United States Court of Appeals for the Federal Circuit

03-1405

ULTRATECH STEPPER, INC.
(now known as Ultratech, Inc.),

Plaintiff-Appellant,

v.

ASM LITHOGRAPHY, INC.,

Defendant-Appellee.

DECIDED: March 30, 2004

Before MAYER, Chief Judge, RADER, and SCHALL, Circuit Judges.

SCHALL, Circuit Judge.

DECISION

Plaintiff-Appellant Ultratech Stepper, Inc. ("Ultratech") appeals from the final decision of the United States District Court for the Northern District of California granting summary judgment of non-infringement in favor of Defendant-Appellee ASM Lithography, Inc. ("ASML"). Ultratech Stepper, Inc. v. ASM Lithography, Inc., No. C-00-4069-DLJ (N.D. Cal. Aug. 15, 2002) ("Summary Judgment Order"). Ultratech alleged in the district court that claims 1, 3, 8, 13, and 18-19 of its United States Patent No. 5,281,996, "Photolithographic Reduction Imaging of Extended Field," (the "'996 patent"), were infringed by ASML's imaging systems, produced abroad but imported for use by ASML's

customers in the United States. Because we do not agree with the district court's claim construction, we reverse the grant of summary judgment and remand the case for further proceedings on the issue of infringement.

DISCUSSION

I.

The '996 patent claims a variation on conventional photolithographic reduction imaging ("PRI") processes. Such processes are used to manufacture semiconductor integrated circuits on silicon "wafers." The ever-decreasing size of these circuits has challenged the industry to devise efficient methods by which circuit patterns can be transferred from a design "mask" (or "reticle") to the silicon wafer.

In the traditional "step and repeat" PRI method, a light source, a mask, and a lens are used to transfer patterns from the mask onto the wafer in the following manner: The desired pattern for the integrated circuit is etched onto the much larger mask, typically made of high quality glass covered with a thin layer of chrome. The etching results in a pattern of opaque and transparent areas on the mask. The silicon wafer, in turn, is covered with a light sensitive photo-resist. Light passes through the transparent areas of the mask and reacts with the photo-resist to "expose" or "image" the desired pattern onto the wafer. Because the mask pattern can only feasibly be constructed on a much larger scale than that necessary for the final circuitry, a lens is used to significantly reduce the mask pattern before it is projected onto the wafer. The wafer can then be "stepped" relative to the mask, and the imaging process repeated to create multiple copies of the mask pattern on the wafer. The resulting photo-resist images serve as a starting point for the creation of detectable patterns ("layers" of circuitry) on the wafer. The process just described is repeated, with different mask patterns, over the same wafer area multiple times, forming numerous overlapping layers of circuit building blocks that eventually become a multi-layered circuit. The wafer upon which the multi-layered circuitry rests is then cut apart to form the final

product, "dies" or "integrated circuit chips."

Lens technology has limited the advance of PRI techniques, as the size of each projected image can never exceed the maximum image field diameter of the lens being used. See '996 patent, Fig. 2.[1] Prior to the invention of the '996 patent, the primary way of increasing the size of the mask pattern, and the resulting image projected onto the wafer, was to increase either the size or the reduction capability of the lens. Increases in lens size, however, are expensive and can compromise necessary detail in the PRI image transfer. Id. col. 3, ll. 16-20. The industry thus sought to devise methods of increasing size without changing the dimensions of the lens.

The '996 patent teaches one such method. Id. col. 1, ll. 23-27. It employs a method of successively and incrementally moving the mask across the viewing field of a reduction lens, while exposing, during each increment, the surface of a wafer, which is moved in tandem with the mask.[2] The '996 patent describes this process as "imaging" the pattern on the mask, in reduced form, onto the wafer. Although the area exposed on the wafer during each increment is smaller than the image field diameter of the lens, the size of the combination of the exposures, the total image, should exceed that diameter. The result is to transfer the mask pattern onto the wafer in an imaged area that is larger than the image field of the lens. This method obviates the need for increased lens size, instead building on photolithography reduction apparatuses already widely available. Id. col. 4, l. 67 – col. 5, l. 1. The '996 patent discloses two embodiments: an extended field image version, see id. Fig. 3, and a scanning version, see id. Fig. 4.

II.

On March 3, 2000, Ultratech brought this suit against ASML in the Eastern District of Virginia, alleging infringement of claims 1, 3, 8, 13, and 18-19 of the '996 patent, both literally and under the doctrine of equivalents. Eventually, venue was transferred to the Northern District of California.

Claim 1 is representative of the claims at issue; it reads as follows:

We claim:

1. A method of imaging a large microcircuit device in a resolution range of 0.1-0.5

micrometers, said method comprising:

> using an axially centered photolithographic reduction lens having a circular image field with a diameter that is less than a diagonal of said microcircuit device;
>
> arranging a stage for a mask for said microcircuit device to be movable relative to said lens;
>
> arranging a stage for a wafer on which said microcircuit device is imaged to be movable relative to said lens;
>
> controlling the accuracy of movement of said stages relative to said lens; and
>
> using said movement of said stages to correlate different regions of said mask moved into a field of view of said lens with correspondingly different regions of said wafer moved into said image field of said lens in a pattern that successively images the entire area of said microcircuit device.

Id. col. 6, l. 60 – col. 7, l. 11 (emphases added).

The critical term is "microcircuit device." Before the district court, Ultratech argued that a "microcircuit device" consists of "one or more die made by superimposing one or more photolithographic patterns onto a wafer, where each photolithographic pattern corresponds to a single mask or reticle." ASML, on the other hand, urged that "microcircuit device" be limited to an "integrated circuit," and that it include only "circuit[s] formed from a single die whose components are formed on a single semiconductor having a diagonal longer than a diameter of the image field of the reduction lens."

After considering the intrinsic evidence, the district court adopted a variant of ASML's construction: "A microcircuit device is a single imaged layer on a single die. A large microcircuit device is a single imaged layer on a single die which has a diagonal longer than the diameter of the image field of the reduction lens." Ultratech Stepper Inc. v. ASM Lithography, Inc., No. C-00-04069-DLJ (N.D. Cal. Dec. 20, 2001).

ASML's accused method, allegedly identical to the scanning embodiment of the '996 patent, exposes on the wafer a single, large image containing patterns for multiple circuits. Each of these circuits, in final form, is smaller than the image field of the reduction lens, although the combination of

the circuits is larger than the image field. These circuits could each be imaged independently, using a step and repeat technique, but instead, to increase its efficiency of production, ASML groups them within a single large pattern that it images onto the wafer using the scanning method. The use of the process as one step in fabrication of multiple dies, rather than one step in what will become a single die, is emphasized by ASML as significant.

The district court determined that ASML's method did not satisfy the "microcircuit device" limitation of the claims as construed by the court. Although ASML "concede[d] that its equipment provides a 'large exposure field,'" because this exposure field contained patterns for multiple circuits, the district court found it to be different than the "microcircuit device" the inventors had claimed. Summary Judgment Order at 23-24. As far as the doctrine of equivalents was concerned, the court determined that the "result" of ASML's accused process, which the court described as a "single imaged layer on multiple die," was substantially different from the result generated by practice of the '996 patented method, described by the court as "a single imaged layer on a single die." Id. at 29. The district court also noted the apparent purpose of the '996 patented invention, "to produce larger single circuits," id. at 31, as a reason to reject Ultratech's doctrine of equivalents claim. Accordingly, the court granted summary judgment against Ultratech on both of its infringement theories.[3]

This appeal followed. We have jurisdiction pursuant to 35 U.S.C. § 1295(a)(1).

III.

Resolution of a claim of infringement requires a two-step analysis. CCS Fitness, Inc. v. Brunswick Corp., 288 F.3d 1359, 1365 (Fed. Cir. 2002). First, the trial court must ascertain the meaning of disputed claim terms. This is a matter of law, which we review de novo. Cyber Corp. v. FAS Techs., Inc., 138 F.3d 1448, 1456 (Fed. Cir. 1998) (en banc). Second, the court compares the claims of the patent, as properly construed, to the allegedly infringing device, "to determine, as a matter of fact, whether all of the limitations of at least one claim are present, either literally or by a substantial equivalent, in the accused device." Teleflex, Inc. v. Ficosa N. Am. Corp., 299 F.3d. 1313, 1323 (Fed. Cir. 2002) (citing Johnson Worldwide Assocs. v. Zebco Corp., 175 F.3d 985, 988 (Fed. Cir. 1999)). "A

district court's infringement decision that is based on an improper claim construction is entitled to no deference when the correct construction of the claim is dispositive of the issue of infringement." Elkay Mfg. Co. v. Ebco Mfg. Co., 192 F.3d 973, 976 (Fed. Cir. 1999).

We review a grant of summary judgment of non-infringement by a district court de novo, applying the same standard as the district court. Cortland Line Co. v. Orvis Co., 203 F.3d 1351, 1355-56 (Fed. Cir. 2000). Summary judgment is appropriate where, drawing all reasonable factual inferences in favor of the non-movant, the record shows "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). See also Anderson v. Liberty Lobby, Inc., 477 U.S. 242, 247 (1986); Johnson Worldwide Assocs., 175 F.3d at 988.

Ultratech urges us to reject the district court's claim construction by eliminating the "single die" limitation. It argues that the term "microcircuit device" "refers to the mask patterns – whatever they contain – that are projected or exposed onto the wafer." According to Ultratech, the term "microcircuit device" means "the portion of an imaged layer within an extended field, whether that portion contains many small die images or one large die image." For its part, ASML argues that we should affirm the district court's claim construction.

IV.

Claim construction begins with the language of the claims. See Interactive Gift Express, Inc. v. Compuserve, Inc., 256 F.3d 1323, 1331 (Fed. Cir. 2001) (citing 35 U.S.C. § 112, ¶ 2) ("In construing claims, the analytical focus must begin and remain centered on the language of the claims themselves, for it is that language that the patentee chose to use to 'particularly point[] out and distinctly claim[] the subject matter which the patentee regards as his invention.'"); Vitronics Corp. v. Conceptronics, Inc., 90 F.3d 1576, 1582 (Fed. Cir. 1996) ("First we look to the words of the claims themselves, both asserted and nonasserted, to define the scope of the patented invention.").

Turning to the claim language, the preamble of claim 1 refers to "[a] method of imaging a large

microcircuit device." Preliminarily, since the mask pattern and the image on the wafer are identical, it is potentially unclear which copy of the pattern is considered the "microcircuit device." We see two possibilities. First, "microcircuit device" could refer to the underlying pattern, whether on the mask or on the wafer. Alternatively, "microcircuit device" could refer just to the image located on the wafer. In this second understanding, the design on the mask would be a pattern for the "microcircuit device," but not the "microcircuit device" itself.

For several reasons, we conclude that the second characterization is correct. We reach this result from the first limitation of claim 1, which requires that the diagonal of the "microcircuit device" exceed the diameter of the image field of the lens. The image field of the lens is positioned relative to the wafer. In both the traditional "step and repeat" and the '996 patented processes, the diagonal of the mask pattern for the microcircuit device would always exceed the diameter of the image field of the lens, depriving limitation (a) of any meaning. See '996 patent, col. 3, ll. 55-63 (illustrating that when mask size ranges in the inches, both the diameter of the lens image field and the diagonal of the resulting image on the wafer will remain only millimeters in length).

The purpose of the '996 patent further persuades us that the second characterization is correct. Although a mask pattern is required to carry out the patented method, the goal and end result of the claims is the exposure, or imaging, of a pattern on the wafer. It is this copy of the pattern, not the copy on the mask, which will be used to eventually create functioning circuitry. Thus, it is appropriate to draw a distinction between the mask pattern and the pattern projected onto the wafer. The specification supports this distinction, contrasting the "square image" exposed onto the wafer, with the "image pattern" contained on the reticle or mask. Id. col. 3, ll. 2-4. We conclude that the image on the wafer is the "microcircuit device," whereas the mask contains the pattern for the "microcircuit device."

Continuing with the claim language, the "mask for said microcircuit device," id. col. 6, l. 67, is to be movable in stages "into a field of view of said lens with correspondingly different regions of said wafer moved into said image field of said lens in a pattern that successively images the entire area of said microcircuit device." Id. col. 7, ll. 6-11. If performed exactly as claimed, the '996 patent's method

creates a pattern on the wafer that exactly mirrors the pattern on the mask.[4] Thus, each reference in the claim to "microcircuit device" is to the pattern that will be found in the photo-resist on the wafer after the patented method has been performed. The claims do not provide a reason for us to inquire further into the particular contents of the mask pattern, and thereby limit the meaning of "microcircuit device" accordingly. In our view, a "microcircuit device" is simply the entirety of the exposed pattern on the wafer that results from the practice of the claimed invention. This will necessarily replicate what is on the mask. An alternative phrasing of our construction for "microcircuit device," would therefore be, as suggested by Ultratech, "the mask patterns – whatever they contain – that are projected or exposed onto the wafer."

Since the meaning of "microcircuit device" in the context of the claims of the '996 patent is clear, we do not rely on dictionary definitions offered by the parties. The meaning of "microcircuit" is relatively undisputed: "an integrated circuit or other very small electrical circuit." Oxford Reference Dictionary 520 (Oxford University Press 1989); see also McGraw-Hill Electronics Dictionary 336 (5th ed. 1994) ("integrated circuit or hybrid circuit"). As far as the word "device" is concerned, Ultratech offers, "[a] mechanism, tool or other piece of equipment designed for specific uses"; ASML describes a "device" as a "thing made or adapted for a particular purpose," but also suggests a more technical definition that was adopted by the district court: "an electric element that cannot be divided without destroying its stated function."

We reject these definitions insofar as they are inconsistent with the meaning of "microcircuit device" we have gleaned from the language of the claims. Both of the parties' definitions would impose upon "device" a requirement of functionality that is unhelpful in the context of the method claimed in the '996 patent, where the resulting image is only a precursor of a functioning circuit. As just seen, as used in claim 1, the term "microcircuit device" simply refers to the pattern on the mask to be transferred to the wafer. Other claims of the '996 patent are similarly limited to a single imaging step within the much more complicated (and unclaimed) process of circuit construction. The pattern on the mask that is imaged onto the wafer using the '996 patented process serves as a design or map for what may become a functioning "device," but that resulting image on the wafer cannot itself be said to have an immediate

"specific use," "stated function," or "particular purpose." It was in this respect, we think, that the district court erred. Its claim construction was framed in terms of the ultimate product. However, that ultimate product, a die, could never be created solely by the exercise of the '996 patented process. For purposes of claim construction, we must begin and end our analysis with the process claimed; what happens to the wafer after the '996 patented process is performed is irrelevant and should not limit the scope of the claimed method.

The specification of the '996 patent supports this conclusion. It highlights, as the critical feature of the invention, the projection and joining of several "image portions" on a wafer to form a single large image or "microcircuit device." See, e.g., '996 patent, col. 1, ll. 51-58 ("reduced images of the mask on the wafer" are formed by movement of the mask and wafer in tandem to "successively image[] the entire area of the microcircuit device"); col. 3, ll. 16-33 (discussing how the claimed process solves the "larger image problem" of "enlarging the size of an image formed on a wafer" by forming 15 mm square images in "juxtaposed registry with each other to produce a single large microcircuit device 30 mm square"); col. 6, ll. 6-17 (discussing how the scanning embodiment of the invention is used to "form[] a reduced image 26" of the mask pattern "on a single wafer 16"); col. 6, ll. 20-28 ("Relatively large and square imaging patterns are shuttled reciprocally into the viewing field of [the] lens; and [the] mask is moved in the image field of [the] lens so that extended field rectangular images are formed on successive regions of wafer. Each of the images is formed by juxtaposing and registering a pair of images carried on double masks." (diagram designations omitted)). The emphasis on the methodology of imaging the "microcircuit device" compels the conclusion that, in using the term "microcircuit device," the inventors were referring to the entire pattern exposed or imaged onto the wafer.

Notwithstanding the language of the claims and portions of the specification that suggest "microcircuit device" is synonymous with the photo-resist image, ASML contends that the purpose of the invention—namely, "to imag[e] larger devices having bigger overall dimensions and containing ever-increasing numbers of finely resolved elements," id. col. 1, ll. 13-16—requires a construction that limits "microcircuit device" to a single circuit or die. In making this argument, ASML points to portions of the specification in which the inventors use "microcircuit device" and circuit interchangeably to

describe how the process might be used to image layers of large circuits. See, e.g., id. col. 1, ll. 59-66 (indicating equivalence between "microcircuit device" and "circuit being imaged"); col. 5, l. 50, 64 (referring to the "mask circuit").

It is certainly the case that the inventors had certain expectations as to how the art would evolve, and framed their specification with those predictions in mind. These statements, however, do not speak to the operation of the invention. Whether the image being transferred will later form a component of one die or multiple die does not affect the manner of "imaging," or its result. The inventors claimed solely a method of image transfer; they did not claim any aspect of the resulting circuitry. Because the "content" of a mask pattern in no way alters the ability of one skilled in the art to perform the claimed method, we should not formulate our construction in those terms. As a matter of law, these statements of use within the '996 patent specification may not alter or undermine the very clear language of the claims. Our construction should be based on what actually was claimed—a method of transferring a pattern from the mask onto the wafer.

In sum, as used in the asserted claims of the '996 patent, the term "microcircuit device" refers to the pattern exposed in the photo-resist on the wafer, as the result of the practice of the method claimed by the '996 patent. The pattern exposed on the wafer will necessarily mirror the pattern on the mask. A "large microcircuit device," then, refers to a pattern on the wafer which, when measured in the diagonal, exceeds the diameter of the image field of the reduction lens.

As we have explained, the parties' focus in the trial court on the creation of a single die or multiple dies was misplaced. It was this misplaced focus, we think, that led the district court to incorrectly conclude that a "microcircuit device" is "a single imaged layer on a single die." We mention this point because the district court's claim construction decision reflects a great deal of thought and care—thought and care which we are confident would have led the court to the construction set forth above had either of the parties pointed it in that direction.

For the foregoing reasons, we reverse the district court's grant of summary judgment of non-infringement in favor of ASML. The case is remanded to the district court for determination of

infringement under the correct construction of the term "microcircuit device." See, e.g., NeoMagic Corp. v. Trident Microsys., Inc., 287 F.3d 1062, 1075-76 (Fed. Cir. 2002).

Each party shall bear its own costs.

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[1] The '996 patent explains that a lens of the type used in PRI has both a "viewing field," within which the mask must be placed, and an "image field," through which the reduced mask pattern is transferred to the wafer. See id. col. 1, ll. 49-59. We maintain that distinction throughout this opinion.

[2] In the prior art "step and repeat" processes, the mask was necessarily fixed in place. See id. col. 1, ll. 64-66. One of the innovations of the '996 patent is that both embodiments enable the movement of the mask relative to the lens.

[3] Before the district court, ASML pressed a counterclaim of invalidity against Ultratech. Following the judgment of non-infringement in ASML's favor, the district court dismissed the counterclaim without prejudice. Ultratech Stepper, Inc. v. ASM Lithography, Inc., No. C-00-04069-DLJ (N.D. Cal. Apr. 15, 2001).

[4] Although we employ the singular form of "mask" throughout this opinion, we do not intend to exclude the possibility that more than one movable mask might be used to image a large pattern onto the wafer. See id. col. 6, ll. 18-27 (presenting example in which "double reticles or masks" are used to image a single "microcircuit device"). In other words, by "mask," we refer to the entirety of the pattern to be imaged on the wafer through one iteration of the claimed process.