Paper No. 21

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

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*Ex parte* PAUL KLOCEK

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Appeal No. 1997-3696
Application No. 08/473,419

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ON BRIEF

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Before GARRIS, PAK, and TIMM, *Administrative Patent Judges*.

TIMM, *Administrative Patent Judge*.

## *DECISION ON APPEAL*

This is a decision on appeal under 35 U.S.C. § 134 from the examiner's final rejection of claims 61-68, which are all of the claims pending in this application.

## *THE INVENTION*

Appellant's invention relates to a method of forming a compound semiconductor material, a method of making silicon (Si) and germanium (Ge) crystals, and a crystalline material. Claims 61, 65, and 66 are illustrative:

61. A method of forming a compound semiconductor material, comprising the steps of:

(a) providing a vessel having a bottom;

(b) placing a flexible compliant carbon cloth containing substantially no contaminants adverse to the formation of said compound semiconductor material on said bottom of said vessel;

(c) forming said compound semiconductor material in crystalline form in said vessel and on said cloth; and

(d) removing said compound semiconductor material in crystalline form from said vessel and from said cloth.

65. A method of making Si and Ge crystals comprising the steps of:

(a) providing a vessel having inner walls and containing one of molten Si and Ge and water thereover, said water containing boron oxide; and

(b) cooling the molten Si or Ge to crystalline form progressively first in a predominantly horizontal direction from the bottom center of said vessel to the inner walls of said vessel and then predominantly vertically from the bottom toward the top of said vessel to form said crystal.

66. A crystalline material having a resistivity in the range of from about 0.7 to about 10 ohm-cm and an electron mobility greater than 3000 $cm^2$/volt-second.

## *THE REFERENCES RELIED UPON*

The prior art references of record relied upon by the examiner in rejecting the appealed claims are:

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| Ciszek et al. (Ciszek) | 4,243,471 | Jan. 6, 1981 |
| Bult et al. (Bult) | 4,585,511 | Apr. 29, 1986 |
| Naumann et al. (Naumann) | 4,738,831 | Apr. 19, 1988 |
| Matsuo et al. (Matsuo) | 4,888,242 | Dec. 19, 1989 |
| Miyazaki[1] (Japan) | 63-123,892 | May 27, 1988 |

We further rely upon the following prior art reference cited and applied by this panel of the Board in a new ground of rejection:

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|---|---|---|
| McNeely et al. (McNeely)[2] | 3,533,967 | Oct. 13, 1970 |

## *THE REJECTIONS*

Claims 61-64 stand rejected under 35 U.S.C. § 103 as being unpatentable over Miyazaki in view of Matsuo. Claim 65 stands rejected under 35 U.S.C. § 103 as being unpatentable over Ciszek

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[1]A translation of Miyazaki accompanies this decision.

[2]A copy of McNeely accompanies this decision.

in view of Naumann and Bult. Claims 66-68 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Miyazaki.

## *OPINION*

We reverse the rejections of claims 61-64 and 66-68 and affirm the rejection of claim 65. In addition, we enter a new ground of rejection with respect to claims 66-68.

***Rejection of Claims 61-64 over Miyazaki in View of Matsuo***

Claim 61 is directed to a method of forming a compound semiconductor material. A flexible compliant carbon cloth is placed on the bottom of a vessel and the compound semiconductor is formed on the cloth and then removed from the vessel and cloth. The cloth contains substantially no contaminants adverse to the formation of the compound semiconductor material.

Miyazaki describes a crucible used in a process of forming a semiconductor single crystal. The crucible is formed by roughening the surface of a quartz boat by, for instance, sand-blasting and then coating the roughened surface with carbon by, for instance, thermal deposition of hydrocarbons (translation, page 4, lines 5-9 and page 5, lines 2-19). The examiner has recognized that Miyazaki does not describe a flexible compliant carbon cloth on the bottom of the crucible and therefore the examiner looks to Matsuo to fill this gap. The examiner states that Matsuo teaches a graphite liner which is flexible and conforms to the crystal growth crucible and concludes that "[i]t would have been

obvious to one of ordinary skill in the art to modify the [Miyazaki] process by the teachings of the [Matsuo] reference to use a flexible graphite liner in order to create a uniform temperature in the vessel." (Answer, page 3).

We agree with appellant that the combined descriptions of Miyazaki and Matsuo do not fairly suggest the method recited in claim 61. What Matsuo describes is a sheet made by, for example, compression or roll forming a material constituted of graphite particles (col. 1, line 52 to col. 2, line 15). As shown in Figure 7, the graphite sheet material 21 is interposed between an upper quartz crucible 20 and a lower graphite crucible 19 (col. 4, lines 40-47). The sheet material serves to protect the underlying graphite crucible and assures a uniform temperature distribution, mitigates thermal impact and diminishes the expansion and contraction stresses due to the difference between quartz and graphite in coefficient of expansion (col. 4, lines 62-68). These are all good reasons for including a flexible graphite sheet between crucibles of differing materials, but a reason, suggestion or motivation to substitute a coating of carbon on a quartz crucible with a flexible cloth is lacking. The examiner indicates that one of ordinary skill in the art would have used a flexible graphite liner in the process of Miyazaki in order to create a uniform temperature in the vessel. However, it is not clear why a coating of carbon would have been expected to have a less uniform temperature distribution than a flexible sheet of graphite.

In our view, the reason, suggestion or motivation for making the combination, as expressed in the examiner's stated rejection, is not adequately grounded in the prior art. Accordingly, we reverse the examiner's rejection of claims 61-64.

***Anticipation of Claims 66-68 by Miyazaki***

The rejection of claims 66-68 rests on a theory that the Group II-VI single crystal semiconductors made by the process described by Miyazaki inherently possess the resistivity and electron mobility properties recited in the claims. "[I]t is elementary that the mere recitation of a newly discovered function or property, inherently possessed by things in the prior art, does not cause a claim drawn to those things to distinguish over the prior art." *In re Best*, 562 F.2d 1252, 1254, 195 USPQ 430, 433 (CCPA 1977)(quoting *In re Swinehart*, 439 F.2d 210, 169 USPQ 226 (1971)). Therefore, where the examiner has reason to believe that a property asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art product, the examiner possesses the authority to require an applicant to prove that the subject matter shown to be in the prior art does not in fact possess the property. *Id*. However, before an applicant can be put to this burdensome task, the examiner must provide enough evidence or scientific reasoning to establish that the examiner's belief that the property is inherent is a reasonable belief. *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Int. 1990); *Ex parte Skinner*, 2 USPQ2d 1788, 1789 (Bd. Pat. App. & Int. 1986). It must be remembered that the burden of establishing a

*prima facie* case of unpatentability rests upon the examiner. *In re Oetiker*, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992); *In re Piasecki*, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984). It is therefore incumbent on the examiner to provide a factual basis for the assertion of inherency which establishes its reasonableness. In the present case, the examiner has not discharged that burden.

Claim 66 is directed to a crystalline material having a resistivity in the range of from about 0.7 to about 10 ohm-cm and an electron mobility greater than 3000 $cm^2$/volt-second. The examiner states that Miyazaki "teaches the claimed semiconductor." (Answer, page 3). The examiner further states that the reference teaches forming a crystalline material by the method shown in the specification including using a carbon liner (Answer, page 5). However, as pointed out by appellant at pages 3-4 of the Reply Brief, the process described by Miyazaki is not the same as that described in the specification. For instance, Miyazaki describes a three temperature horizontal Bridgeman method using a carbon covered quartz crucible for growing the crystals (English abstract; translation, page 2). The specification describes a vertical growth method using a graphite crucible covered with a carbon cloth. The specification indicates that the process overcomes limitations in the Bridgeman process and results in a more uniform and controllable resistivity. The examiner has not provided any convincing technical reasoning or objective evidence tending to show that the differences in the processes would not result in differences in the material. We note that the specification itself seems to indicate that differences in the

processes do result in differences in the crystals obtained. We therefore conclude that a *prima facie* case of anticipation over Miyazaki has not been established.

***New Ground of Rejection***

Pursuant to our authority under 37 CFR § 1.196(b), we enter the following new ground of rejection:

Claims 66-68 are rejected under 35 U.S.C. § 102(b) as anticipated by McNeely.

McNeely describes GaAs crystalline materials which have resistivities and electron mobilities within the claimed ranges. For instance, example 7 describes a slice of GaAs having a resistivity of 2.60 ohm-cm and an electron mobility of about 6150 $cm^2$/volt-second. These values are squarely within the claimed resistivity range of about 0.7 to about 10 ohm-cm and electron mobility range of greater than 3000 $cm^2$/volt-second. The dies of GaAs described in Examples 8 and 9 also have resistivity and electron mobility levels within the claimed ranges. See also, Table I which lists resistivities and electron mobilities along a GaAs ingot. All the resistivity and electron mobility values from a position 11 cm to a position 30.1 cm along the ingot are within the claimed ranges. The GaAs crystalline material at these positions, therefore, is of the claimed composition. See also Table III, positions 10.4 to 17.4 cm, Table IV, positions 20.5 to 25.3; Table V, position 19.0 to 30.0 cm; and Table VI, positions 6.0, 16.0, and 26.0 cm. All these ingots contain positions at which the GaAs has the resistivities and electron mobilities required by the claims.

***Rejection of Claim 65 over Ciszek in View of Naumann and Bult***

Claim 65 is directed to a method of making silicon (Si) and germanium (Ge) crystals by placing one of Si and Ge and water containing boron oxide in a vessel and cooling to crystallize the Si or Ge. The cooling progresses in a predominately horizontal direction from the bottom center of the vessel to the inner walls and then predominately vertically from the bottom toward the top of the vessel to form the crystal. According to the specification, at page 9, this progressive cooling is accomplished by imposing a cold spot on the bottom center of a crucible having a tapered bottom and tapered sides so that nucleation of the melt occurs at the bottom center. A uniform thermal gradient across the furnace and perpendicular to the crucible vertical axis is then imposed on the melt to accomplish crystallization in the vertical direction.

Ciszek describes a process of growing Si crystals using a vertical temperature gradient cooling process. Appellant's sole argument is that the combination of prior art does not teach or suggest the horizontal and vertical progressive cooling step of the claimed process. We agree with the examiner that such a cooling progression would have necessarily occurred in the process of Ciszek. Ciszek describes maintaining a vertical temperature gradient on the melt so that the molten Si solidifies from bottom to top (col. 2, lines 27-31, Figure 1, col. 3, lines 43-44). Ciszek also discloses forming the container with a conical bottom recess for a seed to be placed therein (col. 3, lines 5-7). The point of the conical bottom contains the seed and therefore crystallization will begin at the bottom center of the

container. Furthermore, the crystallization would progress from the tip of the cone horizontally outward before progressing vertically upward because the melt in the horizontal direction would be cooler than the melt above due to the vertical temperature gradient.

We conclude that the examiner has established a *prima facie* case of obviousness with respect to the subject matter of claim 65 which has not been sufficiently rebutted by appellant.

## ***CONCLUSION***

We reverse the examiner's rejection of claims 61-64 under 35 U.S.C. § 103. We reverse the examiner's rejection of claims 66-68 under 35 U.S.C. § 102(b), but enter a new ground rejection. We affirm the examiner's rejection of claim 65 under 35 U.S.C. § 103.

In addition to affirming the examiner's rejection of one or more claims, this decision contains a new ground of rejection pursuant to 37 CFR § 1.196(b)(amended effective Dec. 1 1997, by final rule notice, 62 Fed. Reg. 53,131, 53,197 (Oct. 10, 1997), 1203 Off. Gaz. Pat. & Trademark Office 63, 122 (Oct. 21, 1997)). 37 CFR § 1.196(b) provides that "[a] new ground of rejection shall not be considered final for purposes of judicial review."

> Regarding any affirmed rejection, 37 CFR § 1.197(b) provides:
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> (b) Appellants may file a single request for rehearing within two months from the date of the original decision . . . .

37 CFR § 1.196(b) also provides that the appellants, ***WITHIN TWO MONTHS FROM THE DATE OF THE DECISION***, must exercise one of the following two options with respect to the new ground of rejection to avoid termination of proceedings (37 CFR § 1.197(c)) as to the rejected claims:

> (1) Submit an appropriate amendment of the claims so rejected or a showing of facts relating to the claims so rejected, or both, and have the matter considered by the examiner, in which event the application will be remanded to the examiner. . . .
>
> (2) Request that the application be reheard under § 1.197(b) by the Board of Patent Appeals and Interferences upon the same record. . . .

Should the appellant elect to prosecute further before the Primary Examiner pursuant to 37 CFR § 1.196(b)(1), in order to preserve the right to seek review under 35 U.S.C. §§ 141 or 145 with respect to the affirmed rejection, the effective date of the affirmance is deferred until conclusion of the prosecution before the examiner unless, as a mere incident to the limited prosecution, the affirmed rejection is overcome.

If the appellant elects prosecution before the examiner and this does not result in allowance of the application, abandonment or a second appeal, this case should be returned to the Board of Patent Appeals and Interferences for final action on the affirmed rejection, including any timely request for rehearing thereof.

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

AFFIRMED-IN-PART
37 CFR § 1.196(b)

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| BRADLEY R. GARRIS<br>Administrative Patent Judge | ) |
| CHUNG K. PAK<br>Administrative Patent Judge | ) BOARD OF PATENT<br>) APPEALS<br>) AND<br>) INTERFERENCES |
| CATHERINE TIMM<br>Administrative Patent Judge | ) |

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