically, the reaction space is the reaction chamber and gas inflow and outflow channels communicating immediately with the reaction chamber and must include the entire volume to be evacuated between successive vapor-phase pulses. The parties did not dispute that, in Genus's device, the reaction space must therefore include a gas manifold into which each of the reactants and inert gas are separately injected. The reaction space continues from the gas manifold through an orifice known as OR-4 and includes the reaction chamber on the other end of OR-4. OR-4 is a choked valve. Thus, the gas flow rate through it is affected only by the gas pressure on the manifold side of the valve and is independent of the pressure on the reaction chamber side. Accordingly, under the district court's definition, the gas manifold can

never be evacuated because the gas in the manifold cannot be sucked out by a vacuum pump. Rather, the gas in the manifold can only be pushed out by the purging gas. While ASM contends that there are further disputes of material fact regarding infringement, those disputes are all based on ASM's basic disagreement with the district court's claim construction. Because there is no genuine issue of material fact as to infringement, we uphold the district court's determination on summary judgment that the Genus device does not literally infringe the '590 patent.

II

ASM asserts that Genus infringed claims 1 and 16 of the '365 patent. Claim 1 provides:

> A process of growing thin film by a sequential chemical vapor deposition process, comprising the steps of:
> placing a part in a chamber;
> evacuating the chamber of gases;
> exposing the part to a gaseous first reactant, including a non-semiconductor element of the thin film to be formed, wherein the first reactant adsorbs on the part;
> evacuating the chamber of gases;
> exposing the part, coated with the first reactant, to a gaseous second reactant of radicals, wherein the radicals convert the first reactant on the part to one or more elements, wherein a thin film is formed; and
> evacuating the chamber of gases.

Claim 16 is substantially identical to claim 1, differing only in ways that are irrelevant to the disputed claim terms. ASM contends that the district court erred in construing the phrase "evacuating the chamber of gases."

The district court construed the phrase "evacuating the chamber of gases" in the '365 patent in the same way that it construed the term "evacuation" in the '590 patent. Specifically, the court ruled that the phrase refers to removal of the gases with a vacuum pump and does not encompass the use of an inert gas to push the gases out of

the reaction chamber. ASM claims that the court's construction is contrary to the evidence and improperly reads into the '365 patent a limitation from the '590 patent that appears nowhere in the '365 patent.

ASM first contends that the district court improperly imported from the '590 patent the requirement that the evacuation be accomplished by a vacuum pump. ASM argues that the district court should not have placed constraints on how the gases are removed from the chamber. Under ASM's proposed construction, "evacuating the chamber of gases" could include using an inert gas to purge the chamber.

ASM asserts that its construction is supported by the specification. In discussing the prior art, the specification states that in a prior art patent, "the excess of each gas is removed by flowing a purge gas through the reactor between each exposure cycle." '365 patent, col. 2, ll. 12-14. Therefore, according to ASM, the purge gas can be said to "remove" the gas.

That argument, however, ignores the plain meaning of the claim language and mischaracterizes the specification. Obviously, the statement "evacuating the chamber of gases" means only that the gases in the chamber must be removed. We therefore reject ASM's contention that the phrase includes the act of pushing more gas into the chamber. Additionally, ASM's reference to the specification fails to acknowledge that the prior art patent to which ASM refers was describing removing a specific type of gas; namely, excess reactant gas. That process, which involves removing a specific type of gas, is quite different from evacuating all gases from a chamber.

ASM further asserts that the phrase "evacuating the chamber of gases" should be limited to mean evacuating the chamber of reactant gases. Nothing in the

specification or the claims, however, supports that interpretation. In the first place, the language of the claim does not limit the type of gas that must be removed from the chamber. Additionally, the structure of the claim supports the district court's construction. The term "evacuating the chamber of gases" appears three times in claim 1. The last two times, the phrase appears after reactant gases have been inserted into the chamber. However, the first time it appears is prior to the introduction of any reactant gases. Presumably, there are no reactant gases to evacuate initially or else the process would have already begun. Therefore, ASM's requirement that evacuation include the removal of only reactant gases leads to a nonsensical result for the first instance of evacuation. For the term "evacuating the chamber of gases" to be used consistently throughout the claim, the step must mean evacuating the chamber of all types of gases.

Moreover, nothing in the specification suggests that the patent claims a system that employs selective removal of certain gases from the chamber. Rather, the specification repeatedly refers to the evacuation of the chamber of gases using a vacuum pump. See, e.g., '365 patent, col. 6, ll. 27-28; id. at col. 6, ll. 33-34. More importantly, the specification distinguishes between evacuation and purging with an inert gas. For example, the Background of the Invention portion of the specification describes both the ALD process that requires "evacuating the chamber with a vacuum pump," id. at col. 1, ll. 56-60, and, separately, the process that uses inert gas to carry away excess reactant gas, id. at col. 2, ll. 12-15. The extrinsic evidence further supports the conclusion that a person of ordinary skill in the art would believe that the term "evacuate" means to pump out the gases. For instance, when ASM was

considering purchasing the '365 patent, the company's own Chief Technology Officer stated that the claims of the '365 patent were limited to processes "in which the chamber is pumped down between cycles," and that the claims did not cover the use of a purging gas to remove the reactants. Indeed, the evidence shows that even the inventor of the '365 patent, Dr. Arthur Sherman, considered evacuation to be different from the use of a purge gas. In his notebook for the '365 patent, Dr. Sherman wrote that "an essential requirement of this new process is that it be done in a vacuum chamber, with each step of the process involving dosing and then an evacuation." He distinguished that process from the prior art systems that used a flowing, inert gas to purge the chamber. That distinction is further supported by slides that Dr. Sherman used in teaching a class on ALD. The slides noted that there are two types of ALD systems: "vacuum pumped systems" and "flow purged system." In addition, the slides stated that "flow systems use inert gas purging rather than evacuation."

In sum, the district court was on firm ground in ruling that the term evacuate refers to the removal of gases with a vacuum pump and does not encompass the use of an inert gas to push gases out of the chamber. Because ASM does not contend that Genus's device infringes under that construction, we uphold the district court's summary judgment of noninfringement of the claims of the '365 patent.

AFFIRMED.