THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 44

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte PLASMA PHYSICS CORPORATION

Appeal No. 95-0293
Reexamination Control No. 90/002,399

HEARD: February 10, 1995

Before HARKCOM, Vice Chief Administrative Patent Judge, McKELVEY, Senior Administrative Patent Judge, and BARRETT, Administrative Patent Judge.

HARKCOM, Vice Chief Administrative Patent Judge.

DECISION ON APPEAL

This appeal arises from a decision of a primary examiner rejecting claims 13-33, 42-65, and 69-75. We affirm-in-part.

BACKGROUND

Patentee filed the application that produced United States Patent 4,330,182 (the '182 patent) on April 9, 1980. It purports to be "a continuation-in-part of application Ser. No. [05/]857,690, filed Dec. 5, 1977, now U.S. Pat. No.

4,226,897." (1:6-8.) The '182 patent issued to John H. Coleman on May 18, 1982.

The subject matter of the '182 patent is semiconductor devices with a hydrogenated amorphous silicon layer and a boron-bearing layer forming a junction. Such devices include photovoltaic junctions, rectifying junctions, and image-forming devices. (1:9-2:10.) Although the title of the '182 patent is "Method of forming semiconducting materials and barriers", the claims are directed to devices.

A third party requested reexamination of claims 13, 15, 17, 18, 20-25, and 27-36 in the '182 patent. (Paper 1 at 1.) The examiner granted the request for reexamination. (Paper 7 at 1.) The examiner determined that the following references raised a substantial new question of patentability:

D.E. Carlson and C.R. Wronski, "Amorphous silicon solar cell", 28 Applied Physics Letters 671 (June 1976) (APL)

Carlson (Carlson '521)	4,064,521	Dec. 20, 1977
Carlson et al. (Carlson '506)	4,117,506	Sep. 26, 1978
Pankove	4,109,271	Aug. 22, 1978
Ovshinsky et al. (Ovshinsky)	4,217,374	Aug. 12, 1980 (filed Mar. 8, 1978)

The examiner finally rejected claims 13, 15, 18, 19, 22, 24, 42, and 44 under 35 U.S.C. § 102 in view of APL; claims 13, 15-25, 27-31, 42, 44, 48, and 50 under 35 U.S.C. § 103 in view of Carlson '521; claims 13-15, 17-31; 42, 44, 48, and 50 under § 103 in view of Carlson '521 and '506; claims 32 and 45 under § 103 in view of Pankove; and claims 64 and 65 under § 103 in view of Ovshinsky alone or in combination with Carlson '521. Moreover, the examiner rejected claims 32 and 45 under both §§ 102 and 103 in view of the following reference:

D.E. Carlson, "Factors influencing the efficiency of amorphous silicon solar cells", 35 & 36 J. Non-Crystalline Solids 707 (1980)[1] (JNCS)

The examiner also applied JNCS in combination with Carlson '521 or, alternatively, Pankove in combination with Carlson '521 to reject claims 33, 43, 49, 51, and 52 under § 103. New claims 46-62, 69-72, 74, and 75 were finally rejected under 35 U.S.C. § 112. We discuss the specifics of each rejection below.

DISCUSSION

[1] The examiner found that the requestor had established a publication date of February 28, 1980 for JNCS. (Paper 15 at 2.)

We note at the outset that Patentee and the examiner cannot agree on a proper grouping of the claims for the purposes of appeal. Compare Paper 34 at 10 and Paper 37 at 38 with Paper 35 at 7-8 and Paper 39. When these papers were filed, the test for grouping claims on appeal looked to the way the claims were actually argued. In re Nielson, 816 F.2d 1567, 1572, 2 USPQ2d 1525, 1528 (Fed. Cir. 1987); In re Beaver, 893 F.2d 329, 330, 13 USPQ2d 1409, 1411 (Fed. Cir. 1989). With this in mind, we will consider claims to be separately argued for each rejection only to the extent their limitations have been separately argued for that rejection. Cf. In re Geisler, 116 F.3d 1465, 1471, 43 USPQ2d 1362, 1367 (Fed. Cir. 1997) (Dependent claims stand or fall with their parent claim unless argued separately.).

We further note that Patentee has prosecuted this reexamination as "Inventor pro se, President, Plasma Physics Corp." (See e.g., Paper 34 at 1.) Strictly speaking, Patentee is not appearing "pro se", that is, on his own behalf. The '182 patent was assigned to Plasma Physics Corporation when it issued. No other assignment has been made of record. Hence, Patentee appears before us on behalf of the

patent owner, Plasma Physics Corporation.[2] 37 CFR § 1.33(c). Nevertheless, since Patentee does not appear to be a registered practitioner, we advise him that we must focus on what he has actually argued, not on what he intended to argue or what he might have argued. In re Wright, 999 F.2d 1557, 1563, 27 USPQ2d 1510, 1514 (Fed. Cir. 1993); accord Gechter v. Davidson, 116 F.3d 1454, 1460, 43 USPQ2d 1030, 1035 (Fed. Cir. 1997) (Focus is on contested limitations.).

Finally, Patentee states at several points in his brief that various corporations have licensed the '182 patent from Patentee. (e.g., Paper 34 at 23.) The evidentiary burden for secondary considerations rests with the Patentee. In re Paulsen, 30 F.3d 1475, 1482, 31 USPQ2d 1671, 1676 (Fed. Cir. 1994). The record does not contain any objective evidence of these licenses nor has Patentee explained the nexus of the licenses to the appealed claims. We note that neither the examiner nor the reexamination requestor has challenged the patentability of original claims 1-12. The unchallenged claims may be the basis for any licenses. Thus, we are left

[2] The examiner has not questioned the propriety of Dr. Coleman's representation of Plasma Physics Corp. before the Patent and Trademark Office.

with no objective evidence commensurate with any claim on appeal that the licenses reflect an objective decision by a former litigation opponent,[3] or anyone else, that the appealed claims are patentable.

A. Applied Physics Letters

The examiner rejected claims 13, 15, 18, 19, 22, 24, 42, 44, and 73 under 35 U.S.C. § 102(b) as anticipated by the APL reference. (Paper 22 at 2-4.) APL discloses efficient solar cells using thin films of amorphous silicon (a-Si) formed by glow discharge from silane (SiH_4). The a-Si was deposited on indium-tin-oxide (ITO) coated glass substrates at temperatures of 250-400EC. (APL at 671.) Typical solar cells discussed in the paper have the structure shown in Figure 1.[4] APL uses boron to dope the p-layer of the solar cells. (APL at 672,

[3] Patentee cites In re Hayes Microcomputer Prods., 982 F.2d 1527, 1544 n.12, 25 USPQ2d 1241, 1254 n.12 (Fed. Cir. 1992), for the proposition that settlement by a former opposing party is relevant evidence. We note that in the present case it was opposing counsel who filed the reexamination request. (Paper 1 at 2.) We further note that the evidentiary standard for unpatentability is different than the one for invalidity. In re Etter, 756 F.2d 852, 858-59, 225 USPQ 1, 5-6 (Fed. Cir. 1985) (in banc).

[4] Note that the voltage curve in Figure 1 is specific to devices #8-19, but the device structure is not restricted to those devices.

col. 1.) APL reports that one device had an open circuit voltage (V_{oc}) of 790 millivolts (= 0.79 V). The paper observes that this value may be close to the theoretical limit for such devices.

Claim 13, which comes from the original patent unamended, defines the subject matter of the invention as

> A semiconductor device comprising a body of hydrogenated amorphous silicon having one surface in contact with a body comprising boron to develop a semiconductor junction with enhanced open-circuit voltage.

(Emphasis added.) Although the APL paper does not state that its a-Si layers are hydrogenated (a-Si:H), it does refer (p. 671) to an article by Chittick et al. that the '182 patent cites as teaching the formation of a-Si:H by glow discharge from SiH_4. Moreover, Patentee does not contest this point.

The examiner and Patentee do contest, however, the meaning of "with enhanced open-circuit voltage." The examiner would have us ignore the phrase as meaningless. (Paper 22 at 2-3.) Patentee would have us read the phrase as the functional portion of a means-plus-function limitation. (Paper 34 at 11.) We disagree with both constructions. The phrase states a property of the semiconductor junction, not a function of some unidentified means. Thus, the phrase has a

meaning, but not the one Patentee suggests. To the extent the examiner is hinting that the phrase is indefinite, we note that we cannot reach that issue for original claims in a reexamination.[5] 37 CFR § 1.552(c).

Patentee urges that we should understand the phrase "with enhanced open-circuit voltage" to limit the claims to "the corresponding structures, material and acts described in the '182 specification". (Paper 34 at 11-12.) The "'body of hydrogenated amorphous silicon' [claim 13] and the 'body comprising boron and (carbon)' [claim 32] are said to be the means that function 'to develop a semiconductor junction' with enhanced open circuit voltage." (Paper 34 at 11.) Thus, under Patentee's construction, the silicon body and the boron-bearing body that form the semiconductor junction together form the means for producing enhanced voltage. This construction, which was presented for the first time during this reexamination, would make claims 13 and 32 improper single-means claims since no other structures are claimed. In re Hyatt, 708 F.2d 712, 714, 218 USPQ 195, 197 (Fed. Cir. 1983) (holding that all of the elements in the claim referred

[5] The phrase also appears in claim 32, which is also an original claim.

to the same means). Although we may not newly reject an original claim under § 112, we know of no authority--and Patentee has presented none--that would permit us to construe these claims in violation of § 112. We therefore reject Patentee's attempt to recast his claims as means-plus-function claims.

Patentee has the responsibility to claim particularly and distinctly the subject matter he regards as his invention. 35 U.S.C. § 112[2]. In a reexamination, claims are given their broadest reasonable interpretation. In re Yamamoto, 740 F.2d 1569, 1571, 222 USPQ 934, 936 (Fed. Cir. 1984). This is so because during a reexamination a patentee may amend the claims to define the invention appropriately. Id. at 1572, 222 USPQ at 936-37. We cannot read extrinsic limitations into a claim to clarify its meaning and avoid the prior art. In re Morris, 127 F.3d 1048, 1055, 44 USPQ2d 1023, 1028-29 (Fed. Cir. 1997). Thus, we decline to read "enhanced open-circuit voltage" to mean any voltage better than the prior art[6] because Patentee is obliged by statute to distinguish the claimed invention from the prior art. Id. at 1055, 44 USPQ2d

[6] Such an open-ended construction would also render the claim unduly broad. Hyatt, 708 F.2d at 714, 218 USPQ 197.

at 1029. Instead, we construe "enhanced open-circuit voltage" to be a property of a semiconductor device constructed as claimed since one similarly structured APL device had an open-circuit voltage approaching the theoretical limit. (APL at 673.) In re Swinehart, 439 F.2d 210, 212-13, 169 USPQ 226, 228-29 (CCPA 1971) (Where the Office reasonably believes a function is inherent, the applicant must prove it is not.). Although Patentee would distinguish the APL device with an open-circuit voltage of 790 millivolts because it is said not to have provided useful current (Paper 34 at 14-15), we note that the claims do not have any limitations regarding current levels.

Patentee also argues that a number of process limitations distinguish his claimed invention from the prior art. (Paper 34 at 16-18.) In particular, he points to his disclosure of deposition temperatures below 180EC with a resulting higher hydrogen-silicon ratio. (Paper 34 at 17.) We note that there are no hydrogen limitations in the claims covered by this rejection. Only claims 19, 42, and 44 (which were separately argued) present temperature limitations. The fourth paragraph of § 112 prevents us from interpolating limitations from dependent claims as Patentee suggests.

Transmatic, Inc. v. Gulton Indus., 53 F.3d 1270, 1277, 35 USPQ2d 1035, 1041 (Fed. Cir. 1995) (applying the doctrine of claim differentiation in the context of dependent claims). Indeed, if we know anything about the phrase "with enhanced open-circuit voltage", we know it must not be limited to "said body comprising boron is deposited at a temperature lower than about 180EC"[7] (claim 44) or to having a hydrogen content in excess of 30% and 32% for the N-type semiconductor and the boron-comprising bodies (claims 20 and 21, respectively) because these limitations are used to define dependent claims over their antecedent claims. Thus, we cannot read these limitations into the antecedent claims to avoid the prior art.

Claims 19, 42, and 44, which recite deposition temperature limitations, are separately argued. (Paper 34 at 17.) The specific claimed temperature limitations do not appear in the APL reference. The examiner notes that these limitations are product-by-process limitations and argues that subsequent annealing could undo the effects of low-temperature

[7] In any case, the '182 patent specification provides for depositing boron-bearing layers at temperatures above 600EC without comment on the effect on open-circuit voltage. (6:33-39.) The N-type layer may be deposited at temperatures up to 410EC. (3:44-48.)

deposition. (Paper 35 at 26-27.) Process steps in a product claim are limiting to the extent they further define the structure of the claim. In re Thorpe, 777 F.2d 695, 697, 227 USPQ 964, 965-966 (Fed. Cir. 1985). When the prior art appears to provide a product identical to the product claimed, the patentee has the burden to adduce evidence commensurate in scope with the claims that the products are in fact different. In re Marosi, 710 F.2d 799, 803, 218 USPQ 289, 292-93 (Fed. Cir. 1983).

Claims 19 and 44 require deposition at temperatures less than 180EC. Patentee has adduced evidence that deposition below 180EC results in higher hydrogen concentrations in hydrogenated amorphous silicon layers than occur at the prior art deposition temperatures. The specification, however, also allows for high-temperature (200-250EC) annealing after deposition (8:27-30). Claims 19, 42, and 44 do not explicitly exclude a subsequent annealing step. Reading the claims broadly, we do not see why we should read the claims to exclude annealing when Patentee had the opportunity during prosecution to limit his claims accordingly. One piece of evidence that Patentee submitted shows that annealing adversely affects hydrogen content. W. Beyer & H. Wagner, The

role of hydrogen in a-Si:H - Results of evolution and annealing studies, 59 & 60 J. Non-Crystalline Solids 161, 167 (1983) (Beyer). Thus, annealing may eliminate whatever structural differences might otherwise distinguish the claimed subject matter and the prior art. Patentee has the burden of proof on the effect of his process limitations. We find that the record does not support his argument that his process necessarily produces claimed structures different than those disclosed in the prior art.

The limitation in claim 42 has even less evidentiary support. In claim 42, the "body comprising boron is deposited at a first temperature and said body of hydrogenated amorphous silicon is deposited at a second temperature, said first temperature being lower than said second temperature." No temperature ranges are specified. The deposition temperatures could be well above 180EC and the difference between the first and second temperature could be insignificant (e.g., 1EC).[8] Patentee's evidence regarding deposition below 180EC is not commensurate in scope with claim 42. Thus, the evidence of

[8] By way of comparison, the APL reference teaches deposition over a range (250-400EC).

record does not support a finding that the device in claim 42 is distinct from the devices disclosed in the APL reference.

We affirm this rejection for claims 13, 15, 18, 19, 22, 24, 42, 44, and 73.

B. Carlson '521

The examiner rejected claims 13, 15-24, 25, 27-31, 42, 44, 48, 50, and 73 under 35 U.S.C. § 103 as obvious at the time of invention in view of the Carlson '521 patent. The Office cited the '521 patent during the original examination without basing any rejection on it. After the hearing in this appeal, the Court of Appeals for the Federal Circuit decided In re Portola Packaging, 110 F.3d 786, 790-91, 42 USPQ2d 1295, 1299 (Fed. Cir. 1997), in which it held that an original (or narrower) claim in a reexamination cannot be rejected solely over an originally cited reference even if the reference had not been used to reject those claims. All of the claims rejected in view of Carlson '521, except claims 50 and 73, depend from original claims 13 and 25[9]. The dependent claims are not broader than claims 13 and 25. 35 U.S.C. § 112, ¶ 4. Claims 50 and 73 are narrower because they include the

[9] Original claim 18 has been amended slightly. (Paper 10 at 2.)

structural limitations of claim 13 plus additional limitations (e.g., a semitransparent substrate and hydrogen in the boron body, respectively). Consequently, we must reverse the rejection of claims 13, 15-25, 27-31, 42, 44, 48, 50 and 73 without reaching the merits of the rejection of these claims.

C. Carlson '521 and Carlson '506

The examiner has rejected claims 13-15, 17-31, 42, 44, 48, 50, and 73 under § 103 in view of the '521 and '506 patents to Carlson. The examiner only relies on the '506 patent for the teaching of a tunneling barrier. (Paper 22 at 5-6.) The tunneling, or dielectric, barrier is only a feature of claims 14 and 26 (both original patent claims). Although we reversed the rejection of claims 13 and 25, the parents of claims 14 and 26, respectively, under § 103 in view of Carlson '521 alone as barred by the holding in Portola, that bar does not extend to this rejection, which relies in part on a reference not previously considered. Portola, 110 F.3d at 791, 42 USPQ2d at 1300 (A "rejection made during reexamination does not raise a substantial new question of patentability if it is supported only by prior art previously considered by the PTO".).

The Carlson '521 patent teaches that amorphous silicon is fabricated by a glow discharge in silane (SH_4). (2:39-41.) The amorphous silicon is hydrogenated. (6:16-29.) In one embodiment, Carlson discloses a semiconductor device of amorphous silicon (Fig. 5) with a transmissive electrode **128**, a P-type boron-doped layer **113**, a slightly N-type "intrinsic" layer **117**, an N-type layer **115**, and a second electrode **127**. Light **126** enters the PN junction through the P-type layer. (7:27-8:15.)

Patentee argues that we should limit the claims to the structures and processes disclosed in the specification. (Paper 34 at 25-26.) For the reasons previously discussed, we decline to do so except to the extent such limitations appear in the claims. Patentee particularly points to the 180EC deposition temperature and the hydrogen content limitations. (Paper 34 at 19.) These limitations do not appear in claims 14 or 26 or in their parent claims 13 and 25. In particular, parent claim 13 requires a hydrogenated amorphous silicon body in contact with a boron-bearing body with enhanced open-circuit voltage. The '521 patent teaches the claimed structure (Fig. 5, items 113 and 117, respectively;

7:27-48) and should thus inherently have the same property of enhanced open-circuit voltage. Swinehart, 439 F.2d at 212-13, 169 USPQ at 228-29. Patentee has not provided evidence commensurate with the scope of claims 13 or 14 that the open-circuit voltage for the claimed devices would be significantly different from the prior art devices.

Claim 14 further requires an amorphous silicon layer and a boron-doped layer with an dielectric barrier between one of those layers and an electrode. Claim 26 requires a similar structure, but with the additional requirement that electromagnetic radiation enter a PN junction through the amorphous silicon layer.

The Carlson '506 patent describes a Schottky photovoltaic device with a transmissive metal film **19**, an insulating barrier **18**, an amorphous silicon layer **13**, and another electrode **12**. Although Carlson reports that using two layers with similar conductivity types in place of layer **13** is "preferable" (2:20-23), the '506 patent does not require such a structure (see '506 claim 1). Carlson teaches that both layers may be P-type conductivity, with the layer closest to the insulator being only slightly P-type (i.e., an M/PP^+

Schottky barrier). (3:25-28.) Use of the barrier results in higher open-circuit voltages. (4:35-55.) The amorphous silicon layers are formed by glow discharge in silane (SiH_4) and, thus, produce hydrogenated amorphous silicon as in the '521 patent.

An M/PP^+ structure would meet the limitations of claim 14 since the claim does not exclude a hydrogenated amorphous silicon body that has been doped to be slightly P-type. According to the '506 patent, such a device would have "enhanced open-circuit voltage" by virtue of the M/PP^+ structure. (4:35-39.) Patentee's argument that M/PP^+ structures are unstable does not remove them from the prior art. Moreover, Patentee provides no evidence or claim language indicating that his structures are any more stable than Carlson's.

Patentee urges that the examiner erred because the Carlson '506 barrier material was found not equivalent in the claimed subject matter in a patent (5,073,804) issued to Coleman on December 17, 1991. (Paper 34 at 25.) Patentee has not, however, explained how that finding applies to the subject matter of claim 14 in this reexamination. The examiner (who is also listed as the examiner on '804 patent)

contends that the finding is irrelevant because the subject matter of the '804 patent is different. (Paper 35 at 39.) The independent claims of the '804 patent support the examiner's contention because the barrier material in these claims contains nitrides from the glow-discharge deposition of ammonia or amines. (10:8-36.) Patentee does not rebut the examiner's contention in the reply brief. (Paper 37 at 21-22.) In any case, we note that a possible mistake made in a previous examination does not compel the Office to repeat the mistake in a different examination. In re Cooper, 254 F.2d 611, 617, 117 USPQ 396, 401 (CCPA 1958) ("[T]he decision in this case [is] in accordance with sound law [and] is not governed by possibly erroneous past decisions by the Patent Office."). Accordingly, we affirm this rejection of claim 14.

The M/PP^+ structure would not meet the limitation in claim 26 requiring light to enter a PN junction through the amorphous silicon body. The examiner contends that it would have been obvious to make the amorphous silicon layers of two different types (slightly N-type by the insulator and P-type, i.e., M/NP^+). (Paper 35 at 38.) This contention, however, is refuted by the plain language of the '506 patent: "layer **14** could also be of P type conductivity, in which case, the

second layer **16** would be slightly P type." (3:27-28, emphasis added.) Thus, there is no motivation in the proposed combination to modify the disclosed structures in the manner the examiner suggests.

We affirm this rejection of claim 14 and reverse this rejection of claim 26. Patentee and the examiner only argued claims 13 and 25 separately, so claims 13, 15, 17-24, 42, 44, 48, 50, and 73[10] fall with claim 14, and claims 25 and 27-31 stand with claim 26.

We appreciate that our affirming the rejection of claim 13 in view of Carlson '521 and Carlson '506 may seem contrary to the spirit of Portola given that the '506 reference adds nothing to the analysis of claim 13. Portola is, however, distinguishable in three ways. First, the rejection involves a combination with a new reference, a situation not present in Portola. Second, Patentee chose to argue claims 13-15 and 17-24 as a group, so claim 13 is subject to the infirmities of any claim in the group. 37 CFR § 1.192(c)(7). Finally, when a narrower claim is properly

[10] Although claims 50 and 73 do not depend from claim 13, the reasons Patentee provides for reversing the rejection of claim 25 do not apply to these claims.

rejected for obviousness, the broader claim must also be rejected. In re Muchmore, 433 F.2d 824, 827, 167 USPQ 681, 684 (CCPA 1970). If we had reversed the rejection over the combination, as we did in the case of claims 25 and 26, then this sort of affirmance would not be appropriate; however, on the facts before us, Portola does not bar us from affirming the rejection of claims 13-15 17-24, 42, 44, 48, 50, and 73.

D. Pankove '271

The examiner has rejected claims 32 and 45 under § 103 as having been obvious in light of the '271 patent to Pankove. Claim 32 requires "a body of hydrogenated amorphous silicon having one surface in contact with a body comprising boron and carbon to develop a semiconductor junction with enhanced open circuit voltage." (Emphasis added.) Pankove teaches a semiconductor device of amorphous silicon and amorphous silicon carbide. The layers are prepared by a glow discharge in silane (SiH_4), with and without a doping gas, and, in the case of the silicon carbide, with a hydrocarbon. (1:40-47.) Figure 1 shows a doped silicon layer **12**, an intrinsic silicon layer **14**, and a doped silicon carbide layer **16**. (2:8-17.) "The first layer **12** is of one conductivity type, either P- or

N-type, and the third layer **16** is of the opposite conductivity type." (2:17-19, emphasis added.) Pankove uses trimethyl aluminum (CH_3Al) to give the third layer P-type conductivity. He also teaches that diborane (B_2H_6) may be the doping gas for a P-type layer. (5:35-38.) Pankove reports that "[t]he bandgap energy of a semiconductor material determines the solar radiation absorption capabilities of the semiconductor material." (2:39-42.) "Thus, the relatively wide bandgap of the amorphous silicon carbide transmits most of the useful spectrum to the first and second layers". (2:47-50.)

Affiant Christopher Wronski states that Pankove only teaches doping the silicon carbide layer with aluminum. (Paper 23½ at 3.) Affiant Wronski is literally correct, but Pankove also teaches using boron as a P-type dopant. Nothing in Pankove (or in Wronski's affidavit) bars using boron and aluminum interchangeably as P-type dopants. By way of comparison, the silicon layer is N-doped with phosphorus while the silicon carbide layer is N-doped with nitrogen. (5:40-44 & 62-65.) Absent some evidence or other clear teaching away from the substitution, a person having ordinary skill in the art reading Pankove's patent for all it fairly teaches would

have had motivation to use boron as a P-type dopant in either layer.

Patentee contends that Pankove's amorphous silicon carbide layer could not be doped with boron because the JNCS paper shows that boron adversely affects bandgap. (Paper 34 at 27.) The JNCS paper also teaches, however, that this problem can be addressed by adding a variety of elements, including carbon. (JNCS at 711.) It goes on to say that such doping would increase the built-in potential and might lead to enhanced open-circuit voltages. (APL at 711.) Thus, the JNCS paper does not support Patentee's contention that boron-doping would render Pankove's device inoperative.

Pankove teaches the limitations of claim 32. It shows a semiconductor device **10** with a hydrogenated amorphous silicon body **14** in contact with a P-type body **16** containing carbon, where boron could be the dopant. Patentee has not explained with specificity why Pankove's device does not inherently possess "enhanced open circuit voltage". Swinehart, 439 F.2d at 212-13, 169 USPQ at 228-29. For the reasons already discussed, we decline to interpret that phrase to require us

to read this claim as a single-means claim or to read in limitations from dependent claims (e.g., claim 43).

Claim 45 essentially repeats the limitations of claim 32 with the additional requirement that the boron/carbon body be deposited at a temperature less than 180EC. Pankove teaches deposition at 200-500EC. (5:35-44.) The examiner notes that this is a process limitation. (Paper 35 at 41.) The evidentiary burden to show a difference resulting from the process limitation rests with Patentee. Patentee points to Pankove's teaching that "[t]he average density of localized states of glow discharge amorphous silicon decreases with increasing deposition temperatures up to about 350EC". (3:34-37.) Patentee does not explain the relevance of this teaching to the deposition temperature of the claimed boron-doped amorphous silicon carbide, which is the substrate at issue in claim 45. Indeed, the same text indicates that purity of the silane is another critical factor in localized state density. (3:34-37.) Silane deposited with carbon and boron does not appear to meet Pankove's second condition. Moreover, Patentee does not demonstrate any critical structural difference between boron-doped amorphous silicon carbide deposited at

180EC and at 200EC. We therefore affirm this rejection of claims 32 and 45.

E. The JNCS reference

The examiner has also rejected claims 32 and 45 under § 102(a) as anticipated by, or under § 103 as having been obvious in light of, the JNCS article. (Paper 22 at 6.) In the JNCS paper, Carlson explains that "discharge-produced amorphous silicon contains significant amounts of bonded hydrogen (~10-50 at.%) so that now the material is often referred to as hydrogenated amorphous silicon (a-Si:H)." (p. 707.) The JNCS paper is directed to improving the performance of a p-i-n[11] solar cell on a metal substrate. Carlson notes that many of his suggestions would also be useful for Schottky and MIS devices. (p. 708.) The intrinsic layer can be an undoped amorphous silicon film. (p. 709.) The p-layer may be doped with boron. Carlson explains that boron-doping can cause problems, but does so in the context of explaining improvements. Significantly, in a section discussing improvements to p-layers, Carlson does not propose substituting any other dopant for boron, which suggests that,

[11] P-type layer, intrinsic layer, N-type layer. See Fig. 1.

for all its problems, boron is the best option. Instead, Carlson proposes adding various elements, including carbon, to the p-layer to counteract some of the problems boron causes. Adding carbon improves the bandgap, which might enhance open-circuit voltages to levels observed in undoped amorphous silicon. The contact electrode for the p-layer may be a "transparent conductive oxide (TCO) such as ITO, Cd_2SnO_4 or SnO_2 [tin oxide]". (p. 711.)

The JNCS paper teaches a p-i-n semiconductor device where the i-layer is hydrogenated amorphous silicon in contact with a boron-doped p-layer that may contain carbon, which may enhance open-circuit voltage.[12] Claim 32 requires no more. For the reasons already discussed, claim 32 cannot be considered to be a means-plus-function claim so it is not limited to structures recited in the specification. Although Patentee correctly notes that the results of Carlson's proposed modifications had not been thoroughly studied so that questions remained about their efficacy (Paper 34 at 29-30),

[12] Although the second Wronski affidavit contradicts this finding (Paper 23½, Aff. at 2-3), Wronsky provides no basis for his conclusions. In the face of the clear teaching in the JNCS paper, we do not find Wronski's contention to be credible.

Carlson still described them as ways to improve existing solar cells. Carlson never describes any of the modifications as inoperative and Patentee has produced no evidence to this effect. The requirements of § 102(a) are satisfied if "the invention was . . . described in a printed publication in this or a foreign country, before the invention thereof by the Applicant for patent". Carlson disclosed the broadly claimed subject matter of claim 32 in his JNCS paper before Patentee's filing date. Thus, we find that the JNCS paper anticipates the subject matter of claim 32. This finding also provides sufficient basis to affirm the rejection of claim 32 under § 103. Paulsen, 30 F.3d at 1481, 31 USPQ2d at 1675.

The JNCS paper does not teach a deposition temperature below 180EC for the boron/carbon-bearing layer as required by claim 45. The only temperature disclosed for the p-layer is 335EC (Fig. 2), which is nearly twice the claimed maximum. Our earlier finding that Patentee had not carried his burden of showing a difference between amorphous silicon layers deposited at 200EC versus less than 180EC does not extend to this large a differential. The preponderance of evidence supports Patentee's position that the structure of a boron-doped p-layer will be different if deposited at 335EC instead

of less than 180EC. Thus, the rejection of claim 45 under § 102(a) must be reversed. Since the examiner has not identified any motivation to modify the JNCS paper's teachings to satisfy the temperature limitation, we reverse the rejection under § 103 as well.

F. The JNCS/'521 and Pankove/'521 combinations

The examiner has rejected claims 33, 43, 49, 51, and 52 under § 103 as having been obvious in light of the Carlson '521 patent in light of either the JNCS paper or the Pankove '271 patent. All of these claims except claim 51 depend from claim 32, the rejection of which we have already affirmed in view of both JNCS and Pankove.

Claim 33 adds to claim 32 the limitation that the boron/carbon-bearing body lies between the amorphous silicon body and a conducting substrate. Carlson '521 discloses a conducting substrate. Transmissive electrode **128** is either transparent or semitransparent (7:53-55) and "may be a single layer of a material such as indium tin oxide or tin oxide which are both transparent to solar radiation" (7:57-60). Electrode **128** is a substrate in function, since it is the layer on which the boron-doped (P-type) layer **113** and then

subsequent layers are formed (8:48-9:28), in the same way that Patentee's semitransparent electrode **53** (7:48-51) provides the basis for the claimed substrate (Paper 37 at 20). The JNCS paper teaches a similar electrode (the TCO described at 711). Indeed, the '521 patent is cited in the first sentence of the paragraph in the JNCS paper discussing contact electrodes on the p-layer. The JNCS paper would have motivated one of ordinary skill in the art to add carbon to the boron-doped p-layer **113** in the '521 patent to obtain the bandgap improvements described in the JNCS paper (p. 711).[13] We therefore affirm this rejection of claim 32 over the JNCS paper and the '521 patent.

By contrast, the Pankove '271 patent uses a dot electrode **22** because the silicon carbide layer **16** is itself highly conductive although Pankove says that other electrodes could be used as well. (2:65-3:6.) Patentee's argument that a boron/carbon substrate would have poor electrical properties (Paper 34 at 34) seems at odds with the teaching of Pankove.

[13] Even if, as Patentee has argued, the JNCS paper is based on unproven results, that fact would not matter in an obviousness rejection because the teaching is sufficiently definite to provide motivation for the modification. In re Oelrich, 579 F.2d 86, 91, 198 USPQ 210, 214 (CCPA 1978).

Even if Patentee is right, the poor conductivity of the boron/carbon substrate would have provided the motivation to use the substrate-sized transmissive electrode **128** from the '521 patent instead of the dot electrode **22** in the '271 patent. If a boron-doped silicon carbide layer is a poor conductor, a larger electrode would have been necessary to overcome this disadvantage. This modification would be consistent with the theme in the JNCS paper of compensating for the disadvantages caused by boron-doping. We therefore also affirm this rejection of claim 32 over the '271 and '521 patents.

Claims 49 and 52 require that the substrate be semitransparent and exclude indium tin oxide. As we have previously explained, one embodiment of the transmissive electrode **128** in the '521 patent meets these limitations. (7:57-60.) The transmissive electrode **128** is part of the embodiment shown in Figure 5 of the '521 patent. A person having ordinary skill in the art would have been motivated to modify the Figure 5 embodiment to use carbon for the reasons taught in the JNCS paper. Similarly, a person having ordinary skill in the art would have had motivation to substitute the

transmissive electrode **128** for the dot electrode on Pankove's device. Thus, we affirm the rejections of these claims as well.

Claim 51 depends from claim 50. We have reversed the rejection of claim 50 under § 103 in view of Carlson '521 alone as barred by the holding in Portola. That bar does not extend, however, to this rejection, which relies in part on either of two new references. Portola, 110 F.3d at 791, 42 USPQ2d at 1300.

Carlson '521 discloses the structure of the device in claim 50. Figure 5 shows a photovoltaic device with a hydrogenated amorphous silicon body **117** in contact with a boron-containing body **113** to form a PN semiconductor junction. (7:27-48.) As previously noted, Carlson's device also has a semitransparent substrate **128** that may be a single layer of tin oxide (as opposed to indium tin oxide). (7:57-60.) The substrate **128** is in contact with the boron-containing body **113**. (Fig. 5.)

Claim 51 adds the limitation that the boron-bearing layer also contains carbon and hydrogen. As we noted earlier, amorphous silicon formed by glow discharge in silane is

hydrogenated (i.e., contains hydrogen). All three references use glow discharge in silane. We have also already explained how both Pankove and the JNCS paper provide the motivation to add carbon to a p-layer, which may be boron-doped, to improve bandgap. Thus, the combination of the Pankove '271 patent or the JNCS paper with the '521 patent would have suggested the structure of claim 51. We therefore affirm this rejection of claim 51.

Claim 43 requires that the boron/carbon-bearing layer be deposited at a temperature different than the deposition temperature of the amorphous silicon layer. Nothing in the language of claim 43 requires any specific temperature or range of temperatures. The claimed temperatures could be in the 200-500EC range recited in the '521 patent (8:54-63). Since the differences between the temperatures could be negligible, it is incumbent on the Patentee to show that this limitation would result in a material distinct from the prior art. The evidence of record does not support such a distinction so we affirm this rejection of claim 43.

As we have noted previously, Patentee's arguments concerning long-felt need and settlement of litigation are not commensurate with the scope of the appealed claims.

G. Ovshinsky alone or in combination with Carlson '521

The examiner has rejected claims 64 and 65 under § 103 in view of the Ovshinsky patent alone or in combination with the Carlson '521 patent. New claim 65 depends from original claim 13. New claim 64 is substantially the same as claim 65 except that it is written in independent form and lacks the "enhanced open-circuit voltage" limitation. We have noted that we may not reach the patentability of claim 13 in view of Carlson '521 alone. Portola, 110 F.3d at 791, 42 USPQ2d at 1300. That decision does not prevent us from reaching this rejection of narrower claims 64 and 65, which relies in part on a new reference to address the additional limitations.

We have previously discussed the relevance of Carlson '521 to claim 13. Claims 64 and 65 additionally require the boron-bearing body to be "fabricated by means of a glow discharge in a gaseous mixture comprising boron trifluoride." Ovshinsky's patent is directed to fabricating amorphous silicon films by glow discharge. He adds hydrogen and fluorine to eliminate localized states in the energy gap of solar cells. He teaches "at least two compensating or altering agents, like activated hydrogen and fluorine (e.g., atomic or ionic forms thereof) are preferably generated in the

vicinity of the substrate upon which the amorphous semiconductor film is depositing". (6:15-19.) Ovshinsky does not teach the use of boron trifluoride as a source of fluorine ions, although it plausibly could be a source of fluoride ions for a boron-doped substrate since the boron ions would be used as well. Ovshinsky teaches using "a p-dopant like aluminum, gallium or indium" (12:21-26), all Group III elements like boron, but does not expressly use boron as a p-dopant. (12:21-26.) The Carlson '521 patent uses boron as a p-dopant (5:46-48) and specifically uses diborane (B_2H_6) as a source of boron (6:56-63).

Patentee argues that the product of a fabrication using diborane and fluorine gases, the source materials expressly taught by the combined references, would be structurally different than a product made using boron trifluoride because diborane has a boron-boron bond, but boron trifluoride does not. (Paper 34 at 37.) This contention is, on its face, plausible. The examiner has not refuted the contention nor offered motivation to use boron trifluoride instead of, or at least in addition to, diborane and fluorine. The substitution, or addition, of boron trifluoride seems simple enough, but Patentee's unrefuted contention that it would

result in a different structure is sufficient for us to doubt that the claimed subject matter would have been obvious. We therefore reverse this rejection.

For the reasons we have previously discussed, we do not rely on Patentee's unsupported allegations of secondary considerations in reaching our conclusion.

H. "Polymeric structure"

The examiner has rejected new claim 46 and its dependent claim 47 under § 112 as lacking sufficient written description in the specification to support the "polymeric structure" limitation in claim 46. Claim 46 defines the boron-bearing body as "comprising a polymeric structure." The specification discloses the boron-bearing body as being amorphous, either amorphous boron (3:63-67) or boron-doped amorphous silicon (7:14-19) with or without carbon (7:28-31). The specification (including the original claims) does not describe a "polymeric structure".

The test for written description is satisfied if the patent specification describes the claimed subject matter in sufficient detail so one skilled in the art can clearly conclude that Patentee invented the claimed subject matter. Lockwood v. American Airlines, 107 F.3d 1565, 1572, 41 USPQ2d

1961, 1966 (Fed. Cir. 1997). The specification need not use precisely the same language as the claim, but "must contain an equivalent description of the claimed subject matter." Id. at 1572, 41 USPQ2d at 1966. Compliance with the requirements of § 112 is the Patentee's responsibility. Morris, 127 F.3d at 1056, 44 USPQ2d at 1029.

On appeal, Patentee points to his U.S. Patent 3,0669,283 ('283), issued December 18, 1962, at column 6 as support for the "polymeric structure" limitation. (Paper 34 at 38.) His '182 patent refers to the '283 patent during its discussion of boron trifluoride. (10:18-26.) Patent argues that the '283 patent was "incorporated by reference" to provide "essential material" as authorized by section 608.01(p) of the Manual of Patent Examining Procedure (MPEP). We need not decide whether the reference is properly incorporated under section 608.01(p) because the '283 patent does not support the claim either. Cf. Ex parte Raible, 8 USPQ2d 1709, 1710-11 (Bd. Pat. App. & Int. 1988).

The '283 patent does not disclose polymerization of compounds containing "boron, silicon, and hydrogen" (claim 46) or "boron, silicon, carbon, and hydrogen" (claim 47). Instead, the '283 patent generally refers to "monomers".

(1:54-61.) The sole monomer described in an embodiment is tetrafluoroethylene (C_2F_4), the monomer component of the familiar polymer TEFLON® (polytetrafluoroethylene). (3:49-55, 74.) The '283 patent notes that other organic and inorganic materials, including boron trifluoride, may be substituted for tetrafluoroethylene, but does not disclose a silicon source at all. The use of silicon may be possible within the teaching of the disclosure, but it is far from clearly taught.

Viewing the '182 patent in combination with the '283 patent does not solve the problem either. A description that renders obvious a claimed invention is not sufficient to satisfy the written description requirement for that invention. Lockwood, 107 F.3d at 1572, 41 USPQ2d at 1966. A description that does not even make the invention obvious will not qualify as sufficient written description. University of California v. Eli Lilly & Co., 119 F.3d 1559, 1567, 43 USPQ2d 1398, 1405 (Fed. Cir. 1997) (Eli Lilly). Since the JNCS paper teaches that "short polymer chains of $(SiH_2)_n$ appear to act as recombinations centers [which are] defects" (p. 710), one skilled in the art would not expect Patentee's device to be characterized by short polymer chains. The definition of amorphous materials excludes long polymer chains. (See the

Pankove '271 patent at 3:7-8, "An amorphous material is one which has no long range order in the periodicity of its constituent atoms.") Thus, the preponderance of evidence does not support a finding that the '182 patent clearly described a polymeric structure in a substrate containing boron, silicon, and hydrogen. We affirm this rejection of new claims 46 and 47.

I. "Semitransparent substrate"

The examiner has rejected new claims 48-52 under § 112 as lacking sufficient written support in the specification. (Paper 22 at 11-12.) Patentee does not argue these claims separately. Claim 48 requires a semitransparent substrate in contact with a boron-bearing body. The semitransparent substrate is selected from a group of conducting metal oxides excluding indium tin oxide.

We agree with Patentee that he has disclosed a semitransparent conducting metal oxide electrode **53** that may be a thin tin oxide substrate. (7:48-51.) In this decision, we have consistently read the term substrate broadly to include any supporting layers in the semiconducting device. We thus reject the examiner's contention that there is no semitransparent substrate disclosed. Claim 48, however,

exhibits several other defects. First, it is not clear what "conducting metal oxides" Patentee has disclosed for use as a semitransparent substrate other than tin oxide. When Patentee defines "a conducting metal oxide (CMO)" in a different embodiment, he includes rather than excludes ITO. (4:22-26.) Second, electrode **53**, on which Patentee relies, does not contact any boron-bearing layer. It is sandwiched between N-type layers **52** and **54**. (7:36-56.) Thus, it would not have been clearly apparent to one skilled in the art that Patentee possessed an invention including a semitransparent substrate excluding ITO and in contact with a boron-bearing body. Although Patentee contends that his invention avoids glow-discharge bombardment damage to Carlson's ITO layered, this would not have been apparent (or even relevant to the semitransparent substrate) from the portion of his disclosure that he cites in support of his contention. (Paper 34 at 39, citing 5:6-8.) Again, it is not enough for the claimed subject matter to have been obvious in light of other disclosures, and it certainly is not enough when the subject matter would not even have been obvious. Eli Lilly, 119 F.3d at 1567, 43 USPQ2d at 1405.

Patentee's proposed amendment (substituting "electrode" for "substrate") would not remedy the problems with the claims. We therefore affirm this rejection of new claims 48-52.

J. Open-ended Markush groups"

The examiner has also rejected new claims 48-51 under § 112 as being indefinite because they contain putative Markush groups that are open-ended. We need not reach the merits of this rejection because Patentee has not contested the rejection. Instead, he argues that the fault lies with the examiner for failing to assist him in drafting the claims. He requests a remand so he may receive such assistance.

The Patentee has the responsibility to define the claimed subject matter precisely during the reexamination. Morris, 127 F.3d at 1056, 44 USPQ2d at 1029. A remand at this stage would not necessarily lead to allowable claims. Patentee has had several interviews with the examiner and has submitted several amendments since the final rejection, but has not reached an accord with the examiner yet. Since we see little prospect for resolution on remand, we deny Patentee's request and, instead, affirm this rejection pro forma based on Patentee's concession.

K. "Crystallites essentially free of polycrystallites"

The examiner has rejected new claims 53-63 as lacking sufficient written and enabling description in the specification because he finds no basis for limitations relating to "crystallites" (claims 53-58 and 61-63) and "crystalline phase" (claims 59 and 60). (Paper 22 at 12.) The '182 patent discloses that for N-type layer **32,** "it is important to maintain the [chemical vapor deposition] temperature below the value where poly-crystallites form on a macro-scale and produce surface roughness which is damaging to the a-Si:H layers deposited subsequently." (3:39-43.) It further discloses that "a mixture of B_2H_6/SiH_4 may be used to CVD the layer **40** on stainless steel substrate **11** and at temperatures up to about 600EC. and above, provided the CVD temperature is maintained below the value where polycrystallites form and produce surface roughness." (6:33-38.) Thus, the '182 patent teaches using deposition temperatures up to, but not including, the point at which polycrystallites form and produce surface roughness. This teaching applies to both N-type and boron-bearing layers. We find Patentee's contention "that there is no way for poly-

crystallites to form on a macro-scale until crystallites are first formed, essentially free of polycrystallites on a macro scale" (Paper 37 at 35) to be persuasive. Since at least some crystallites will form before macroscale polycrystallites form, the specification adequately describes the claimed invention.

"[T]o be enabling, the specification of a patent must teach those skilled in the art how to make and use the full scope of the claimed invention without 'undue experimentation.'" In re Wright, 999 F.2d 1557, 1561, 27 USPQ2d 1510, 1513 (Fed. Cir. 1993). The specification instructs that avoidance of polycrystallites is a matter of remaining below a threshold temperature. (3:39-43.) For boron-bearing layers, the specification advises that the threshold temperature is around 600EC. (6:33-39.) Armed with this information, one skilled in the art should be able to fabricate an N-type or a boron-bearing body with crystallites, but essentially free of polycrystallites on a macro-scale, without undue experimentation. We therefore reverse this rejection.

L. "Means to enhance the barrier potential"

The examiner has rejected new claims 69 and 70 under § 112 as lacking sufficient written description of the claimed subject matter and as indefinite. (Paper 22 at 13.) Claims 69 and 70 recite a boron-bearing body with "means to enhance the barrier potential of said" PN and semiconductor junctions, respectively. The '182 patent never discloses "barrier potential" or means to enhance barrier potential in haec verba.

Patentee points to his U.S. Patent 4,226,897 ('897) patent for support. (Paper 34 at 40.) The '182 patent resulted from a continuation-in-part of the application that produced the '897 patent. The '897 patent discloses "enhanced barrier potential" in claim 1, which recites:

> The method of treating the surface of a semiconductor comprising subjecting the surface to activated gaseous species of nitrogen and hydrogen, coating said treated surface with a metallic oxide and active metal to form a Schottky barrier with enhanced barrier potential.

(Emphasis added.) The support in the '897 patent disclosure says:

> Referring again to the apparatus of FIG. **1**, I found that barrier-height and Voc of an untreated a-Si material may be increased by glow-discharging in N_2 gas instead of NH_3. However, using the structure

> of Fig. **2*a***, when layer **30** was formed from a N_2 discharge the increase in Voc amounts to only about 100 mV instead of 250 mV with NH_3. Also, nitrogen atoms (N.) produced an increased barrier.

(5:12-19.) We need not reach the question of whether the '897 patent was properly incorporated by reference because it does not disclose the claimed subject matter. Instead, the '897 patent discloses a process for enhancing Schottky barriers (metal/semiconductor junctions) using nitrogen gas. This is not the claimed subject matter. Moreover, Patentee's contention that "'barrier height and V_{oc}' are used interchangeably" (Paper 34 at 40) is not consistent with the '897 disclosure, which in the portion quoted above treats barrier height and open-circuit voltage separately. As previously noted, even if this disclosure would have made the claimed invention obvious, it is not sufficient to satisfy the written description requirement.

We are also uncertain what Patentee intended as the structure equivalent to the means to enhance barrier of the junction. According to Patentee, "in the '182 [patent] specification, such means as described in the specification and claims, including the act of deposition at temperatures below 180EC (claim 19), and the act of glow-discharging in

gases containing BF_3 and H_2, as described in the '182 specification at column 10, lines 18-27 (claims 64, 65) support such means".[14] Acts, however, correspond to process steps--not means--in claims drafted under the sixth paragraph of § 112. O.I. Corp. v. Tekmar Co., 115 F.3d 1576, 1582-83, 42 USPQ2d 1777, 1781-82 (Fed. Cir. 1997). The Federal Circuit has indicated that when a claim drafted in accordance with paragraph six lacks corresponding support in the specification, it is properly rejected as indefinite. In re Dossel, 115 F.3d 942, 946, 42 USPQ2d 1881, 1884-85 (Fed. Cir. 1997). Thus, we affirm the rejection under the first paragraph because the function is not adequately disclosed and under the second paragraph because the means is not adequately disclosed.

M. "Dielectric barrier opposite the boron-bearing body"

The examiner has rejected new claim 71 under § 112 as lacking sufficient written description in the specification. (Paper 22 at 14.) Claim 71 requires a hydrogenated amorphous silicon body and a boron-bearing body forming a PN junction in

[14] The junction itself cannot be the means since all of the elements in the claim define the junction. Thus, if the junction is the means, the claim would be a single-means claim.

which radiation enters through the silicon body and "a dielectric barrier is disposed on a second surface of said body of hydrogenated amorphous silicon opposite said body comprising boron." The examiner contends that in the disclosure, light enters the PN junction of the embodiment with a dielectric barrier through the boron-bearing body **60**. (Paper 22 at 14; Fig. 6.) Patentee points to the disclosure of the embodiment in Figure 3 for support, but that embodiment does not disclose a dielectric barrier. While it is true that the '182 patent as a whole discloses individual elements of claim 71, it does not disclose the whole subject matter. Even if it were obvious to combine the embodiments in Figures 3 and 6, it is not clear from the disclosure that Patentee intended that combination to be part of his invention. We therefore affirm this rejection of claim 71.

N. "Semiconductor junction comprises nitrogen and hydrogen"

The examiner has rejected new claim 72 under § 112 as lacking sufficient written description in the specification. (Paper 22 at 15.) Claim 72, which depends from allowed claim 35, requires a semiconductor junction formed between a hydrogenated amorphous silicon layer and a boron/carbon-bearing layer "in which said semiconductor junction comprises

nitrogen and hydrogen." We understand the claim to mean that at least one semiconducting layer forming the junction contains hydrogen and at least one contains nitrogen. Since one of the layers is "hydrogenated amorphous silicon" (claim 35), the presence of hydrogen is a given. The locus of the nitrogen, however, is obscure.

Patentee argues that "nitrogen and hydrogen were fully disclosed throughout the parent '897 specification in connection with enhanced voltage and enhanced barrier junctions containing excess hydrogen." (Paper 37 at 37.) We need not reach the question of whether the '897 patent was incorporated by reference because the '897 patent does not disclose the claimed invention. Instead, it teaches that an amorphous silicon layer is treated with nitrogen or ammonia (NH_3) gas to form a barrier layer in a Schottky (metal/semiconductor) junction (e.g., '897 claim 1.), not a junction between two semiconductors. There is no disclosure of a silicon body in contact with a boron/carbon-bearing body, one of which also contains nitrogen. Even if it were obvious to modify part of a semiconductor junction to be like a Schottky barrier, the fact that claimed subject matter would have been obvious is not sufficient to provide adequate

written disclosure of the invention. Eli Lilly, 119 F.3d at 1567, 43 USPQ2d at 1405.

O. "A ratio of boron to silane greater than 0.05"

The examiner has rejected new claim 74 under § 112 as lacking sufficient written and enabling description and as failing to claim the subject matter Patentee regards as his invention. (Paper 22 at 15.) Claim 74, which depends from claim 13, has two references to silane (SiH_4) as part of the boron-bearing body. Patentee concedes that "silicon" should replace "silane" in the claim and requests a remand to the examiner to make this change.

Patentee had previously tried to make this change after the final rejection. (Unnumbered draft amendment received November 12, 1993.) The examiner had declined this amendment because it "would raise new issues and require further examination." (Paper 33 at 2.) Review of this action lies with the examiner's group director. MPEP § 1002.02(c)(4)(b). Since Patentee concedes that he did not mean to use the term "silane" in the claim and does not otherwise challenge the substance of the rejections, we affirm these rejections of this claim.

P. "A maximum value exceeding 0.05"

The examiner has rejected new claim 75 under § 112 as failing to claim subject matter that Patentee regards as his invention because of the phrase:

> in which the ratio of boron to hydrogen has a maximum value exceeding 0.05.

(Paper 22 at 15-16.) Patentee concedes that the phrase is an error. (Paper 34 at 41-42.) In his brief, he proposes the following amendment:

> in which the ratio of hydrogen to silicon has a maximum value exceeding 32%.

(Paper 34 at 42.) Patentee first offered this amendment after the final rejection. (Unnumbered draft amendment received November 12, 1993.) The examiner declined this amendment because it "would raise new issues and require further examination." (Paper 33 at 2.) Review of this action lies with the examiner's group director. MPEP § 1002.02(c)(4)(b). Since the record reflects that the present claim 75 does not claim the subject matter that Patentee regards as his invention, we affirm the rejection.

DECISION

We affirm the examiner's rejection of claims 13, 15, 18, 19, 22, 24, 42, 44, and 73 under § 102(b) as anticipated by the Applied Physics Letters reference.

We reverse pro forma the rejection of claims 13, 15-25, 27-31, 42, 44, 48, 50, and 73 under § 103 based on Carlson '521.

We affirm the rejection of claims 13-15, 17-24, 42, 44, 48, 50, and 73 under § 103 as being directed to subject matter that would have been obvious to a person having ordinary skill in the art in light of Carlson '521 and Carlson '506. We reverse this rejection with respect to claims 25-31.

We affirm the rejection of claims 32 and 45 under § 103 in light of Pankove.

We affirm the rejection of claim 32 under §§ 102(a) and 103 in light of the JNCS reference, but reverse the rejection with respect to claim 45.

We affirm the rejection of claims 33, 43, 49, 51, and 52 under § 103 in light of Carlson '521 and the JNCS reference and, alternatively, in light of Carlson '521 and the Pankove reference.

We reverse the rejection of claims 64 and 65 under § 103 in light of Ovshinsky alone or in combination with Carlson '521.

We affirm the rejection of claim 46, and of its dependent claim 47, under § 112 as lacking sufficient written description in the specification.

We affirm the rejection of claims 48-52 under § 112 as lacking sufficient written description in the specification.

We deny the request for a remand and affirm pro forma the rejection of claims 48-51 under § 112 as being indefinite.

We reverse the rejections of claims 53-63 under § 112.

We affirm the rejections of claims 69 and 70 under § 112 as unsupported and indefinite.

We affirm the rejection of claim 71 under § 112 as unsupported by sufficient written description.

We affirm the rejection of claim 72 under § 112 as unsupported by sufficient written description.

We affirm the rejection of claim 74 under § 112 as unsupported, not enabled, and indefinite.

Finally, we affirm the rejection of claim 75 under § 112 as not claiming the subject matter Patentee regards as his invention.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a). See 37 CFR § 1.136(b).

AFFIRMED-IN-PART

GARY V. HARKCOM, Vice Chief Administrative Patent Judge	)	
FRED E. McKELVEY, Senior Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
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9	SAPJ McKelvey

AFFIRMED-IN-PART

HEARD: February 10, 1995

CORRECTIONS: