The opinion in support of the decision being entered today was *not* written for publication and is *not* binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte Peng Tan[1]

Appeal 2006-3235
Reexamination Control 90/006,696
Patent 4,682,857[2]
Technology Center 2800

Decided: March 28, 2007

Before JOHN C. MARTIN, LEE E. BARRETT, and JAMESON LEE, *Administrative Patent Judges*.

[1] The appellant is the patent owner, inventor Peng Tan. This reexamination proceeding was initiated at the request of a third-party requester, Philips Intellectual Property & Standards ("Requester"). *See* Request for Reexamination Transmittal Form, dated July 7, 2003.

[2] Based on Application 06/718,866, filed April 2, 1985.

MARTIN, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal under 35 U.S.C. §§ 134(b) and 306 from the final rejection of Claim 11[3] under 35 U.S.C. § 102(b) for anticipation by Aszodi.[4] We have jurisdiction under 35 U.S.C. §§ 134(b) and 306.

Although the patent under reexamination expired on July 28, 2004, which was during the course of this reexamination proceeding, we retain jurisdiction because a patent may be reexamined until the end of its period of enforceability,[5] which runs until six years after its expiration date. *See* 35 U.S.C. § 286.[6]

We affirm.

I. STATUS OF RELATED LITIGATION

The patent being reexamined (hereinafter "the '857 patent") was the basis for an infringement action styled *Peng Tan v. Advanced Micro Devices, Inc.*, C99-05228 MMC (N.D. Cal.). *See* Third Party Requestor's Statement In Support of the Request for Ex Parte Reexamination Under

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[3] Claims 1-10 stand allowed.

[4] G. Aszodi, J. Szabon, I. Janossy, and V. Szekely, *High Resolution Thermal Mapping of Microcircuits Using Nematic Liquid Crystals*, 24 Solid-State Electronics 1127-33 (1981). Br. Ex. C.

[5] *See* 37 C.F.R. § 1.510(a) (2006) ("Any person may, at any time during the period of enforceability of a patent, file a request for *ex parte* reexamination by the Office of any claim of the patent on the basis of prior art patents or printed publications cited under § 1.501.").

[6] 35 U.S.C. § 286 (2000) provides in pertinent part: "Except as otherwise provided by law, no recovery shall be had for any infringement committed more than six years prior to the filing of the complaint or counterclaim for infringement in the action."

37 C.F.R. § 1.510 (hereinafter "Reexamination Request"), dated July 7, 2003, at 5-6.[7] During the oral argument in this reexamination proceeding, Appellant's counsel explained that that action has been dismissed.

During that litigation, Advanced Micro Devices, Inc. moved for summary judgment against Claim 11 for invalidity under 35 U.S.C. § 101 and § 112, second paragraph. Reexam. Request 5-6 & Exhibits 7-10. The court denied the motion in an order entered April 24, 2000, on the ground that "the issue presented is inextricably linked to the Court's construction of Claim 11 and that it is inappropriate to construe the claim based on the record presented in connection with the instant motion." Order Denying Defendant's Motion for Summary Adjudication of Invalidity of Claim 11.[8]

The question of whether Claim 11 complies with 35 U.S.C. §§ 101 and 112 has not been raised and could not properly have been raised for consideration during this reexamination proceeding. Patentability challenges to Claim 11 are limited to unpatentability over prior patents and publication because no subject matter has been added to or deleted from the

[7] The Reexamination Request was accompanied by a "Declaration Under 37 C.F.R. § 1.131" by David L. Burgess (Attachment 1), a list of exhibits (Attachment 2), the exhibits themselves (Attachment 3) (hereinafter "Reexam. Ex. __"), and a PTO-1449 form (Attachment 4) listing the exhibits of Attachment 3 and other documents. Some of the Reexamination Exhibits are also exhibits to the Brief.

[8] This order is before us as the last two pages of the exhibits (Attachment 3) to the Reexamination Request. These two pages follow Exhibit 10 but are not marked as Exhibit 11. Although the list of exhibits (Attachment 2) includes an Exhibit 11 identified as U.S. Patent 3,934,199 to Channin, apparently no such exhibit was provided.

patent during this reexamination proceeding. 37 C.F.R. § 1.552 (2006).[9]

We presume for purposes of this appeal that Claim 11 satisfies the requirements of 35 U.S.C. §§ 101 and 112.

II. APPELLANT'S INVENTION

Appellant invented a method of using a nematic liquid crystal to detect a "hot spot" in an integrated circuit device. The various steps of the method are recited in detail in allowed independent Claim 1, on which allowed Claims 2-10 depend. Broadly speaking, these steps include applying a thin film of a liquid crystal to the surface of an integrated circuit die or wafer, illuminating the liquid crystal with polarized light, delivering a current to the integrated circuitry on the die or wafer, using a heating system to vary the temperature liquid crystal in the specific manner recited in the claim, and detecting changes in the polarization angle that indicate that the phase transition temperature of the liquid crystal has been exceeded in the corresponding portion of the die or wafer. Dependent claim 9 specifies that the liquid crystal comprises a nematic liquid crystal, or a cholesteric liquid crystal, or a smectic liquid crystal. Claim 10, dependent on claim 9,

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[9] § 1.552. Scope of reexamination in *ex parte* reexamination proceedings.

(a) Claims in an *ex parte* reexamination proceeding will be examined on the basis of patents or printed publications and, with respect to subject matter added or deleted in the reexamination proceeding, on the basis of the requirements of 35 U.S.C. 112.

(b) Claims in an *ex parte* reexamination proceeding will not be permitted to enlarge the scope of the claims of the patent.

(c) Issues other than those indicated in paragraphs (a) and (b) of this section will not be resolved in a reexamination proceeding. . . .

specifies that the liquid crystal is 4 "CYANO-4'HEXYL-BIPHENYL, [whose] trade name is K-18 nematic liquid crystal."

Claim 11, which is the subject of this appeal, reads:

> 11. A new use of liquid crystal for detecting hot spot on die or wafer with a hot spot detection method, said liquid crystal comprises:
> 4 CYANO-4'HEXYL-BIPHENYL, trade name is K-18 nematic liquid crystal[;] or
> 4 CYANO-4'PENTYL-BIPHENYL, trade name is K-15 nematic liquid crystal; or
> 4 CYANO-4'HEPTYL-BIPHENYL, trade name is K-21 nematic liquid crystal; or
> 4 CYANO-4'OCTYL-BIPHENYL, trade name is K-24 nematic liquid crystal; or
> 4 CYANO-4'NONYL-BIPHENYL, trade name is K-27 nematic liquid crystal; or
> 4 CYANO-4'DECYL-BIPHENYL, trade name is K-30 nematic liquid crystal; or
> 4 CYANO-4'UNDERDECYL-BIPHENYL, trade name is K-33 nematic liquid crystal; or
> 4 CYANO-4'DODECYL-BIPHENYL, trade name is K-36 nematic liquid crystal.

III. SUMMARY OF THIS REEXAMINATION PROCEEDING TO DATE

The Requester asserted that Claim 11 is anticipated by each of Aszodi, Stephens,[10] and Burgess/Tan,[11] Reexam. Request 7-14, and also unpatentable for obviousness over those and other references. *Id.* at 14-24.

[10] C.E. Stephens and F.N. Sinnadurai, *A Surface Temperature Limit Detector Using Nematic Liquid Crystals with an Application to Microcircuits*, 7 Journal of Physics E: Scientific Instruments 641-43 (1974). Br. Ex. J; Reexam. Ex. 6.

On September 23, 2003, the Examiner ordered reexamination of Claims 1-11. Order Granting/Denying Request for Ex Parte Reexamination (Paper No. 6).

In an Office action ("First Action") dated June 3, 2004,[12] the Examiner indicated that claims 1-10 are allowable and rejected Claim 11 for (1) anticipation by Aszodi under 35 U.S.C. § 102(b) and (2) anticipation by Burgess/Tan under 35 U.S.C. § 102(a).

Seven weeks later, on July 28, 2004, the '857 patent, which issued on July 28, 1987, with a seventeen-year term, expired.

On September 1, 2004, Appellant responded to the First Action by submitting a "Declaration of the Patentee Under 37 C.F.R. § 1.132" (Paper No. 11) and supporting declarations by Richard Yeager Moss II and Frank Jung[13] purporting to establish sole inventorship by Appellant of the subject matter the Examiner relied on in Burgess/Tan and thereby remove it as prior art.

In a December 21, 2004, final Office action ("Final Action"[14]), the Examiner (at 8-9) withdrew the rejection based on Burgess/Tan in light of the § 1.132 showing and repeated the rejection for anticipation by Aszodi.

Appellant responded on February 28, 2005, by filing declarations under 37 C.F.R. § 1.132 by Kin Ping Lim (Br. Ex. F) and Frank Jung

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[11] David L. Burgess and Peng Tan, *Improved Sensitivity for Hot Spot Detection Using Liquid Crystals*, 22nd Annual Proceedings of I.E.E.E. Reliability Physics Symposium, 1984, pp. 119-21. Br. Ex. E.

[12] Paper No. 7; Br. Ex. A.

[13] Exhibits A and B to Appellant's § 1.132 declaration.

[14] Paper No. 16; Br. Ex. B.

(Br. Ex. G) challenging the Examiner's interpretation of Claim 11 and his conclusion of anticipation by Aszodi. These declarations were accompanied by a paper entitled "Showing of Good and Sufficient Reasons Why the Declaration Under 37 C.F.R. § 1.132 Is Necessary and Was Not Earlier Presented."

The Appeal Brief was filed on April 22, 2005.

In an advisory Office action (Paper No. 24) mailed on April 27, 2005, the Examiner explained that he had considered the Lim and Jung declarations but would maintain the rejection.

A first Examiner's Answer was mailed on August 2, 2005, and a Reply Brief was received on October 6, 2005. Following a February 13, 2006, remand by the Board for clarification of certain matters, the Examiner mailed a revised Examiner's Answer on April 20, 2006 (hereinafter "Answer").[15] On May 5, 2006, Appellant filed a Supplemental Reply Brief directed to the revisions in the Answer. The Reply Brief and the Supplemental Reply Brief were entered and considered by the Examiner.[16]

The appeal was orally argued on January 9, 2007.

VI. ISSUES

The only question before us is whether Appellant has established that the Examiner erred in rejecting Claim 11 as anticipated by Aszodi. Resolution of this question requires consideration of the following issues:

1. What effect, if any, does the expiration of the '857 patent have on the construction of Claim 11?

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[15] Of the two Examiner's Answers, we have limited our consideration to the revised version.

[16] *See* Papers mailed November 18, 2005, and June 7, 2006.

2. Is Appellant correct to assert that the relevant field of endeavor is limited to failure analysis?

3. Is Appellant correct to construe the claim as limited to failure analysis?

4. Is Appellant correct to construe the claim as precluding the use of a mixture of liquid crystal materials?

5. Does Aszodi satisfy every limitation of the claim?

ISSUE 1 – WHAT EFFECT, IF ANY, DOES THE EXPIRATION OF THE '857 PATENT HAVE ON THE CONSTRUCTION OF CLAIM 11?

A. Facts

As noted above, the '857 patent expired seven weeks after the First Action was mailed and before Appellant's response thereto was filed.

B. Principles of Law

As explained in *In re Am. Acad. of Sci. Tech Ctr.*, 367 F.3d 1359, 1364, 70 USPQ2d 1827, 1830 (Fed. Cir. 2004):

> During examination, "claims . . . are to be given their broadest reasonable interpretation consistent with the specification, and . . . claim language should be read in light of the specification as it would be interpreted by one of ordinary skill in the art." *In re Bond*, 910 F.2d 831, 833 [15 USPQ2d 1566] (Fed. Cir. 1990); accord [*In re*] *Bass*, 314 F.3d [575,] 577 [65 USPQ2d 1156, 1158 (Fed. Cir. 2002)] ("[T]he PTO must apply the broadest reasonable meaning to the claim language, taking into account any definitions presented in the specification.").

(Bracketed citations in USPQ2d version.) "[T]he claims themselves provide substantial guidance as to the meaning of particular claim terms." *Phillips v. AWH Corp.*, 415 F.3d 1303, 1314, 75 USPQ2d 1321, 1327 (Fed. Cir. 2005) (en banc).

The policy basis for construing claims broadly during a reexamination proceeding is explained as follows in *Am. Acad.*, 367 F.3d at 1364, 70 USPQ2d at 1830:

> Construing claims broadly during prosecution is not unfair to the applicant (or, in this case [a reexamination proceeding], the patentee), because the applicant has the opportunity to amend the claims to obtain more precise claim coverage. *See* [*In re*] *Yamamoto*, 740 F.2d [1569,] 1571-72 [222 USPQ 934, 936 (Fed. Cir. 1984)] ("Applicants' interests are not impaired since they are not foreclosed from obtaining appropriate coverage for their invention with express claim language. An applicant's ability to amend his claims to avoid cited prior art distinguishes proceedings before the PTO from proceedings in federal district courts on issued patents. When an application is pending in the PTO, the applicant has the ability to correct errors in claim language and adjust the scope of claim protection as needed.").

We note that in *Ex parte Papst-Motoren*, 1 USPQ2d 1655 (Bd. Pat. App. & Int. 1986), the Board held on rehearing that *Yamamoto's* "broadest reasonable interpretation" standard was inapplicable because the patent had expired before the Board issued its initial decision on appeal, which is also the situation presented by the instant appeal.[17] The facts in *Papst-Motoren* were as follows. PTO records show that the order authorizing reexamination was issued on October 17, 1983. The patent expired on January 9, 1985, which was prior to the Board's February 27, 1986, initial decision on appeal. Papst-Motoren did not exercise its right to amend the patent claims or propose new claims prior to expiration of the patent, at which time that right

[17] Neither the Examiner nor Appellant has addressed *Papst-Motoren* or *Ex parte Bowles*, 23 USPQ2d 1015, 1017 (Bd. Pat. App. & Int. 1991), which applies the claim construction standard of *Papst-Motoren*.

expired pursuant to 37 CFR § 1.530(d) (1986) ("No amended or new claims may be proposed for entry in an expired patent. Moreover, no amended or new claims will be incorporated into the patent by certificate issued after the expiration of the patent."). Citing that provision, the Board held on rehearing that

> in reexamination proceedings in which the PTO is considering the patentability of claims of an expired patent which are not subject to amendment, a policy of liberal claim construction may properly and should be applied. Such a policy favors a construction of a patent claim that will render it valid, i.e., a narrow construction, over a broad construction that would render it invalid. *See Roberts Dairy Co. v. United States,* 530 F.2d 1342, 1367, [182 USPQ 218, 234] (Ct. Cl. 1976). *See also*, *ACS Hosp. Systems, Inc. v. Montefiore Hosp.*, [732 F.2d 1572,] 1577, [221 USPQ 929, 932 (Fed. Cir. 1984)]).

Papst-Motoren, 1 USPQ2d at 1656.[18]

[18] However, *Phillips*, 415 F.3d at 1327, 75 USPQ2d at 1336-37 explains that

> [w]hile we have acknowledged the maxim that claims should be construed to preserve their validity, we have not applied that principle broadly, and we have certainly not endorsed a regime in which validity analysis is a regular component of claim construction. *See Nazomi Communications* [*Inc. v. ARM Holdings, PLC*], 403 F.3d [1364,] 1368-69 [74 USPQ2d 1458, 1461 (Fed. Cir. 2005)]. Instead, we have limited the maxim to cases in which "the court concludes, after applying all the available tools of claim construction, that the claim is still ambiguous." *Liebel-Flarsheim* [*Co. v. Medrad, Inc*.], 358 F.3d [898,] 911 [69 USPQ2d 1801, 1811 (Fed. Cir. 2004)] [other citations omitted].

C. Analysis

We decline to follow *Papst-Motoren*[19] because, in our view, it misconstrues *Yamamoto*, which does not preclude application of the "broadest reasonable interpretation" standard to reexamination proceedings involving a patent that expired prior to entry of a Board decision on appeal. Instead, *Yamamoto* explains that claim interpretation standard applies where the patent owner had "an opportunity" to amend the claims, without indicating how long such an opportunity must last:

> An applicant's ability to amend his claims to avoid cited prior art distinguishes proceedings before the PTO from proceedings in federal district courts on issued patents. When an application is pending in the PTO, the applicant has the ability to correct errors in claim language and adjust the scope of claim protection as needed. This opportunity is not available in an infringement action in district court. District court[s] may find it necessary to interpret claims to protect only that which constitutes patentable subject matter to do justice between the parties. [*In re Prater*, 415 F.2d 1393,] 1404, 162 USPQ [541,] 550 [(CCPA 1969)].
>
> The same policies warranting the PTO's approach to claim interpretation when an original application is involved have been held applicable to reissue proceedings because the reissue provision, 35 U.S.C. § 251, permits amendment of the claims to avoid prior art. *In re Reuter*, 651 F.2d [751,] 756, 210 USPQ [249,] 253-54 [(CCPA 1981)]. The reexamination law, set forth below, gives patent owners the same right:
>
> > In any reexamination proceeding under this chapter, the patent owner will be permitted to propose any

[19] Neither *Papst-Motoren* nor *Bowles* constitutes binding precedent. *See Standards of Operating Procedure 2 – Publication of Opinions and Binding Precedent* (Revision 6) (Aug. 10, 2005) (hereinafter "SOP2") (available at: http://www.uspto.gov/web/offices/dcom/bpai/ stdproced.html).

> amendment to his patent and a new claim or claims thereto, in order to distinguish the invention as claimed from the prior art cited under the provisions of section 301 of this title, or in response to a decision adverse to the patentability of a claim of a patent. No proposed amended or new claim enlarging the scope of a claim of the patent will be permitted in a reexamination proceeding under this chapter.
>
> 35 U.S.C. § 305 (1982).
>
> Appellant therefore had an opportunity during reexamination in the PTO to amend his claims to correspond with his contribution to the art. The reasons underlying the PTO's interpretation of the claims in reissue proceedings therefore justify using the same approach in reexamination proceedings.

Yamamoto, 740 F.2d at 1572, 222 USPQ at 936-37. In this reexamination proceeding, the patent owner had an opportunity to amend the patent claims or propose new claims in response to the rejection given in the First Action but elected not to do so. This opportunity to amend continued for about seven weeks, at which time the '857 patent expired.

D. Conclusion

In accordance with *Am. Acad.* and *Yamamoto*, we will give Claim 11 its broadest reasonable interpretation consistent with the disclosure of the '857 patent.

ISSUE 2 -- IS THE RELEVANT FIELD OF ENDEAVOR LIMITED TO FAILURE ANALYSIS?

A. Facts (many of which are also relevant to Issue 3, involving claim interpretation)

The specification of the '857 patent

1. The title of the '857 patent is "Liquid Crystal Hot Spot Detection With Infinitesimal Temperature Control."

2. The "Background of the Invention" portion ("Background") of the '857 patent begins by explaining that liquid crystal materials are used for "analyzing integrated circuits":

> There are two distinct ways of using the liquid crystal properties for analyzing integrated circuits. These are:
>
> (A) using the light scattering property of the liquid crystal (see reference 3 [Fergason[20]] and 4 [Dixon[21]]), and
>
> (B) the phase transition property of the liquid crystal (see reference 1 [Hiatt[22]] and 2 [Fleuren[23]]).

Specification, col. 1, ll. 7-11.

3. The specification further explains that "[t]he invention uses the phase transition property of the liquid crystal" and that "[t]herefore, the discussion shall be limited to the hot spot detection method." *Id*. at col. 1, ll. 12-14. The specification does not define "detect," "hot spot," or "hot spot detection method."

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[20] J. L. Fergason, *Liquid Crystals in Nondestructive Testing*, 7 Applied Optics 1729-37 (1968) (not in evidence).

[21] G. D. Dixon*, Cholesteric Liquid Crystal in Nondestructive Testing*, Materials Evaluation, Jun. 1977, pp. 51-55 (not in evidence).

[22] John Hiatt, *A Method of Detecting Hot Spots on Semiconductors Using Liquid Crystals*, 19th Annual Proceedings of the IEEE Reliability Physics Symposium, 1981, pp. 130-3. Br. Ex. H.

[23] E.M. Fleuren, *A Very Sensitive, Simple, Analysis Technique Using Nematic Liquid Crystals*, 21st Annual Proceedings of the IEEE Reliability Physics Symposium, 1983, pp. 148-49. Br. Ex. I; Reexam. Ex. 1 (a better copy).

4. The specification discusses Hiatt and Fleuren without mentioning that they concern failure analysis. Specifically, the specification explains that the methods disclosed in Hiatt and Fleuren are unable to detect low-power hot spots:

> Both the cholesteric and nematic liquid crystal have been used for detecting hot spot (see reference 1[Hiatt] and 2 [Fleuren]). Hiatt . . . reported that with a cross polarized light and a LC-127 cholesteric liquid crystal, he obtained a spatial resolution of ten to twenty microns. Also, the heating was not used, therefore the lowest detectable power of the hot spot is in the range of one hundred to two hundred milliwatts. [Fleuren] reported the use of a N5 nematic liquid crystal phase to detect hot spots. The particular nematic liquid he used is called N5. He used a P.I.D. control and achieved a constant temperature of 0.1 degree [C]elsius to a specified temperature. He could routinely detect a hot spot of 100 microwatts or more, with the P.I.D. control. However, by chance, if the liquid crystal's ambient temperature happens to be much less than 0.1 degree celsius (say a 0.005 degree celsius) below the liquid crystal phase transition temperature, he could detect a lower power hot spot. He managed to detect a hot spot of 3.6 microwatts once.

Specification, col. 1, ll. 18-35.[24]

6. The specification asserts that Appellant's hot spot detection method is capable of routinely detecting hot spots having powers of as low as one or two microwatts. *Id.* at col. 1, ll. 57-62.

7. The "Summary of the Invention" ("Summary") in the specification similarly explains that "[t]his invention invented [sic] a few processes that significantly improve the effectiveness of the liquid crystal hot spot

[24] The only other discussion of Hiatt and Fleuren in the '857 patent (also in the Background) is to explain that "[p]rior to this invention, the heating mode was either conductive (see reference 2 [Fleuren]) or no heating at all (see reference 1 [Hiatt])." Specification, col. 1, ll. 47-49.

detection method in terms of the ability to detect the lowest power hot spot on a die or wafer." *Id.* at col. 2, ll. 48-51. The Summary makes no mention of testing failed or defective devices. Nor does the Abstract.

8. In the "Detailed Description of the Invention" (cols. 4-7), the first through penultimate paragraphs discuss applying the method of the invention to a "device under test, "device under test 4," or "the die 17 or wafer 40 under test" without indicating that the tested device, die, or wafer is a failed or defective device. *Id*. at col. 5, ll. 16-22 and 30-31; col. 6, ll. 5-7, 20-29, and 58-60. The first and only mention of a defective device in the Detailed Description appears in the ultimate paragraph thereof:

> For a typical pointed source hot spot of a typical integrated circuit (for example, a filament type of short in the diode of a[n] input pad of a DL 2416 integrated circuit), this method has been shown to be able to locate the center of the hot spot within 0.3 microns.

Id. at col. 7, ll. 55-59.

9. None of the claims of the '857 patent identifies the device being tested as a defective or failed device.

10. The Examiner argues that "hot spot detection method" is broad enough to read on causing a hot spot to be manifested visibly, whether or not its location is already known and whether or not it corresponds to a failed component, quoting the following definitions of "detect" in *The American Heritage Dictionary of the English Language* (4th ed. 2000): "1. to discover or ascertain the existence, presence, or fact of. 2. to discern (something hidden or subtle)" (hereinafter "*American Heritage* definitions"). Final Action 2-3.

11. Appellant argues that "hot spot detection method" is restricted to discovering the location of a hot spot for the first time and thus refers to detecting the location of a failed component, quoting the following definitions of "detect" in *Webster's New World Dictionary, 2nd College Edition* (date unknown): "finding something unknown" or "to catch or discover something hidden or not easily noticed" (hereinafter "*Webster's* definitions"). Br. 18.

12. As support for limiting the claimed "hot spot detection method" to failure analysis, Appellant notes that Hiatt and Flueren, which Appellant characterizes as incorporated by reference into the '857 patent, use their disclosed hot spot detection techniques exclusively for failure analysis. As further support, Appellant relies on Burgess/Tan and the declarations by Lim and Jung.

Hiatt (Br. Ex. H)

13. The title of the Hiatt article is "A Method of Detecting Hot Spots on Semiconductors Using Liquid Crystals." The term "hot spot" also appears in Figure 2 (at 130).

14. Hiatt's abstract specifically addresses failure analysis:

> This paper presents a failure analysis technique which uses cholesteric liquid crystals and polarized light to locate areas of high power dissipation on an integrated circuit. The technique is non-destructive and can be performed in a few minutes using common failure analysis equipment. An example is given involving the analysis of a CMOS latch-up mechanism.

Hiatt at 130.

15. Under the heading "Background," Hyatt explains that "[c]holesteric liquid crystals have been used to map surface temperatures in

a wide variety of applications." Hiatt at 130, 2d para. These applications include making thermal "color maps" of the surfaces of monolithic integrated circuits. *Id*. at 130, 3d para.

16. Under the heading "An Improved Method," Hiatt explains that his improved method employs a polarizing microscope and that heating a region of a cholesteric liquid crystal layer to a temperature above its cholesteric-isotropic phase transition temperature will cause that region to appear as a "black spot." *Id.* at 130, 5th para. The term "black spot" also appears at page 131, paragraph 6, and in the caption for Figure 7 (at 132).

17. The last paragraph under "Procedure" explains that "the method has the potential to make accurate junction-to-case thermal resistance measurements on semiconductors." Hiatt at 131, 1st col. There is no indication that this type of measurement is to be performed on a failed or defective device.

18. Hiatt discloses two examples of failed integrated circuits on the with the disclosed hot spot detection method was used: (a) a short circuit in a CMOS integrated circuit, *id*. at 131, and (b) a CMOS latch-up mechanism. *Id.* at 131. Hiatt concludes by stating that the method "has been used extensively to find the location of short circuits in integrated circuits, and it is a powerful tool for studying CMOS latch-up mechanisms" *Id.* at 133.

Fleuren (Br. Ex. I; Reexam. Ex. 1)

19. The title of the Flueren article is "A Very Sensitive, Simple, Analysis Technique Using Nematic Liquid Crystals." Reexam. Ex. 1.[25]

[25] The title is missing from the copy in evidence as Br. Ex. I.

20. Fleuren's "Summary" explains that the paper "describes a fast, cheap and nondestructive method to locate currents in semiconductors by visualizing very small temperature differences." Fleuren at 148, 1st col.

21. Under the heading "Introduction," Flueren explains that "[a] common characteristic of a failing device is excess current and/or current on [sic] the wrong time and/or place" and that nematic liquid crystals provide a nondestructive, fast, cheap, simple, and very sensitive tool to locate these currents. *Id*. Fleuren further explains that "[o]ften knowing the exact location of the failure is sufficient. If not, additional analysis with e.g. a SEM may be necessary." *Id.*

22. Under the heading "Principle of Operation," Fleuren explains that his technique employs a polarizing microscope and that any portion of the liquid crystal material heated above its anisotropic-isotropic transition or clearing temperature will appear as a "black spot." *Id*.

23. Although Flueren employs the term "black spot" but not "hot spot," the '857 patent is correct (at col. 1, ll. 24-25) to characterize Fleuren as disclosing hot spot detection, because it would have been understood that Fleuren's "black spots" are generated as the result of "hot spots."

24. Under the heading "Applicability," Fleuren states that "[n]early 10 years of experience have proven this technique as very valuable in (failure) analysis of semiconductor devices. Almost any kind of current conducting phenomena may be detected and/or localized." Fleuren at 148. Fleuren further explains that "[e]xamples of defects visualized with this technique are: parasitic and leakage currents, floating gates, isolation defects, interconnect opens and shorts, leaky junctions, diffusion defects and all kind of breakdown phenomena." *Id.*

25. Under the heading "Conclusion," Fleuren states that the disclosed thermotropic use of nematic liquid crystals "is nondestructive, fast, cheap, simple and very sensitive (.1 ºC and 1 μm^2) technique. It is applicable to all kind of semiconductor processes and has proven itself over the years as ideally suited for (failure) analysis purposes." *Id*. at 149.

Stephens (Br. Ex. J; Reexam. Ex. 6)

26. As rebuttal to Appellant's argument that "hot spot" detection is limited to failed or defective devices, the examiner relies on C.E. Stephens and F.N. Sinnadurai, *A Surface Temperature Limit Detector Using Nematic Liquid Crystals with an Application to Microcircuits*, 7 Journal of Physics E: Scientific Instruments 641-43 (1974) ("Stephens"). Answer 11.

27. Stephens discloses using any of various nematic liquid crystal materials for "hot spot detection" in microcircuitry that is not characterized as including a failed device:

> **3.3 Microcircuit hot spot detection**
> To illustrate the use of the technique in locating hot spots in microcircuits, an operational amplifier was coated with a nematogen film. Bias was applied to the circuit and the power dissipation increased until a dark area appeared in the film[,] which happened at the contact between a metal track and a diffused resistor (figure 4). The nematogen was then removed from the microcircuit surface, and the area around the hot spot was investigated with the infrared microradiometer, figure 5 indicating surface temperatures at various points in the vicinity of the hot spot. The isotropic transition of the nematogen gives a clearly visible profile confirming the infrared microradiometer measurements, but without the need for reference to calibrations.

Stephens at 642, 2d col. Stephens further explains, under the heading "3.4 Isothermal plotting," that

> [t]o assist in microcircuit design evaluation, the technique may be used to obtain isotherms of the die surface. . . .
>
> An increase in the hot stage temperature results in the same increase in the device surface temperature, thus producing dark areas wherever the threshold temperature is exceeded; successive incremental increases in hot stage temperature enable an isothermal profile to be built up.

Stephens at 643, 1st col.[26]

Sinnadurai (Br. Ex. L; Reexam. Ex. 4)

28. The two authors of the Stephens article (i.e., C.E. Stephens and F.N. Sinnadurai) are two of the three inventors named in British Patent Specification No. 1,442,802, entitled "Temperature Measurement Using Liquid Crystals" (hereinafter "Sinnadurai").

29. Sinnadurai discloses using the anisotropic-isotropic transition temperature of a liquid crystal material to locate a plurality of isotherms which can be used to generate a temperature profile of an active integrated circuit device. Sinnadurai at 1, ll. 10-15.

> In the case, for example, of the surface of an electrical component having a temperature field across it by virtue of an electrical dissipation within it, a temperature profile for the component surface can be built up by determining positions of isotherms for differing ambient temperatures of the component by the method described hereinbefore.

Id. at 1, ll. 81-89.

[26] As explained *infra*, Aszodi likewise uses the results of plural detection processes to form an isothermal profile of a device.

30. In a specific example, the disclosed method employs a nematic liquid crystal material (p. 2, l. 31) to generate isotherms for creating a temperature profile of a nichrome resistor (p. 2, l. 5), which is not characterized as failed or defective. *Id*. at 2, ll. 110-16. Sinnadurai explains that "due to thermal diffusion in the liquid crystal, the visible dark regions 12 are slightly larger than their associated component hot spots." *Id.* at 2, ll. 117-20.

31. In addition to being used to generate thermal profiles,

> [t]he method of the invention . . . may alternatively be used in the detection of a thermal limit to test integrated circuits against procurement specifications that set an upper limit to surface temperatures. In the latter application a nematogen is selected having an upper threshold temperature equal to the specification upper limit.

Id. at 2, l. 129 to p. 3, l. 6.

Burgess/Tan (Br. Ex. E; Reexam. Ex. 3)

32. The title of the Burgess/Tan article, which Appellant characterizes as incorporated by reference into the '857 patent (Br. 9-10), is "Improved Sensitivity for Hot Spot Detection Using Liquid Crystals."

33. The "Introduction" explains that "[l]iquid crystals have been used for failure analysis for several years" and briefly describes the disclosures of the Hiatt and Fleuren articles. Burgess/Tan at 119.

34. Burgess/Tan describes hot spot detection using K-18 nematic liquid crystal material. *Id.* at 119-20, under heading "Liquid Crystal Selection."

35. The article does not mention using either hot spot detection in general or the disclosed hot spot detection method for applications other than failure analysis.

Jung's and Lim's Rule 132 declarations (Br. Exs. F and G)

36. Jung and Lim each claim to be a person having ordinary skill in the art of failure analysis. Jung Decl. para. 3; Lim Decl. para. 1.

37. Jung testified that the '857 patent is "exclusively within the field of semiconductor failure analysis" and that "the term 'detecting hot spot' in claim 11 of the '857 patent has the same meaning as in the field of semiconductor failure analysis." Jung Decl. para. 8. Lim similarly testified that "in the '857 patent specification, the term 'hot spot detection method' means nothing but a failure analysis method." Lim Decl. para. 5.

38. Both declarants testified that a person having ordinary skill in failure analysis would have understood that the hot spot detection method disclosed in the '857 patent necessarily includes locating the center of the hot spot in order to identify the site of a failed component whose location was not previously known. Jung Decl. paras. 6-10; Lim Decl. paras. 3-10. Both declarants base that testimony on the example of a shorted diode given in the '857 patent specification and on the Hiatt and Fleuren articles. Jung Decl. paras. 9-10; Lim Decl. paras. 6-10.

39. Jung does not address Stephens or Sinnadurai, which describe using hot spot detection to generate isotherms and thermal profiles of nondefective devices. Lim discusses Stephens and Sinnadurai without acknowledging that aspect of their disclosures. Lim Decl. paras. 16-17.

Burgess's Rule 131 declaration (Reexam. Request Attachment 1).

40. Appellant correctly notes (Br. 16) that Mr. Burgess's Rule 131 declaration, filed with the Reexamination Request, implicitly limits the relevant field of endeavor to failure analysis by asserting that the subject matter of Claim 11 would have been "obvious to a person having ordinary skill in the field of failure analysis, generally, or hot spot detection, specifically" (Burgess Decl. at 7, para. 27) and "obvious to a person having ordinary skill in the field of fault analysis" (*id*. at 12, para. 44).

The Reexamination Request

38. As noted by Appellant (Br. 16), the Reexamination Request (signed by Requester's counsel, Mr. Westerlund) asserts: "The '857 patent discloses a particular method of detecting hot spots on a die or wafer under test, also referred to as a Device Under Test ('DUT'). Hot spots are produced at locations on a *failed* integrated circuit ("IC") wafer or die . . . ." Reexam. Request 1 (our emphasis).

B. Principles of law

The relevant field of endeavor must be determined before the claims can be construed. *See Phillips*, 415 F.3d at 1313, 75 USPQ2d at 1326 ("claims are construed . . . as they would be understood by persons in the same field of endeavor").

As explained in *In re Bigio*, 381 F.3d 1320, 72 USPQ2d 1209 (Fed. Cir. 2004), addressing the "field of endeavor" test for determining whether cited prior art is analogous[27]:

[27] As explained in *Bigio*, 381 F.3d at 1325, 72 USPQ2d at 1212:

> [The field of endeavor] test for analogous art requires the PTO to determine the appropriate field of endeavor by reference to explanations of the invention's subject matter in the patent application, including the embodiments, function, and structure of the claimed invention. *See Wood*, 599 F.2d at 1036 [202 USPQ at 174] (confining the field of endeavor to the scope explicitly specified in the background of the invention); *see also Deminski*, 796 F.2d at 442 [230 USPQ at 315] (determining that the cited references were within the same field of endeavor where they "have essentially the same function and structure").

381 F.3d at 1321, 72 USPQ2d at 1212 (bracketed citations in USPQ2d version.) The issue of what constitutes the relevant "field of endeavor" is a question of fact. *See Bigio,* 381 F.3d at 1324, 72 USPQ2d at 1211 ("The identification of analogous prior art is a factual question.").

The specification includes any subject matter properly incorporated by reference therein. As explained in *Cook Biotech, Inc. v. ACell, Inc*., 460 F.3d 1365, 1376, 79 USPQ2d 1865, 1872 (Fed. Cir. 2006):

> "Incorporation by reference provides a method for integrating material from various documents into a host document . . . by citing such material in a manner that makes clear that the material is effectively part of the host document as

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> Two separate tests define the scope of analogous prior art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed and, (2) if the reference is not within the field of the inventor's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved. *In re Deminski*, 796 F.2d 436, 442 [230 USPQ 313] (Fed. Cir. 1986); *see also In re Wood*, 599 F.2d 1032, 1036 [202 USPQ 171] (CCPA 1979).

(Bracketed citations in USPQ2d version.)

> if it were explicitly contained therein." *Advanced Display Sys., Inc. v. Kent State Univ.*, 212 F.3d 1272, 1282 [54 USPQ2d 1673] (Fed. Cir. 2000) (citations omitted). "To incorporate material by reference, the host document must identify with detailed particularity what specific material it incorporates and clearly indicate where that material is found in the various documents." *Id.* (citations omitted). Whether and to what extent material has been incorporated by reference into a host document is a question of law. *Id.*

(Bracketed citations in USPQ2d version.)

Expert testimony can be useful to establish that a term had a particular meaning in the art as well as to provide background on the technology at issue and explain how an invention works. *Phillips*, 415 F.3d at 1318, 75 USPQ2d at 1330. However, "the Board is entitled to weigh the declarations and conclude that the lack of factual corroboration warrants discounting the opinions expressed in the declarations." *Am. Acad.,* 367 F.3d at 1368, 70 USPQ2d at 1833.

Finally, unsubstantiated attorney argument is no substitute for competent, substantiated expert testimony. *Invitrogen Corp. v. Clontech Laboratories, Inc*., 429 F.3d 1052, 1068, 77 USPQ2d 1161, 1172 (Fed. Cir. 2005.

C. Analysis

The "Background" portion of the specification of the '857 patent begins by explaining that there two known ways of using liquid crystals for "analyzing integrated circuits" col. 1, ll. 6-7, and that the prior art methods disclosed in Hiatt and Fleuren employ the phase transition property. *Id.* at col. 1, ll. 10-11. The specification then goes on to explain that "[t]he invention uses the phase transition property of the liquid crystal" and that

"[t]herefore, the discussion shall be limited to the hot spot detection method." *Id.* at col. 1, ll. 12-14. The foregoing statements, in our view, identify the relevant field of endeavor as the use of the phase transition property of liquid crystal materials to detect "hot spots" in integrated circuits without regard to whether they include failed or defective components. For the following reasons we reject Appellant's position that the specification of the '857 patent further restricts the field of endeavor to failure analysis, i.e., the detection of hot spots generated by failed or defective components.

Appellant argues that failure analysis is implied by the phrase "hot spot detection." Specifically, Appellant contends (1) that "hot spot detection" means discovering the location of a hot spot for the first time, citing the *Webster's* definitions (i.e., "finding something unknown" or "to catch or discover something hidden or not easily noticed") and (2) that the only type of hot spot whose location is unknown prior to performance of the detection method is a hot spot generated by a failed component. Br. 19-20. The Examiner, on the other hand, argues that "hot spot detection" is broad enough to read on causing a hot spot to be manifested visibly, whether or not its location is already known, presumably relying on the second part of the *American Heritage* definition ("1. to discover or ascertain the existence, presence, or fact of. 2. to discern (something hidden or subtle)"). Final Action 3. As will appear, the Examiner's broader interpretation is both reasonable and consistent with the '857 patent disclosure.

As further support for restricting "hot spot detection method" to failure analysis, Appellant argues that Hiatt and Fleuren are incorporated by reference into the '857 patent and disclose using their spot detection methods exclusively for failure analysis. This argument fails for several

reasons. First, although Claim 11 is to be given the broadest reasonable interpretation consistent with the disclosure of the '857 patent, that disclosure does not include the entirety of the disclosures of the Hiatt and Fleuren articles. The '857 patent fails to indicate that Hiatt and Fleuren are incorporated by reference, let alone explain which parts which are being incorporated, as required to achieve a legally effective incorporation by reference. *Cook Biotech,* 460 F.3d at 1376, 79 USPQ2d at 1872. As a result, Hiatt and Fleuren are part of the '857 patent only to the extent they are discussed in the patent, which does not mention that they address only failure analysis.

Even assuming for the sake of argument that Hiatt and Fleuren are incorporated by reference in their entirety, Appellant's argument fails because nothing in those articles indicates that "hot spot detection" is a term of art that necessarily refers to failure analysis. To the contrary, Hiatt and Fleuren suggest that their methods are not limited to failure analysis. Hiatt, in the last paragraph under the heading "Procedure," explains that "the method has the potential to make accurate junction-to-case thermal resistance measurements on semiconductors," Hiatt at 131, an application which has not been demonstrated or even asserted to involve defective semiconductors. Fleuren explains in his "Conclusion" (at 149) that the disclosed thermotropic use of nematic liquid crystals "is applicable to all kind of semiconductor processes and has proven itself over the years as ideally suited for (failure) analysis purposes." The inclusion of "failure" in parentheses ahead of "analysis" suggests that failure analysis is only one type of analysis for which the method is suited.

Appellant also places undue reliance on the fact that the sole example of a hot spot given in the '857 patent is a hot spot generated by a failed diode. The passage in question reads:

> For a typical pointed source hot spot of a typical integrated circuit (for example, a filament type of short in the diode of a[n] input pad of a DL 2416 integrated circuit), this method has been shown to be able to locate the center of the hot spot within 0.3 microns.

Specification, col. 7, ll. 55-59. This discussion of a specific example would not have been understood to restrict Appellant's field of endeavor to failure analysis. In the first place, the short-circuited diode is characterized as a "typical pointed source hot spot," not as a "typical hot spot." Second, even if the passage had characterized a short-circuited diode is a "typical hot spot," its effect would simply have been to identify a nonlimiting example of a hot spot.

For the foregoing reasons, the relevant field of endeavor set forth in the specification appears to be the analysis of defective and nondefective integrated circuits by using the phase transition property of liquid crystal materials to detect "hot spots," i.e., areas having a temperature in excess of a predetermined temperature.

As further evidence that the field of endeavor of the '857 patent would have been understood to be limited to failure analysis, Appellant relies on the 37 C.F.R. § 1.132 declarations by Jung and Lim, each of whom identified his area of expertise as failure analysis, Jung Decl. para. 3; Lim Decl. para. 1, and testified that a person having ordinary skill in the art of failure analysis would have understood the '857 patent to be limited to failure analysis. Jung Decl. para. 8; Lim Decl. para. 5. For purposes of this

discussion, we assume that both have the qualifications to testify in that capacity; the examiner does not contend otherwise.

Because Jung and Lim are testifying as persons having ordinary skill in the field of failure analysis, their testimony sheds little light on the question of how the phrase "hot spot detection method" as used in the '857 patent would have been understood by a person having ordinary skill in the broader field of endeavor indicated by the '857 patent, i.e., the use of liquid crystals to detect hot spots in defective and nondefective integrated circuits. Their testimony is also unpersuasive even if we assume for the sake of argument that they are testifying as persons having ordinary skill in that broader field of endeavor. They have not testified that an artisan in that broader field of endeavor would have understood the terms "hot spot" and "hot spot detection" to be terms of art limited to failure analysis. Nor could they have given such testimony, since Stephens and Sinnadurai, which are in that field of endeavor, describe using their "hot spot" detection methods on nondefective devices for the purpose of generating isotherms and temperature profiles, Stephens at 643 (under heading "3.4 Isothermal Plotting"); Sinnadurai at 2, ll. 110-20, and also for testing integrated circuits against procurement specifications that set an upper limit to surface temperatures. Sinnadurai at 2, l. 129 to p. 3, l. 9. Instead, they testified that the artisan would have would have understood the phrase "hot spot detection method" as used in the '857 patent to be limited to failure analysis. As support for this conclusion they rely on the shorted-diode example given in the '857 patent and on Hiatt and Fleuren, which reliance is misplaced for the reasons given above.

For the foregoing reasons, the testimony of Jung and Lim fails to persuade us that the term "hot spot detection method" in the specification and Claim 11 of the '857 patent would have been understood to be limited to failure analysis.

Turning now to Burgess/Tan, that article is not even mentioned in the specification of the '857 patent, let alone incorporated by reference therein. Appellant is incorrect to treat it as incorporated by reference simply because it was cited during the prosecution of the '857 patent (Br. 9-10). Also, while it is true, as Appellant notes, that this article discusses hot spot detection solely in the context of failure analysis, this does not demonstrate that the terms "hot spot" and "hot spot detection method" would have been understood to be limited to failure analysis by persons working in the broader field of endeavor indicated by the '857 patent.

Appellant's reliance on Mr. Burgess's characterization of the field of endeavor of the '857 patent as "the field of failure analysis" (Burgess Decl. at 7, para. 27) and "the field of fault analysis" (*id*. at 12, para. 44) is misplaced because that characterization is unsupported by any analysis. *Am. Acad.*, 367 F.3d at 1368, 70 USPQ2d at 1833.

Appellant's reliance on the fact that the Reexamination Request (signed by Mr. Westerlund) describes hot spots as being produced by failed integrated circuits is misplaced because that description is unsubstantiated attorney argument, which is no substitute for competent, substantiated expert testimony. *Invitrogen*, 429 F.3d at 1068, 77 USPQ2d at 1172.

D. Conclusion

We hold that the relevant field of endeavor is the analysis of defective and nondefective integrated circuits by using the phase transition property of

liquid crystal materials to detect a "hot spot," which is a region having a temperature higher than a predetermined temperature.

ISSUE 3 – IS CLAIM 11 LIMITED TO FAILURE ANALYSIS?

A. Facts

The relevant facts are the same facts given above in the discussion of the field of endeavor.

B. Principles of Law

As explained above, Claim 11 will be given its broadest reasonable interpretation consistent with the patent specification. *Am. Acad.*, 367 F.3d at 1364, 70 USPQ2d at 1830; *Yamamoto*, 740 F.2d at 1571-72, 222 USPQ2d at 936. While such claim interpretation must take into account any definitions presented in the specification, *Am. Acad.,* 367 F.3d at 1364, 70 USPQ2d at 1830, limitations from examples given in the specification are not to be read into the claims. *Constant v. Advanced Micro-Devices, Inc*., 848 F.2d 1560, 1571, 7 USPQ2d 1057, 1064 (Fed. Cir. 1988). Nor is it proper to construe claims as limited to a preferred or sole embodiment. *Conoco, Inc. v. Energy & Envtl. Int'l LC*, 460 F.3d 1349, 1357-58, 79 USPQ2d 1801, 1807 (Fed. Cir. 2006) .

C. Analysis

For purposes of this appeal, we are construing Claim 11 to recite using "liquid crystal" to detect hot spots in a die or wafer, wherein the liquid crystal comprises K-18, or K-15, or K-21, or K-24, or K-27, or K-30, or K-

33, or K-36.[28] This appears to be the interpretation adopted by the Examiner and Appellant. Had the Examiner been of the view that the claim simply recites the liquid crystals materials in the alternative, he presumably would have rejected the claim for anticipation by K-18, which the specification indicates was obtained from E.M. Chemicals. Specification, col. 1, ll. 61- 64.

As support for construing the term "hot spot detection method" in the claim as limited to failure analysis, Appellant, Jung, and Lim essentially repeat their arguments for construing the field of endeavor as limited to failure analysis, arguments which are unconvincing for the reasons given above. Their reliance on the '857 patent's example of a short-circuited diode to limit the claimed "hot spot detection method" to failure analysis constitutes an improper attempt to read a disclosed example into the claim, *Constant,* 848 F.2d at 1571, 7 USPQ2d at 1064, or limit the claim to the sole disclosed embodiment. *Conoco,* 460 F.3d at 1357-58, 79 USPQ2d at 1807.

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[28] In the civil action, it was argued that a new use of a known composition must be claimed as a process under 35 U.S.C. §§ 101 and 100(b) and that Claim 11 is unpatentable because the limitation "for detecting hot spot on die or wafer with a hot spot detection method" recites an intended use rather than a process step. *See In re Moreton*, 288 F.2d 708, 709, 129 USPQ 227, 228 (CCPA 1961) ("[S]ince one cannot claim a new use per se, because it is not among the categories of patentable inventions specified in 35 U.S.C. 101, [the invention] is claimed as a method, as permitted by 35 U.S.C. 100(b)."); *In re Wiggins*, 397 F.2d 356, 359 n.4, 158 USPQ 199, 201 n.4 (CCPA 1968). It was further argued that because Claim 11 attempts to claim a process without reciting any process steps, it fails the definiteness requirement of 35 U.S.C. § 112, second paragraph. Because reexamination proceedings may not consider these issues for original claims, we express no opinion on those issues.

Appellant's contention that the claimed "detecting hot spot on die or wafer with a hot spot detection method" requires locating the "center" of the hot spot (Br. 18) is unpersuasive because it presumes, incorrectly, that the claimed is limited to failure analysis. Moreover, even assuming the claim were limited to failure analysis, it would not require locating the center of the hot spot rather than just the outline of the hot spot.

For the foregoing reasons, we hold that the phrase "detecting hot spot on die or wafer with a hot spot detection method" in Claim 11 would not have been understood to be limited to detecting a hot spot in a failed or defective device.

D. Conclusion

Claim 11 is not limited to failure analysis.

ISSUE 4 – DOES CLAIM 11 PRECLUDE THE USE OF A MIXTURE OF LIQUID CRYSTAL MATERIALS?

A. Facts

1. Claim 11 reads in pertinent part as follows:

> 11. A new use of liquid crystal for detecting hot spot on die or wafer with a hot spot detection method, said liquid crystal comprises:
> . . . K-18 nematic liquid crystal, or
> . . . K-15 nematic liquid crystal; or
> . . . K-21 nematic liquid crystal; or
> . . . K-24 nematic liquid crystal; or
> . . . K-27 nematic liquid crystal; or
> . . . K-30 nematic liquid crystal; or
> . . . K-33 nematic liquid crystal; or
> . . . K-36 nematic liquid crystal.

2. The only liquid crystal material mentioned in the "Detailed Description of the Invention" is K-18. (The other seven recited liquid crystal materials are mentioned only in Claim 11.)

3. The specification does not mention using a mixture of liquid crystals or liquid crystal materials for hot spot detection.

B. Principles of Law

"The word "comprising" transitioning from the preamble to the body signals that the entire claim is presumptively open-ended." *Gillette Co. v. Energizer Holdings, Inc*., 405 F.3d 1367, 1371, 74 USPQ2d 1586, 1590 (Fed. Cir. 2005).[29] A preamble is "an introductory phrase that may summarize the invention, its relation to the prior art, or its intended use or properties." Donald S. Chisum, 3 *Chisum on Patents* § 8.06[1][b][ii] (2003).

Nontransitional occurrences of "comprising" and "comprises" are "interpreted according to the normal rules of claim interpretation." *Moleculon Research Corp. v. CBS, Inc*., 793 F.2d 1261, 1272 n.8, 229 USPQ 805, 812 n.8 (Fed. Cir. 1986). As noted by Appellant, a nontransitional occurrence of "comprising" was given a closed construction in *Moleculon,* 793 F.2d at 1272 n.8, 229 USPQ at 812 n.8. However, nontransitional occurrences of "comprising" were construed as open-ended in *Versa Corp. v. Ag-Bag Int'l Ltd.*, 392 F.3d 1325, 1329, 73 USPQ2d 1191,

[29] In contrast, the transitional phrase "consisting of" signifies restriction and exclusion of unrecited steps or components, *Conoco*, 460 F.3d at 1360, 79 USPQ2d at 1808 (citing MPEP § 2111.03), and the transitional phrase "consisting essentially of" excludes ingredients that would materially affect the basic and novel characteristics of the claimed composition. *Atlas Powder Co. v. E.I. Du Pont De Nemours & Co.*, 750 F.2d 1569, 1574, 224 USPQ 409, 412 (Fed. Cir. 1984).

1194 (Fed. Cir. 2004) and *Georgia-Pacific Corp. v. U.S. Gypsum Co.*, 195 F.3d 1322, 52 USPQ2d 1590 (Fed. Cir. 1999), discussed infra.

C. Analysis

Appellant alternatively argues (1) that the term "comprises" in Claim 11 is not used as a transitional term and thus should be construed as closed and (2) that even assuming "comprises" is used as a transitional term, the resulting presumption of open-endedness of the claim has been rebutted by other language in the claim.

As support for the argument that "comprises" in Claim 11 is not a transitional term, Appellant contends that the language which precedes that term does not fit the above definition of "preamble" given in *Chisum on Patents* ("an introductory phrase that may summarize the invention, its relation to the prior art, or its intended use or properties") Br. 25. Because Claim 11 is not in the format of a conventional process or apparatus claim, we agree with Appellant that "comprising" as used therein is not a "transitional" term in the sense of the case law holding that transitional uses of "comprises" and "comprising" create a presumption that the claim is open-ended rather than closed.

As a result, we will construe "comprising" in Claim 11 according to the normal rules of claim construction, *Moleculon*, 793 F.2d at 1272 n.8, 229 USPQ at 812 n.8, which in this reexamination proceeding is the broadest reasonable interpretation consistent with Appellant's disclosure. *Amer. Acad.*, 367 F.3d at 1364, 70 USPQ2d at 1830; *Yamamoto*, 740 F.2d at 1572, 222 USPQ at 936-37.

The broadest reasonable interpretation of a nontransitional occurrence of "comprises" has been held to be open-ended one. As explained in *Versa*:

> After setting forth the "means . . . for creating air channels" limitation, that limitation is further defined by the next clause of the claim, which reads: "said means for creating air channels comprising positioning means which positions at least one elongated, perforated pipe . . . . '910 patent, col. 4, ll. 13-15. Although *"comprising" language is not limiting and may include features not recited in the claim*, such language cannot be read to require other structure.

392 F.3d at 1329, 73 USPQ2d at 1194 (emphasis added). Also, *Georgia-Pacific* gave an open-ended construction to the phrase "said mat comprising randomly distributed glass fibers bonded by an adhesive material" in the body of Claim 1 of Patent 4,810,569. As support, the court quoted MPEP § 2111.03 (6th ed. 1997) ("The transitional term 'comprising' . . . is inclusive or open-ended and does not exclude additional , unrecited elements or method steps") and also cited *Moleculon* and *In re Baxter*, 656 F.2d 679, 210 USPQ 795 (CCPA 1981). *Georgia-Pacific*, 195 F.3d at 1327-28 & n.4, 52 USPQ2d at 1595 & n.4.

Appellant is therefore incorrect to cite *Moleculon* as support for the general proposition that a nontransitional occurrence of "comprises" or "comprising" should be treated as a closed term. Furthermore, it is clear that *Moleculon's* closed construction of the nontransitional term "comprising" was due to the structure of the involved claim, which read:

> 3. A method for restoring a preselected pattern from sets of pieces which pieces have constantly exposed and constantly nonexposed surfaces, the exposed surfaces adapted to be combined to form the preselected pattern, which sets when in random engagement fail to display said preselected pattern which *comprises*:
>
> a. engaging eight cube pieces as a composite cube;
>
> b. rotating a first set of cube pieces *comprising* four cubes about a first axis;

> c. rotating a second set of four cubes about a second axis; and
>
> d. repeating steps (b) and (c) until the preselected pattern is achieved.

793 F.2d at 1263, 229 USPQ at 806-07 (emphasis added). The court construed the nontransitional "comprising" in step (b) as closed rather than open-ended because steps (a) and (c) differed from step (b) by not employing "comprising" or a similar term:

> 8. During the oral argument, Moleculon argued that the word "comprising" in step (b) ("rotating a first set of cube pieces comprising four cubes about a first axis") means that the step covers four cubes or more. "Comprising" is not used here as a transitional phrase and has no special legal effect as such. Hence, it should be interpreted according to the normal rules of claim interpretation. No analogous word precedes the structural recitation of the number of cube pieces in steps (a) and (c). "Comprising" in step (c) [sic, (b)] reasonably interpreted means "having" but not "having at least."

Moleculon, 793 F.2d at 1272 n.8, 229 USPQ at 812 n.8. This *Moleculon* holding clearly has no applicability to Appellant's Claim 11, which does not recite a plurality of steps, let alone at least one step that employs the term "comprises" or "comprising" and at least one step that does not.

For the foregoing reasons, we hold that "comprises" in Claim 11 is nontransitional and open-ended and thus does not preclude the claimed "liquid crystal" from being part of a mixture containing another liquid crystal material.

We would have reached the same conclusion regarding the scope of Claim 11 even if we had held that "comprises" is used therein as a transitional term and thus renders the claim presumptively open-ended.

As support for the argument that that even if "comprises" in Claim 11 is a transitional term, the resulting presumption of open-endedness of the claim has been rebutted, Appellant cites several decisions. The first is *Innovad, Inc. v. Microsoft Corp.*, 260 F.3d 1326, 59 USPQ2d 1676 (Fed. Cir. 2001), which held that the presumption of open-endedness of a claim that employed "comprising" as a transitional term had been rebutted to some extent by the use of the term "single" in a paragraph (designated f by the court) in the body of the claim. That paragraph read: "a single, bi-state switch operable from the exterior of said case for activating said signal means to produce said sequence of dual tone modulated frequency signals during said dialing mode corresponding to said digits in said reprogrammable memory means."[30] The court held that although the transitional term "comprising" permits more than one bi-state switch, "[t]he term 'single,' however, precludes the use of multiple [bi-state] switches to perform the activating function for one phone number." 260 F.3d at 1333, 59 USPQ2d at 1681. This decision has no bearing on Appellant's Claim 11, which does not employ the term "single" or an equivalent term.

Appellant (Br. 31) also relies on *AbTox, Inc. v. Exitron Corp.*, 122 F.3d 1019, 43 USPQ2d 1545 (Fed. Cir.), *modified on reh'g*, 131 F.3d 1009, 46 USPQ2d 1735 (Fed. Cir. 1997), wherein the court construed the claim term "a gas-confining chamber" to mean a single gas-confining chamber, noting, *inter alia*, that "[r]epeatedly, the claim refers to 'said chamber' as its describes various portions of the apparatus. This term itself, 'said chamber,' reinforces the singular nature of the chamber." 122 F.3d at

[30] The claim (claim 22) is reproduced in *Innovad* at 260 F.3d at 1329, 59 USPQ2d at 1677-78.

1024, 43 USPQ2d at 1548. This holding has no relevance to Appellant's Claim 11, which includes only one occurrence of "said liquid crystal."

Another argument by Appellant for treating the presumption of open-endedness as rebutted is that in contrast to the terms "method" and "process," which inherently are open-ended, the term "liquid crystal" used in the preamble of the claim would have been understood to mean "a single liquid crystal." Br. 26. We do not agree. The phrase "liquid crystal" without being preceded by "a" is broad enough to refer to a single liquid crystal material or to a plurality of liquid crystal materials. Moreover, even assuming for the sake of argument that "liquid crystal" should be construed to mean "*a* liquid crystal," that phrase would read on a mixture of liquid crystal materials because "a" in a claim is customarily construed to mean "one or more." *KCJ Corp. v. Kinetic Concepts, Inc.*, 223 F.3d 1351, 1357, 55 USPQ2d 1835, 1839 (Fed. Cir. 2000

Appellant also argues that the presumption has been rebutted because in contrast to open-ended method or apparatus claims, which are characterized by having the term "comprises" followed by a list of steps or elements joined by the connective "and," the term "comprises" in Claim 11 is followed by a plurality of elements connected by repeated occurrences of the disjunctive "or," a format Appellant contends conveys the meaning of "exclusive of others." Br. 26. We do not agree. Rather than implying exclusivity, the multiple uses of "or" would have been understood as simply making it clear to the reader before reaching the end of the claim that the liquid crystal materials are being recited in the alternative. Appellant's related contention that in order to be open-ended, the claim would have to use syntax such as "said liquid crystals comprise K18 and K24" (Br. 27) is

incorrect. Such a claim would be limited to a liquid crystal mixture containing both K18 and K24.

While Appellant is correct to note (Br. 31-32) that the "Detailed Description of the Invention" discusses the use of a single liquid crystal material, namely, K-18, and does not mention using mixtures of liquid crystal materials, those facts do not provide a sufficient basis for restricting the claim to the use of one liquid crystal material at a time. As already noted, it is improper to read limitations from examples given in the specification into the claims, *Constant*, 848 F.2d at 1571, 7 USPQ2d at 1064, or to construe a claim as limited to a preferred or sole embodiment. *Conoco*, 460 F.3d at 1357-58, 79 USPQ2d at 1807.

Finally, Appellant's reliance (Br. 25-30) on a number of district court decisions[31] is misplaced because those decisions are not binding precedent as to this Board. S*ee* SOP2.

D. Conclusion

Claim 11 does not preclude the use of a mixture of liquid crystal materials.

ISSUE 5 -- DOES ASZODI SATISFY EVERY LIMITATION OF CLAIM 11?

A. Facts

1. Aszodi (Br. Ex. C; Reexam. Ex. 5) describes the use of nematic liquid crystal materials to generate thermal maps of microcircuits and more particularly the use of mixtures of two nematic liquid crystal materials for

[31] *Tulip Computers Internationali B.V. v. Dell Computer Corp.*, 236 F.Supp.2d 364 (D. Del. 2002) (Br. 28-29); *Bristol-Myers Squibb Co. v. Immunex Corp.*, 86 F.Supp.2d. 447 (D.N.J. 2000) (Br. 25); *Novo Nordisk A/S v. Eli Lilly and Co.*, No. 98-643 MMS, 1999 WL 1094213, at *12-13 (D. Del. Nov. 18, 1999) (Br. 29).

that purpose. Aszodi at 1127, Abstract. One of these materials is 8CB (a.k.a. K24), one of the liquid crystal materials recited in Claim 11; the other is 80CB (a.k.a. M24), which is not recited in the claim.

2. Figure 1, *id.* at 1128, is a graph showing that the clearing point (i.e., nematic-isotropic transition) temperature of the mixture is a linear function of the proportions of M24 (80CB) and K24 (8CB). The left end point of the graph represents 100 mole percent of 8OCB (M24) and shows a transition temperature of about 80 ºC. The right end point represents 100 mole percent of 8CB (K24) and shows a transition temperature of about 40 ºC. Thus, neither end point represents a mixture.

3. The caption under Figure 1 explains that the small circle on the line representing the nematic-isotropic transition temperature corresponds to a specific example of a mixture containing 60 mole percent 8CB (i.e., K24) and 40 mole percent of 8OCB (i.e., M24). *Id.*

4. Figure 2 (at 1128) demonstrates that the liquid crystal material appears to be dark when it is in the isotropic phase (i.e., its temperature is at or exceeds the nematic-isotropic transition temperature).

5. Aszodi describes an experiment in which the M24/K24 mixture is used for thermal mapping of "a chip . . . from a commonly manufactured LED with an octagonal active area." *See* sentence bridging pages 1128 and 1131 (page 1129 consists of Figure 5; page 1130 is blank). Figure 4 (*id.* at 1131) illustrates the structure of the LED. Aszodi does not characterize this LED as being a failed or defective device.

6. Figure 5 (at 1129), which is nearly illegible in the photocopy of record, depicts a photomicrograph obtained during the experiment. The caption under this figure reads:

> Fig. 5. Original photomicrograph of part of a LED with octagonal dissipation area. The isotherm corresponding to 31.9 K [sic, ºC] is the boundary of the nematic-isotropic regions. Using a polarized incident light beam the isotropic region is the dark one. The evaporated Au-contacts can also be seen. Due to the higher current density (dissipation) near the contacts, the surface is at a higher temperature there.

Aszodi at 1129. Regarding this figure, Aszodi further explains: "The 'heating map' of the chip with a given electrical driving power as a parameter is illustrated in Fig. 5; this is a photomicrograph of an LED with a well-observable phase transition trajectory. For the sake of clarity only one isotherm is given." *Id.* at 1131, 1st col., 1st full para.

7. The caption for Figure 6 explains that Figure 6(a) is a temperature map of the same part of the LED that is depicted in Figure 5 and was constructed from eleven photographs. *Id.* at 1311.

8. Figure 6(b) shows the chip surface divided into temperature regions labeled T_1-T_6, of which T_6 is the smallest and hottest (i.e., 38 ºC).

9. The caption for Figure 6 describes Figure 6(b) as "a computer simulation for the thermal map of LED. . . . Dissipated power was 1 W." Regarding Figure 6(b), Aszodi further explains:

> To simulate the thermal properties of the LED in question (i.e. the isotherms corresponding to a given input power) we applied the computer program THERMANAL [endnote number omitted]. In Fig. 6(b) the shape of the thermal map and the relative differences in temperature between isotherms correspond to a dissipated power of 1W.

Id. at 1131, 1st col., 1st full para.

B. Principles of law

Anticipation is a question of fact. *Med. Instrumentation & Diagnostics Corp. v. Elekta AB,* 344 F.3d 1205, 1220, 68 USPQ2d 1263,

1275 (Fed. Cir. 2003). A claim is anticipated if each and every limitation of the claim is found in a single prior art reference. *Atofina v. Great Lakes Chem. Corp.*, 441 F.3d 991, 999, 78 USPQ2d 1417, 1423 (Fed. Cir. 2006).

Although the examiner previously asserted anticipation by the 100% K24 formulation that is one of the end points of Aszodi's Figure 1 graph, Final Action 6, the Examiner has abandoned that position because "*Aszodi* discloses a mixture of K-24 and M-24, and does not disclose using 100% K-24 with sufficient specificity (as argued by the patentee on p. 50 [of the Brief], and the examiner agrees)." Answer 15, last four lines. Page 50 of the Brief cites "Manual of Patent Examining Procedures § 2131.0" [sic], which we assume was intended to be a reference to § 2131.03 because that section quotes *Atofina's* holding that "the disclosure of a range is no more a disclosure of the end points of the range than it is of each of the intermediate points." *Atofina*, 441 F.3d at 1000, 78 USPQ2d at 1424.

Finally, we note that "[t]he discovery of a new property or use of a previously known composition, even when that property and use are unobvious from prior art, can not impart patentability to claims to the known composition." *In re Schreiber*, 128 F.3d 1473, 1477, 44 USPQ2d 1429, 1431 (Fed. Cir. 1997) (quoting *In re Spada*, 911 F.2d 705, 708, 15 USPQ2d 1655, 1657 (Fed. Cir. 1990)).

C. Analysis

For purposes of this analysis, we will focus on whether Claim 11 is anticipated by Aszodi's specific example of a 40/60 M24/K24 mixture.

Comparing Claim 11 to Aszodi, we agree with the Examiner (Answer 10) that the dark regions in the single microphotograph depicted in Figure 5 are the result of detecting hot spots in the LED chip and that Aszodi

therefore satisfies the preambular language, "A . . . use of liquid crystal for detecting hot spot on die or wafer with a hot spot detection method." As explained above, none of the claim language requires that the hot spot detection method be performed on a failed or defective device or precludes the location of the detected hot spot from being known prior to performance of the hot spot detection method. The body of the claim is satisfied because Aszodi's method employs K24, one of the claimed liquid crystal materials, in a mixture also containing M24 and the claim does not preclude a mixture of liquid crystal materials. Based on the same reasoning, the claim is also anticipated by the process of obtaining each of the eleven microphotographs used to create the temperature map depicted in Figure 6(a).

In view of the above, it is not necessary for us to consider the Examiner's alternative reliance on region T_6 in the temperature map depicted in Figure 6(b).

In addition to the arguments already addressed above, Appellant attempts to distinguish Claim 11 from Aszodi for reasons that have no basis whatsoever in the claim language. One such reason is that "Aszodi's thermal mapping method is done with respect to a known 'temperature range.' (Refer to Fig. 6(a), page 1131, Col. 1, paragraph 2)[.] As against this, in claim 11, there is no such 'temperature range.'" Brief 39, para. 4. Nothing in the claim precludes the detection of hot spots with respect to a known "temperature range."

Another argument having no basis in the claim language is the assertion that the phase transition sharpness of K24, recited in the claim, is almost 200 times greater than the phase transition sharpness of Aszodi's the M24/K24 mixture. Br. 39, para. 7. Specifically, Appellant characterizes

Aszodi's Figure 3 as showing an approximate sharpness of 0.2 ºC and contrasts that with the 0.001 ºC figure attributed to K18 at column 3, lines 61-66 of the '857 patent:

> One of the nematic liquid crystals used for this invention is 4 cyano-4'hexyl-biphenyl. It is sold by E.M. Chemical under the trade name of K-18 nematic liquid crystal. I found it has 4 phase transition temperatures; the temperature band width of each phase transition is estimated to be on the order of 0.001 degree Celsius.

Br. 39, para. 7. However, the claim places no restriction on the degree of sharpness of the phase transition. Nor is it material to the rejection that Aszodi fails to discuss the detectable power level of the hot spot, Br. 39, para. 8, since the claim does not address power levels. Furthermore, even if the results achieved by Appellant's invention are unexpectedly superior in the forgoing respects to those obtained by Aszodi, unexpected results cannot be relied on to overcome a rejection for anticipation. *Schreiber*, 128 F.3d at 1477, 44 USPQ2d at 1431; *Spada,* 911 F.2d at 708, 15 USPQ2d at 1657.

Nor does the claim preclude knowledge of the heater temperature, ambient temperature, and phase transition temperature, as is allegedly required by Aszodi. Br. 40, paras. 9-11.

D. Conclusion

The Examiner has established that Aszodi satisfies every limitation of Claim 11. Accordingly, the rejection of Claim 11 under 35 U.S.C. § 102(b) for anticipation by Aszodi is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended. *See* 37 C.F.R. § 1.136(a)(1)(iv)(2006).

AFFIRMED

LEE, *Administrative Patent Judge,* concurring.

Claim 11 begins with language introducing a "new use of liquid crystal" and further expressing that the new use is "for detecting hot spot on die or wafer with a hot spot detection method." The referenced "hot spot detection method" is not the claimed invention, but a redundant recitation of the intended use. No step of any method has been set forth in the claim. While Claims 1-10 are drawn to a method invention, Claim 11 is not. What we have in Claim 11 are just the intended use of a specified material and the material itself. Because the intended use of a material is not itself a recognized class of statutory subject matter for patenting, I would construe Claim 11 as a claim drawn to the material, accompanied by a recitation of the material's intended use. The law is clear that intended use is of no patentable weight and cannot distinguish the recited material or composition from the same composition or material in the prior art. *E.g., In re Schreiber*, 128 F.3d 1473, 1477, 44 USPQ2d 1429, 1431 (Fed. Cir. 1997). The patent owner acknowledges on page 50 of the appeal brief that K-24 nematic liquid crystal, octylcyanobiphenyl, was a known and preexisting material. Accordingly, whether or not Aszodi discloses "hot spot detection" is irrelevant. Aszodi refers to K-24 nematic liquid crystal, octylcyanobiphenyl, which the patent owner acknowledges as old. I would affirm the rejection of Claim 11 for anticipation on that basis alone.

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