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opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.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. 17

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte KELVIN T. HIGA,
ROBERT W. GEDRIDGE, JR.
RALPH KORENSTEIN,
and STUART J.C. IRVINE

Appeal No. 96-3475
Application 08/245,775[1]

ON BRIEF

Before JOHN D. SMITH, PAK and OWENS, Administrative Patent Judges.

JOHN D. SMITH, Administrative Patent Judge.

DECISION ON APPEAL

This is an appeal pursuant to 35 U.S.C. § 134 from the final rejection of claims 1-13.

Claims 1, 6, 7, and 13 are representative and are reproduced below:

[1] Application for patent filed May 18, 1994.

1. A process for indium doping of a Group II/Group VI semiconductor material by chemical vapor deposition wherein the indium source is triisopropylindium.

6. The process of claim 1, wherein the indium doping concentration of said doping reaction takes place at a carrier concentration ranging from about 1 x $10^{19}cm^{-3}$ to about 1 x $10^{14}cm^{-3}$ in said Group II/Group VI semiconductor material.

7. A process for indium doping a Group II/Group VI semiconductor material by chemical vapor deposition which comprises reacting triisopropylindium and one or more sources of a Group II material and one or more sources of a Group VI material by chemical vapor deposition at a temperature sufficiently high to at least partially decompose the triisopropylindium and said Group II and said Group VI source materials, and depositing said Group II/Group VI semiconductor materials on a semiconductor substrate such that minimal indium memory doping occurs.

13. An indium-doped Group II/Group VI semiconductor material produced by the process of claim 1, wherein the indium doping concentration of said doping reaction takes place at a carrier concentration ranging from about 1 x $10^{19}cm^{-3}$ to about 1 x $10^{14}cm^{-3}$ in said Group II/Group VI semiconductor material.

The reference of record relied upon by the examiner is:

Chen et al. (Chen), "Triisopropylindium for OMVPE growth", Journal of Crystal Growth, Vol. 124, Nos. 1-4, (1992), pp. 88-92.

A reference cited and relied upon by the Board is:

Gedridge	5,346,852	Sept. 13, 1994 (filed Feb. 25, 1993)

The appealed claims stand rejected under 35 U.S.C. § 103 as unpatentable over admitted prior art (specification, page 2, lines 7-11) in view of Chen.

We agree with the examiner's conclusion that the claimed subject matter on appeal would have been obvious to a person of ordinary skill in the art. However, because our analysis of the prior art is based on a more comprehensive review of the record including, inter alia , the disclosure of application 08/027,314[2] which matured into U.S. Patent No. 5,346,852 to Gedridge and because we rely on a rationale substantially different from that expressed by the examiner, we denominate our affirmance of the stated rejection as involving a new rejection (37 CFR § 196(b)).

The subject matter on appeal, in general, relates to the doping of semiconductor materials, and more particularly, to the use of triisopropylindium as a dopant precursor in the chemical vapor deposition of Group II/Group VI semiconductor materials. By way of background in the "related art" section of the specification (pages 1-3), appellants indicate that the II/VI semiconductor materials such as mercury cadmium telluride have been used commercially as infrared detectors and infrared emitters . Such applications of the II/VI semiconductor materials have required controlled extrinsic doping of both the p-type and n-type semiconductor materials. According to appellants, low level doping of the n-type mercury cadmium telluride in the range of 10^{14} atoms per cm^3 to 10^{15} atoms per cm^3 has remained a problem in the art. Thus when

[2] The disclosures of this document are discussed in the specification at page 2, lines 12-18. The Gedridge patent which issued from this application is prior art under 35 U.S.C. § 102 (e).

trimethylindium is used as indium dopant precursor, the lowest doping achieved is in the mid 10^{16} atoms per cm^3. See the specification at page 2, line 22. This is caused by the relatively high vapor pressure of trimethylindium. Appellants further indicate that trimethylindium is not a suitable precursor for doping because it suffers from transport problems. Thus as acknowledged in the specification at page 2, lines 13-16, since trimethylindium is a solid at or below room temperature the effective vapor pressure of trimethylindium in a conventional bubbler changes with time due to changes in the surface area of the solid. In addition, appellants point out that when trimethylindium is used as the precursor for doping of II/VI semiconductor materials, it has shown a significant memory effect, i.e., the indium doping persists for a number of growth runs following the introduction of the trimethylindium source.

Thus, while admitting that indium is the prior art "dopant of choice" which is primarily provided by trimethylindium as the indium dopant precursor in prior art doping in both "interdiffusion multilayer and directed alloy growth" processes, appellants indicate that trimethylindium is the cause of the above mentioned problems when used in such processes. To solve the problems associated with the use of solid trimethylindium as a dopant precursor, appellants utilized a liquid indium dopant precursor, i.e., triisopropylindium, which is said to provide a constant quantity with better control of the dopant at reasonable temperatures, thus permitting doping at low carrier concentrations with a reduction of the memory effect. Generally see the specification at page 3.

Relying on appellants' admissions (specification, page 2, lines 7-11) and Chen's disclosure that triisopropylindium has a much lower decomposition temperature than trimethylindium, the examiner contends that it would have been obvious to a person with ordinary skill in the art to utilize the claimed source in place of the trimethylindium precursor to effectively reduce the temperature of the doping processing. With respect to the admitted prior art doping processes involving the interdiffused multilayer process and directed alloy growth process for the doping of mercury cadmium telluride, however, doping temperature ranges are not disclosed. Thus there is no objective or factual support explaining why one of ordinary skill in the art would desire to lower the effective doping temperature or why there would be any advantage for doping II/VI semiconductor materials at lower temperatures. Accordingly, the rationale of the examiner's stated rejection is not adequately factually supported. For the reasons below, however, we agree with the examiner's conclusion that the claimed subject matter would have been obvious.

As indicated above, the use of trimethylindium presents transport problems when used as a low level n-type dopant in the chemical vapor deposition of II/VI semiconductor materials, such as mercury cadmium telluride. Thus, because it is a solid at or below room temperature, its effective vapor pressure changes with time, and thus it does not provide a constant quantity of indium during the prior art doping processes. The Gedridge patent relates to the use of the claimed material, triisopropylindium as an alternative precursor for the chemical vapor deposition growth (not doping) of indium-containing semiconductor materials, i.e. III/V semiconductors. More particularly, however, Gedridge indicates that triisopropylindium is a liquid with a low

freezing point and has a useful vapor pressure in chemical vapor deposition systems (col. 2, lines 30-35). Thus liquid triisopropylindium is said to offer a "substantial advantage" (col. 4, line 62) over the solid trimethylindium in terms of transport properties, and provides a constant and controllable quantity of indium to a chemical vapor deposition reactor when a carrier gas is bubbled through the liquid (col. 4, lines 53-63 and col. 2, lines 20-24). In light of the disclosures in Gedridge, one of ordinary skill in the art, motivated by the desire to solve the prior art "transport problem", would have been led to use triisopropylindium as a liquid dopant precursor source with a reasonable expectation that a constant and controllable quantity of indium would be provided for the doping of II/VI semiconductor materials.

Appellants state in their specification that just because a given compound may demonstrate acceptable results when used as a source compound for semiconductor materials does not lead one to the conclusion that the same compound can be used as a dopant source for semiconductor materials with equally good results. See the specification at page 3, lines 3-6. However, in light of the disclosures in the Gedridge patent, why such equally good results would not have been expected for the liquid compound, triisopropylindium, has not been adequately explained by appellants. Moreover, we observe that trimethylindium, the prior art solid source material, has provided acceptable results both as a source compound for semiconductor materials and as dopant source for II/VI semiconductor materials such as mercury cadmium telluride at least at dopant concentrations in the mid $10^{16}cm^{-3}$ range. Again see the specification at page 2, lines 20-22. Further, as the examiner has accurately pointed out in the answer, appellants have

presented no claim on appeal which is directed to the low level doping of II/VI materials providing a dopant concentration in the range of 10^{14} atoms per cm^3. In this regard, appealed claims 6, 12, and 13 all recite concentration ranges from "about 1 x $10^{19}cm^{-3}$ to about 1 x 10^{14} cm^{-3}" in the Group II/Group VI semiconductor material.

Further, although a person of ordinary skill in the art might understand that triisopropylindium is more sterically demanding than trimethylindium in a doping process as claimed (Brief, page 8), appellants have not explained why one of ordinary skill in the art would not have expected at least acceptable doping within the broad dopant concentration range claimed.

Appellants have asked for separate consideration of appealed process claims 7-11. See the brief at page 5. These claims define the process more specifically and indicate that "minimal indium memory doping occurs". Judging from the evidence before us, appellants may have been the first to recognize that the use of triisopropylindium in a doping process as claimed provides a benefit in that the memory effect is reduced. However, it is a well settled principle of law that the motivation in the prior art to combine the teachings of the prior art does not have to be identical to that of an applicant to establish a prima facie case of obviousness. In re Dillon, 919 F.2d 688, 693, 16 USPQ2d 1897, 1901 (Fed. Cir. 1990) (in banc) cert. denied, 500 U.S. 409 (1991). To the extent that the attainment of "minimal indium memory doping" is said to establish results which would not have been expected by person of ordinary skill in the art, we point out that there

is no side by side comparison or other data in the record establishing the extent to which the claimed process "minimizes" the memory doping.

Although appellants have grouped product-by-process claim 13 with independent process claim 1, we observe that the examiner correctly separately treated the subject matter of this claim in the answer at pages 4 and 5. Since this claim also provides for a broad range of carrier concentration ranging "from about 1 x $10^{19}cm^{-3}$ to about 1 x $10^{14}cm^{-3}$ in the Group II/Group VI semiconductor material", the claim covers prior art indium-doped Group II/Group VI semiconductor material having a carrier concentration in the range of $10^{16}cm^{-3}$. Thus, it is apparent that this claim does not define patentable subject matter.

In summary, we agree with the examiner's conclusion that the claimed subject matter on appeal would have been obvious to a person of ordinary skill in the art within the meaning of 35 U.S.C. § 103. However, since we have relied on the Gedridge patent and a more comprehensive view of the prior art admissions and have provided a different rationale than that of the examiner, we denominate our affirmance of the rejection as involving a new ground of rejection. 37 CFR § 1.196(b).

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, "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:

> (b) Appellant 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 appellant, 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 reconsidered 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; 37 CFR § 1.196(b)

JOHN D. SMITH Administrative Patent Judge	)
CHUNG K. PAK Administrative Patent Judge	) BOARD OF PATENT) APPEALS AND) INTERFERENCES
TERRY J. OWENS Administrative Patent Judge	)

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