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Paper 28
Entered: January 21, 2015

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

OSRAM GMBH,
Petitioner,

v.

E. FRED SCHUBERT,
Patent Owner.

Case IPR2013-00459
Patent 6,294,475 B1

Before JENNIFER S. BISK, GREGG I. ANDERSON, and
MATTHEW R. CLEMENTS, *Administrative Patent Judges.*

ANDERSON, *Administrative Patent Judge.*

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. BACKGROUND

A. Introduction

On July 19, 2013, OSRAM GmbH ("Petitioner") filed a petition requesting *inter partes* review of claims 1, 2, 4, 11–14, and 16 of U.S. Patent No. 6,294,475 B1 (Ex. 1001, "the '475 patent"). Paper 3 ("Pet."). We instituted trial on all challenged claims 1, 2, 4, 11–14, and 16 of the '475 patent on certain grounds of unpatentability alleged in the Petition. Paper 11 ("Dec. Inst.").

After institution of trial, E. Fred Schubert ("Patent Owner") filed a Patent Owner Response. Paper 18 ("PO Resp."). Petitioner filed a Reply. Paper 21 ("Pet. Reply"). An oral hearing was held on October 15, 2014. The transcript of the hearing has been entered into the record. Paper 27 ("Tr.").

We have jurisdiction under 35 U.S.C. § 6(c). This final written decision is issued pursuant to 35 U.S.C. § 318(a). We have considered all the evidence of record, including arguments made at the oral hearing. We conclude that Petitioner has failed to show by a preponderance of the evidence that claims 1, 2, 4, 11–14, and 16 of the '475 patent are unpatentable.

B. Related Proceedings

The '475 Patent is involved in co-pending cases captioned *E. Fred Schubert v. OSRAM GmbH.*, Case No. 12-cv-923-GMS (D. Del) and *E. Fred Schubert v. Koninklijke Philips Electronics N.V.*, Case No. 12-cv-924-GMS (D. Del). Pet. 1.

C. The '475 Patent

The '475 Patent relates to a method for processing a III-Nitride epitaxial layer system on a substrate. Ex. 1001, Abstract. III-Nitride epitaxial layer systems include gallium nitride ("GaN"). *Id.* III-Nitrides are used for producing light-emitting devices including light-emitting diodes ("LEDs") and lasers. *Id.* at 1:24–27.

GaN has a hexagonal crystalline structure ("HCP") where the top surface is the c-plane or <0001>.[1] Ex. 1001, 3:9–17. The layer of atoms that lies parallel to a basal plane is the c-plane of the crystal. Ex. 1003 ¶ 31. GaN may be grown on a c-plane sapphire substrate. Ex. 1001, 3:9–17.

The '475 Patent discloses that the c-plane of GaN was impervious to all of the chemicals with which etching had been attempted. *Id.* at 3:21–23. The '475 patent describes that by employing an initial processing step, non-c-planes could be etched crystallographically by molten potassium hydroxide ("KOH"). *Id.* at 3:19–21.

The '475 Patent discloses a two-step process to achieve crystallographic etching on non-c-plane surfaces. Ex. 1001, 2:17–23; 3:52–64. The process is disclosed in Figure 3, which is reproduced below.

[1] According to the testimony of Professor James R. Shealy ("Shealy Declaration," Ex. 2002), the various brackets associated with the four Miller indices are interpreted as follows: parentheses ( ) denote a specific plane; curly brackets { } denote a set of planes with equivalent symmetry; square brackets [ ] denote a specific crystal direction; and angle brackets < > denote a set of crystal directions normal to planes with equivalent symmetry. Ex. 2002 ¶ 36.

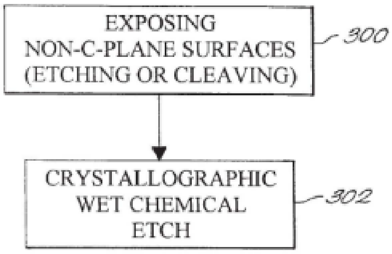

FIG. 3

Figure 3 shows at first block 300 an exposing step, which step removes material to expose the non-c-plane surfaces of a GaN epitaxial layer system. Ex. 1001, 3:52–59. The exposing step uses a known method, such as reactive ion etching in chlorine-based plasma, photoelectrochemical ("PEC") etching in a KOH solution, or cleaving. *Id.* Crystallographic etching step 302 includes immersing the epitaxial layer system in a wet chemical etch, such as phosphoric acid, molten KOH, KOH dissolved in ethylene glycol, sodium hydroxide dissolved in ethylene glycol, tetraethyl ammonium hydroxide, or tetramethyl ammonium hydroxide. *Id.* at 2:27–33. Step 302 produces a smooth crystallographic surface. *Id.* at 3:59–62.

Figures 9A–9C show how the process is used to make a laser diode. Figures 9A–9C are reproduced below.

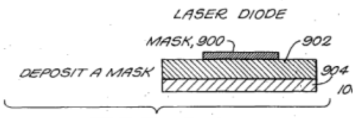

FIG. 9A

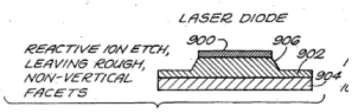

FIG. 9B

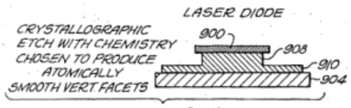

FIG. 9C

As shown in Figures 9A–9C, mask 900 is deposited initially on III-Nitride device structure 902, which is configured on sapphire substrate 904. Ex. 1001, 5:3–5, Fig. 9A. A reactive ion etch is performed, leaving rough, non-vertical facets 906 in the structure. *Id.* at 5:5–6, Fig. 9B. Then a crystallographic etch produces atomically smooth vertical facets 908, 910. *Id.* at 5:6–7, Fig. 9C.

D. Illustrative Claims

Claims 1, 11, and 13 are the three independent claims of the challenged claims that illustrate the claimed subject matter. Claims 1, 11, and 13 are reproduced below:

> 1. A method of processing a III-Nitride epitaxial layer system provided on a substrate, comprising:
>
> exposing non-c-plane surfaces of said III-Nitride epitaxial layer system; and
>
> crystallographically etching said epitaxial layer system in order to obtain crystallographic plane surfaces.
>
> 11. A method of processing a III-Nitride epitaxial layer system comprising:
>
> providing a III-Nitride epitaxial layer system on a substrate; and
>
> wet chemical crystallographic etching said epitaxial system along non-c-plane crystal directions.
>
> 13. A method of processing a III-Nitride epitaxial layer system comprising:
>
> providing a III-Nitride epitaxial layer system on a substrate; and
>
> crystallographically etching said epitaxial layer system by immersing said epitaxial layer system into a liquid chemical.

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