UNITED STATES DISTRICT COURT
DISTRICT OF MASSACHUSETTS

TRUSTEES OF BOSTON UNIVERSITY, Plaintiff, v. EVERLIGHT ELECTRONICS CO., LTD., et al., Defendants.	Consolidated Civil Action No. 12-11935-PBS
TRUSTEES OF BOSTON UNIVERSITY, Plaintiff, v. EPISTAR CORPORATION, et al., Defendants.	Civil Action No. 12-12326-PBS
TRUSTEES OF BOSTON UNIVERSITY, Plaintiff, v. LITE-ON INC., et al., Defendants.	Civil Action No. 12-12330-PBS

MEMORANDUM AND ORDER

June 9, 2015

Saris, Chief Judge.

I. INTRODUCTION

Defendants move for summary judgment of invalidity of U.S. Patent No. 5,686,738 (the '738 patent), which relates to a two-step method of preparing gallium-nitride (GaN) films, a common

component of blue-colored light-emitting diodes (LEDs). The invalidity dispute involves the "non-single crystalline buffer layer" limitation in all asserted patent claims. The Court has construed the claim limitation "non-single crystalline" to mean "polycrystalline, amorphous or a mixture of polycrystalline and amorphous." Trustees of Boston University v. Everlight Electronics Co., Ltd., 23 F. Supp. 3d 50, 62 (D. Mass. 2014). Defendants argue that all asserted claims[1] of the '738 patent are invalid under 35 U.S.C. § 112, ¶¶ 1 and 2 on the grounds that (1) the patent's specification has no written description of a "non-single crystalline" limitation; (2) the disclosure does not

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[1] Claim 1 of the patent provides:

> 1. A semiconductor device comprising:
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> a substrate, said substrate consisting of a material selected from the group consisting of (100) Silicon, (111) silicon, (0001) sapphire, (11-20) sapphire, (1-102) sapphire, (111) gallium aresenide, (100) gallium aresenide, magnesium oxide, zinc oxide and silicon carbide;
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> a non-single crystalline buffer layer having a thickness of about 30A to about 500A, comprising a first material grown on said substrate, the first material consisting essentially of gallium nitride; and
>
> a first growth layer grown on the buffer layer, the first growth layer comprising gallium nitride and a first dopant material.

(Emphasis added).

enable a person skilled in the art to make and use the invention; and (3) the term "non-single crystalline" is indefinite. The Court assumes familiarity with the underlying technology. See id. at 53-57. After hearing (Docket No. 1065), Defendants' motion is **DENIED**.

II. STANDARD OF REVIEW

Issued patents are presumed valid under the Patent Act, 35 U.S.C. § 282. As a result, the party challenging the validity of patent claims bears the burden of showing by clear and convincing evidence that the patent is invalid. AK Steel Corp. v. Sollac & Ugine, 344 F.3d 1234, 1238-39 (Fed. Cir. 2003).

In deciding a case on summary judgment, the Court views the facts in the light most favorable to the non-moving party and makes all reasonable inferences in that party's favor. O'Connor v. Steeves, 994 F.2d 905, 907 (1st Cir. 1993). Summary judgment is appropriate when no genuine issue exists as to any material fact, and the moving party is entitled to judgment as a matter of law. Eli Lilly & Co. v. Barr Labs, Inc., 251 F.3d 955, 962 (Fed. Cir. 2001). "When evaluating a motion for summary judgment, the court views the record evidence through the prism of the evidentiary standard of proof that would pertain at a trial on the merits." Id. "Thus, a moving party seeking to invalidate a patent at summary judgment must submit such clear and convincing

evidence of invalidity so that no reasonable jury could find otherwise." Id.

III. DISCUSSION

A. Written Description of "Non-Single Crystalline" Limitation

Defendants argue that the '738 patent's specification does not contain an adequate written description of a GaN buffer layer that is "amorphous, polycrystalline or a mixture of amorphous and polycrystalline." Defendants contend that the specification does not expressly teach a non-single crystalline buffer layer for a completed device, pointing out that the specification never mentions the terms "non-single" or "polycrystalline." While they acknowledge that the specification describes an "amorphous" buffer layer, Defendants contend that it mentions "amorphous" to describe an intermediate state that is crystallized during the second step: as such, there is no amorphous buffer in the completed device. Defendants submitted extrinsic evidence to support their core contention that the patent's inventor, Dr. Theodore Moustakas, actually invented a "single crystalline" buffer layer, but added the modifier "non-single crystalline" on the suggestion of the Patent and Trademark Office examiner. Docket No. 881-3, Yoches Decl., Ex. 8C, Excerpts from File History of the '738 Patent, at 11-12. Defendants argue this was an opportunistic change unsupported by the specification.

A patent's written description "must convey with reasonable clarity . . . that, as of the filing date sought, [the patentee] was in possession of the invention, and demonstrate that by disclosure in the specification of the patent." Carnegie Mellon Univ. v. Hoffman-La Roche Inc., 541 F.3d 1115, 1122 (Fed. Cir. 2008) (internal quotation omitted). Assessing such "possession as shown in the disclosure" requires "an objective inquiry into the four corners of the specification from the perspective of a person of ordinary skill in the art." Ariad Pharm., Inc. v. Eli Lilly & Co., 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc). A "mere wish or plan" for obtaining the claimed invention is not an adequate written description. Regents of the Univ. of Cal. v. Eli Lilly & Co., 119 F.3d 1559, 1566 (Fed. Cir. 1997). The sufficiency of a patent's written description is ordinarily a question of fact, but "[a] patent also can be held invalid [as a matter of law] for failure to meet the written-description requirement based solely on the face of the patent specification." Centocor Ortho Biotech, Inc. v. Abbott Labs., 636 F.3d 1341, 1347 (Fed. Cir. 2011).

The specification of the '738 patent states that the buffer layer is amorphous at "the low temperatures of the nucleation step" and "can" be "crystallized" by heating. '738 patent at 2:40-42. In the description of the preferred embodiment, the patent states, "The buffer is the only part of the film which is

highly defective."[2] '738 patent at 4:49-50. As defense counsel conceded, the term "crystallized" includes a polycrystalline buffer layer, so the specification does disclose a polycrystalline buffer. Dkt. No. 1029, Ex. 22, Piner Depo. 44:5-6, 45:9-12 (pointing out that there can also be a polycrystalline layer with amorphous regions). Plaintiffs emphasize the word "can" to argue that the specification does not require that the amorphous layer ever crystallize. The plain meaning of "can" is "to be able to; to have the ability, power or skill to" or "to have the possibility." Random House Unabridged Dictionary 302 (2d ed. 1993). Plaintiff's expert, Dr. Piner, a professor of Physics and Material Sciences, Engineering and Commercialization at Texas State University, testified that "the '738 patent discloses that the buffer layer may be purely amorphous." Dkt. No. 945-2, Piner Decl. ¶ 35. Dr. Piner added that, in his own research, he has "directly observed a monocrystalline GaN growth layer 'on'[3] a 100% amorphous buffer layer." Id. at ¶ 37. Consistent with this plain meaning, Piner testified that "can crystallize" does not mean "must be crystallized." Id. at ¶ 35.

Despite this, Defendants argue that the patent specification

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[2] Because a single crystal can be "highly defective," the term "highly defective" in the specification does not resolve the question as to whether the buffer layer is monocrystalline.

[3] The Court defined the term "grown on" to mean "formed directly or indirectly above." Trustees of Boston University, 23 F. Supp. 3d at 59.

does not adequately describe a completely amorphous buffer layer in the completed device. In their view, the amorphous film crystallizes during the two-step process, and any further growth takes place on the crystallized GaN buffer layer. Therefore, Defendants insist that "can" crystallize should be interpreted to mean "must" crystallize. They point out that there is no evidence that one could make the claimed semiconductor device with a purely amorphous buffer layer. Defendant's expert, Dr. Eugene Fitzgerald, a professor of Material Sciences at MIT, testified as follows:

> Q. And during the high temperature growth step described in the '738 patent, the increase in the temperature causes the amorphous gallium nitride buffer layer to crystallize into a polycrystalline or mixed polycrystalline and amorphous layer of gallium nitride. Is that correct?
>
> A. Yes. It can do either. It could - if you're at high enough temperature, it could recrystallize into a single crystal. If you have the first layer too thick, it could - it could crystallize into amorphous and polycrystalline. There's a variety of outcomes. Yes.

Dkt. No. 945-3, Fitzgerald Depo. at 39:9-20. Defendants also cite the testimony of inventor Dr. Moustakas, who stated that one "would not be able to grow a single crystal on an amorphous buffer layer." Dkt. No. 945-4, Moustakas Depo. 200:18-204:4; but see id. 88:21-89-8 (stating he had grown a growth layer on top of a purely amorphous layer). The parties' experts, both eminently qualified, thus disagree whether a monocrystalline growth layer

may grow on an amorphous buffer layer. This debate is better resolved in the context of enablement. Summary judgment on whether the patent adequately describes an amorphous buffer zone in the claimed device is denied.

B. Enablement

Defendants assert that the '738 patent fails to teach how a person skilled in the art would grow a single-crystalline growth layer directly on top of an amorphous buffer layer.

To meet the enablement requirement, a patent specification must enable "one skilled in the art . . . [to] practice the claimed invention without undue experimentation." AK Steel Corp., 344 F.3d at 1244 (Fed. Cir. 2003) (citation omitted). The Federal Circuit has explained that the written description requirement and the enablement requirement are distinct, but they "often rise and fall together." Ariad, 598 F.3d at 1352.

Defendants argue that the plaintiffs have not enabled the full scope of their claimed invention. After the Markman hearing, I construed the term "non-single crystalline buffer layer" to mean "a layer of material that is not monocrystalline, namely, polycrystalline, amorphous, or a mixture of polycrystalline and amorphous." Trustees of Boston University, 23 F. Supp. 3d at 62-63. I drew this construction from Dr. Moustakas' express definition of "non-single crystalline" during the prosecution of the parent patent, '819, noting that his limitation of this term

for the parent application "applies with equal force to the '738 patent." Id. Based on this tripartite definition, Defendants argue that the patent must enable a semiconductor device containing a buffer layer that is polycrystalline, one containing a buffer layer that is amorphous, and one containing a buffer layer that is a mixture of polycrystalline and amorphous. Since, in Defendants' view, Plaintiffs have failed to show that the buffer layer can ever be purely amorphous, they contend the patent fails on enablement grounds.

Defendants base this argument in a number of cases indicating that, for a patent to be valid, the "scope of the claims must be less than or equal to the scope of the enablement." Sitrick v. Dreamworks, LLC, 516 F.3d 993, 995 (Fed. Cir. 2008) (where court construed claims to encompass an audio signal able to connect to both video games and movies, patent held invalid because it enabled only how to connect signal to video games); see also Automotive Techs. Int'l, Inc. v. BMW of North America, Inc., 501 F.3d 1274, 1277 (Fed. Cir. 2007) (where court construed phrase "corresponding structure" to include both mechanical switches and electronic switches, holding patent invalid because it enabled only mechanical switch); Liebel-Flarsheim Co. v. Medrad, Inc., 481 F.3d 1371, 1378-79 (Fed. Cir. 2007) (where claim encompassed injectors with pressure jackets and injectors without jackets, holding patent invalid because it

only enabled injectors with jackets); Tronzo v. Biomet, Inc., 156 F.3d 1154, 1158-59 (Fed. Cir. 1998) (holding that "the disclosure must describe the claimed invention with all its limitations"). Plaintiffs argue that a person of ordinary skill in the art could construct, without undue experimentation, a semiconductor device containing a fully amorphous buffer layer.[4]

Factual disputes remain regarding whether the full scope of the '738 patent is sufficiently enabled. It is clear, as BU's expert Dr. Piner stated, that at least some version of the claimed device can be created without any undue experimentation, since the patent teaches process parameters that are "clear, sufficiently concise, and sufficiently complete." Piner Decl. ¶ 38. Even Defendants' expert, Dr. Fitzgerald, stated that he had built a device using the process described by the '738 patent. Dkt. No. 945-3, Fitzgerald Depo. at 40:21-41:2. His tutorial explains how to make the device. Dkt. No. 295-1.

The harder question is whether the patent enables a device with a purely amorphous buffer layer. Defendants present evidence that Dr. Moustakas's contemporaneous research into gallium-nitride films dealt with single-crystalline buffer layers as

[4] At the hearing, Plaintiffs did remark in passing that "the case law is pretty clear that you only need to enable one mode of making the claimed invention." Docket No. 1072 at 58. However, Plaintiffs did not press this argument, either during oral argument or in the briefs, and cited no support in the case law.

opposed to non-single,[5] and argue that it is "impossible" to grow a single-crystalline growth layer directly on an amorphous buffer layer. Dkt. 879 at 4. But plaintiffs raise several points in response. For one thing, as discussed above, Dr. Piner testified that:

> I have directly observed a monocrystalline GaN growth layer on a 100 % amorphous buffer layer . . . Thus, my own published experience confirms that the growth layer described by the '738 patent can be grown on a purely amorphous buffer layer.

Dkt. No. 945-2, Piner Decl. ¶ 37. For another, Plaintiffs highlight that additional layers may exist between an amorphous buffer layer and a monocrystalline growth layer under the Court's construction of the phrase "grown on," which may mean "formed indirectly above." Trustees of Boston University, 23 F. Supp. 3d at 59 (emphasis added). Finally, Plaintiffs challenge Defendants' reliance on the views of Dr. Gopinath Menon, who, they argue, is currently a plastic surgeon and thus not a person of ordinary skill in the art. Dkt. No. 945 at 16. Based on this evidence, factual disputes preclude summary judgment on enablement.

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[5] Defendants cite these articles: Epitaxial growth of zinc blende and wurtzitic gallium nitride thin films on (001) silicon, 59(8) Appl. Phys. Lett. 944 (1991); Epitaxial growth and characterization of zinc-blende gallium nitride on (001) silicon, 71 J. Appl. Phys. 10 (1992); A Comparative Study of GaN Films Grown on Different Faces of Sapphire by ECR-Assisted MBE, 242 Mat. Res. Soc'y Symp. Proc. (Symp. G - Wide Band-Gap Semiconductors) 427, 427-28 (1992); Growth by GaN by ECR-assisted MBE, 185 Physica B: Condensed Matter 36, 45 (1993).

C. Claiming the Subject Matter and Definiteness

Defendants' last argument is that the asserted claims in the '738 patent are invalid under 35 U.S.C. § 112, ¶ 2 because (1) there is a contradiction between the claims and the specification; (2) the claims recite a limitation not disclosed in the specification; and (3) the term "non-single crystalline" is indefinite. The first two arguments appear to involve the same issues addressed in the discussion of enablement and written description. The third argument raises new issues.

Title 35 U.S.C. § 112, ¶ 2 states that a specification "shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention." The Federal Circuit has stated that ¶ 2 contains two requirements. First, the claims must set forth what the applicant regards as his invention. Allen Eng'g Corp. v. Bartell Indus., Inc., 299 F.3d 1336, 1348 (Fed. Cir. 2002). Second, the claim must set forth the invention with "sufficient particularity and distinctness, i.e., the claim must be sufficiently definite." Id. (quotation marks omitted); see also Nautilus, Inc. v. Biosig Instruments, Inc., ___ U.S. ___, 134 S. Ct. 2120, 2124 (2014).

For a patent specification to be invalid for indefiniteness, it must be "insolubly ambiguous," Halliburton Energy Servs. Inc. v. M-I LLC, 514 F.3d 1244, 1249 (Fed. Cir. 2008), such that

"reasonable efforts at claim construction prove futile." Exxon Research and Engineering Co. v. United States, 265 F.3d 1371, 1375 (Fed. Cir. 2001). Imprecise language is not enough to render a claim indefinite, because only a "reasonable degree of particularity" is required. Id. at 1381. "Claims amenable to more than one construction should, when it is reasonably possible to do so, be construed to preserve their validity." Karsten Manuf. Corp. v. Cleveland Gold Co., 242 F.3d 1376, 1384 (Fed. Cir. 2001). A Court's claim construction "need not always purge every shred of ambiguity," Acumed LLC v. Stryker Corp., 483 F.3d 800, 806 (Fed. Cir. 2007), and "some line-drawing problems may be left to the trier of fact." CardioFocus, Inc. v. Cardiogenesis Crop., 827 F. Supp. 2d 36, 43 (D. Mass. 2008). As the Federal Circuit has observed:

> Even if it is a formidable task to understand a claim, and the result not unanimously accepted, as long as the boundaries of a claim may be understood, it is sufficiently clear to avoid invalidity for indefiniteness.

Invitrogen Corp. v. Biocrest Mfg., L.P., 424 F.3d 1374, 1383 (Fed. Cir. 2005).

Defendants argue that the term “non-single crystalline” is indefinite because there is no accepted method in the field for determining whether a substance is single-crystalline versus non-single crystalline. Dr. Fitzgerald has testified that the easiest way to determine crystallinity is by a Transmission Electron Microscopy (TEM) diffraction. Dkt. No. 945-3, Fitzgerald Depo.

59:16-60:3. In his declaration, he stated: "There is no clear and accepted boundary between a single crystalline and a polycrystalline material." Dkt. No. 882 at 2. However, he also acknowledged that certain materials are considered single crystalline or polycrystalline but "when the crystallinity of a material is in the middle range between the two extreme, determining the crystallinity category of such a material is highly subjective and depends on the characterization technique." Id.; see also Molnar Depo. at 154:18-20 ("Again, I think single crystal versus polycrystal is a somewhat subjective term."). While the experts disagree on how to read the TEM diffraction patterns in this case, they do not disagree that TEM is a reliable method for determining crystallinity. Piner Decl. ¶ 47.

Similarly, both experts agree that certain kinds of high-angle "grain boundaries" indicate polycrystallinity, although they dispute whether a person of ordinary skill in the art would determine that the low-angle grain boundaries in the Exemplar buffer layers render those layers "non-single crystalline" or simply indicate defects in a monocrystalline layer. See Trustees of Boston University v. Everlight Electronics Co, Ltd., 2015 WL 2400760 at *3 (D. Mass. May 20, 2015) (denying Defendants' motion for summary judgment as to infringement of the '738 patent).

Finally, both experts agree that a person of ordinary skill would define a single-crystalline GaN layer by its defect

density. See Dkt. No. 945-3, Fitzgerald Depo. at 54:10-55:2 (stating that in the gallium nitride field, "a high quality single crystal . . . might have a defect density of 10 to the 8th dislocations per centimeter squared"); Dkt. No. 945-2, Piner Decl. at ¶ 49 (discussing the defect density in a non-single crystalline GaN buffer law as > 10^{10} or even 10^{12}). While the precise lines the experts draw with respect to dislocations differ, there are accepted lines for determining with reasonable certainty the boundaries for defect density between single crystalline and non-single crystalline layers. In sum, though, on the margin, there may be some ambiguity as to whether a layer is monocrystalline or polycrystalline, some imprecision does not invalidate a claim.

After a review of the record and the case law, I deny the motion for summary judgment on the ground that the patent is invalid for indefiniteness.

ORDER

Defendants' Motion for Summary Judgment of Invalidity (Docket No. 878) is **DENIED**.

/s/ PATTI B. SARIS
Patti B. Saris
Chief United States District Judge