UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte SCOTT THOMAS SHEPPARD, SCOTT THOMAS ALLEN,
and JOHN WILLIAMS PALMOUR

Appeal 2007-4373
Application 10/440,727
Technology Center 2800

Decided: March 27, 2008

Before JOSEPH F. RUGGIERO, ANITA PELLMAN GROSS, and MAHSHID D. SAADAT, *Administrative Patent Judges*.

SAADAT, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellants appeal under 35 U.S.C. § 134(a) from a final rejection of claims 1, 2, 4-6, 9, 10, 13, 14, 17, 18, 21, and 22 which are all of the claims

pending in this application as claims 3, 7, 8, 11, 12, 15, 16, 19, and 20 have been canceled. We have jurisdiction under 35 U.S.C. § 6(b).[1]

Appellants' invention relates to a high electron mobility transistor (HMET) where a two dimensional electron gas (2DEG) formed at the junction of two semiconductor materials having different bandgap energies provide the high electron mobility area. The transistor comprises a semi-insulating silicon carbide substrate, an aluminum nitride buffer layer on the substrate, an insulating gallium nitride layer on the buffer layer, an active structure of aluminum gallium nitride on the gallium nitride layer, a passivation layer on the aluminum gallium nitride active structure, and respective source, drain, and gate contacts to the aluminum gallium nitride active structure. (Spec. 3). According to Appellants, the passivation layer appears to minimize or eliminate the problem of unterminated chemical bonds at the surface by trapping a proportion of the electrons that would otherwise flow in the 2DEG of a HEMT. (Spec. 7-8).

Claim 5, which is representative of the claims on appeal, reads as follows:

> 5. A high electron mobility transistor for generating high power signals within the RF spectrum, comprising:
>
> a substrate that is sufficiently non-conductive to reduce parasitic charge in the substrate;
>
> a transition layer on said substrate;
>
> a Group III nitride heterojunction on said transition layer, said heterojunction comprising:

[1] An oral hearing for this application was held on March 12, 2008.

an undoped gallium nitride layer on said transition layer, and

an active region on said gallium nitride layer, said active region comprising:

a first undoped A1GaN layer on said gallium nitride layer;

a conductively doped A1GaN layer on said first undoped A1GaN layer, and

a second undoped A1GaN layer on said doped A1GaN layer;

respective source, gate, and drain contacts electrically connected to said heterojunction; and

a passivation layer on said active region, said passivation layer at least partially covering said source, gate, and drain contacts;

wherein a two dimensional electron gas develops in said gallium nitride layer directly beneath said first undoped A1GaN layer of said active region, said two dimensional electron gas providing a conductive path from said source contact to said drain contact.

The Examiner relies on the following prior art in rejecting the appealed claims:

O'Neil	US 5,739,557	Apr. 14, 1998
Razeghi	US 5,831,277	Nov. 3, 1998

Kenneth K. Chu, *High Speed High Power AlGaN/GaN Heterostructure Field Effect Transistors with Improved Ohmic Contacts*, IEEE/Cornell Conference on Advanced Concepts, 399-406 (1997).

Claims 5, 9, 10, 13, 18, 21, and 22 stand rejected under 35 U.S.C. § 103(a) based upon the teachings of Chu and O'Neil.

Claims 1, 2, 4, 6, 14, and 17 stand rejected under 35 U.S.C. § 103(a) based upon the teachings of Chu, O'Neil, and Razeghi.

Rather than reiterate the opposing arguments, reference is made to the Briefs (Substitute Appeal Brief filed Aug. 26, 2006 and Reply Brief filed May 15, 2006) and the Answer (mailed Nov. 14, 2006) for the respective positions of Appellants and the Examiner.

We affirm.

ISSUES

1. Under 35 U.S.C. § 103(a), with respect to the appealed claims 5, 9, 10, 13, 18, 21, and 22, would the ordinarily skilled artisan have found it obvious to combine Chu and O'Neil to render the claimed invention unpatentable?

2. Under 35 U.S.C § 103(a), with respect to the appealed claims 1, 2, 4, 6, 14, and 17, would one of ordinary skill in the art at the time of the invention have found it obvious to combine Chu, O'Neil, and Razeghi to render the claimed invention unpatentable?

FINDINGS OF FACT

The following findings of fact (FF) are relevant to the issue involved in the appeal and are supported by substantial evidence.

O'Neil

1. O'Neil relates to a heterostructure field effect transistor that includes improved ohmic contact metallization (col. 1, ll. 6-8).

2. O'Neil's disclosure addresses three problems with existing heterostructure transistors: 1) ohmic contact metallization, 2) oxidization of the AlGaAs surface when it is exposed to air, 3) controlled etching of the highly doped cap layer (col. 1, ll. 23-44).

3. The transistor stack is capped with a GaAs passivation layer 20, an AlAs etch stop layer 22, and an InGaAs cap layer 24 (col. 3, ll. 12-14).

4. The passivation layer 20 prevents oxidation of AlGaAs layer 18 during the etch process (col. 4, ll. 1-2).

5. A dielectric layer 42, formed of Si_3N_4, is deposited over the stack to define the ohmic contact areas 50 (Fig. 4; col. 4, ll. 5-15).

6. A thick dielectric layer 60, formed of SiO_4, Si_3N_4, or some other oxynitride material, is deposited to further define via openings 62 for deposition of interconnect metal (Fig. 6; col. 4, ll. 34-41).

Razeghi

7. Razeghi provides a GaN-based composition in a superlattice structure (Abstract).

8. The substrates used by Razeghi are disclosed to be GaAs, Si, Al_2O_3, MgO, SiC, ZnO, $LiGaO_2$, $LiAlO_2$, $MgAl_2O_4$ or GaN (col. 3, ll. 37-39).

9. Razeghi further discloses that before forming the AlGaAs active layers, a buffer layer of AlN, a contact layer, and n-doped confinement layers of GaN and AlGaN are deposited on the substrate (col. 4, ll. 44-47).

PRINCIPLES OF LAW

The test for obviousness is what the combined teachings of the references would have suggested to one of ordinary skill in the art. *See In re Kahn*, 441 F.3d 977, 987-88 (Fed. Cir. 2006), *In re Young*, 927 F.2d 588, 591 (Fed. Cir. 1991) and *In re Keller*, 642 F.2d 413, 425 (CCPA 1981).

"Section 103 forbids issuance of a patent when 'the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.'" *KSR Int'l Co. v. Teleflex Inc*., 127 S. Ct. 1727, 1734 (2007).

ANALYSIS

1. Rejection of claims 5, 9, 10, 13, 18, 21, and 22

The Examiner reads substantially all of the claimed features related to the stacked layers on the AlGaN/GaN heterostrucutre field effect transistor (HFET) of Chu and further relies on O'Neil for adding a passivation layer on the active region of the transistor for partially covering the source, drain, and gate contacts of the HFET (Ans. 4-5). Appellants contend that the devices disclosed in Chu and O'Neil are incompatible since they use different cap layers and only O'Neil includes a passivation layer and an etch stop layer (App. Br. 11-12).

Initially, we note that Appellants' arguments appear to be based on using the passivation layer 20 of O'Neil in the device of Chu and do not address the silicon nitride dielectric layers 42 and 60, which are what the Examiner characterizes as the passivation layer. As argued by the Examiner (Ans. 7-8), the dielectric layers 42 and 60 are formed on the active region and at least partially cover the source, drain, and gate contacts (FF 5-6). While O'Neil calls layer 20 a passivation layer (FF 3), the function and material of layer 20 is so different from a silicon nitride layer that it cannot be what the Examiner cited as a "silicon nitride top passivation layer" (Ans.

7). The only silicon nitride layers in O'Neil are dielectric layers 42 and 60 which are formed of Si_3N_4, or some oxynitride material (FF 5-6). It is also important to note that calling a dielectric top layer a "passivation layer" is commonly known to those skilled in the art. This characterization is consistent with Appellants' own Specification (¶ [0030]) wherein the passivation layer 23 is indicated as a silicon nitride or silicon dioxide layer.

We therefore do not agree with Appellants that the stated differences between the structure disclosed by O'Neil and Chu are significant enough to discourage their combination. In fact, consistent with *KSR*, one of ordinary skill in the art would have found it obvious to use the dielectric passivation layer of O'Neil over the structure disclosed by Chu to benefit from the protection against environmental contaminants and mechanical damages that otherwise exposed surfaces of the device would have likely incurred. We also agree with the Examiner (Ans. 8) that the protection provided by the passivation layer against the above mentioned elements would be available to HFET structures regardless of the type and thickness of the cap layer and any other layers under the dielectric passivation layer.

Based on our analysis of Chu and O'Neil, we agree with the Examiner's assessment of the teaching value of O'Neil regarding using a passivation layer as a solution with predictable results. Therefore, it is our view that the Examiner has set forth a prima facie case of obviousness, which Appellants have not successfully overcome by presenting either convincing arguments or evidence to support the patentability of the claims. Additionally, Appellants have presented no arguments in the Reply Brief to indicate that the teachings in the applied references would have discouraged a person of ordinary skill from applying the dielectric passivation layer

taught in O'Neil in combination with Chu to rebut the Examiner's prima facie case.

Therefore, in view of the analysis above, we find that one of ordinary skill in the art would have combined Chu and O'Neil in order to benefit from the protection provided by a dielectric passivation layer. Accordingly, since we find no error in the Examiner's position, we sustain the 35 U.S.C. § 103(a) rejection of independent claim 5, as well as claims 9, 10, 13, 18, 21, and 22 argued together with claim 5 as one group, over Chu and O'Neil.

2. Rejection of claims 1, 2, 4, 6, 14, and 17

With respect to the rejection of independent claim 1, Appellants take the position that Razeghi's device is incompatible with the structures disclosed in Chu and O'Neil and, therefore, could not be combined (App. Br. 13-14). Appellants further contend that the Examiner's selection of SiC from the list of substrates disclosed in Razeghi is not supported by any reason based on a teaching or suggestion (App. Br. 14).

The Examiner relies on using the SiC substrate as a common substrate disclosed to be suitable for epitaxially growing an AlN buffer layer before forming a GaN-based layered structure (Ans. 10). The Examiner further points out that the choice of substrate does not depend on what additional layers are further stacked over the substrate and the buffer layer, whereas other factors such as cost and availability do matter (*id.*).

We agree with the Examiner's rationale in combining Razeghi with Chu and O'Neil and using a SiC substrate since the different substrates disclosed by Razeghi are all suggested to be suitable for forming a GaN active layer (FF 7-8). Again, we find the rationale for the combination proposed by the Examiner to be consistent with *KSR,* which held obvious the

combination of familiar elements according to known methods when the results are predictable. Here, a SiC substrate is used for forming the stacked layers of a heterostructure device where an AlN buffer layer and a GaN active layer, similar to those disclosed and claimed by Appellants, are formed on the substrate. The predictability of the proposed combination is further supported by the fact that Razeghi lists the SiC substrate as equal and compatible with other semi-insulating substrates such as GaAs used in O'Neil and Al_2O_3 (or sapphire) used in Chu.

For all of the previously discussed reasons and in view of our analysis of Razeghi, we find no error in the Examiner's position that using a SiC substrate as the semi-insulating substrate in combination with Chu and O'Neil would be recognized by the skilled artisan as an obvious alternative substrate. Therefore, we sustain the 35 U.S.C. § 103(a) rejection of claim 1, as well as claims 2, 4, 6, 14, and 17 which are not argued separately, over Chu, O'Neil, and Razeghi.

DECISION

The decision of the Examiner rejecting claims 1, 2, 4-6, 9, 10, 13, 14, 17, 18, 21, and 22 is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. 1.136(a)(1)(iv).

AFFIRMED

tdl/gw

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