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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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*Ex parte* LEO J. SCHOWALTER, GLEN A. SLACK,  
J. CARLOS ROJO, ROBERT T. BONDOKOV,  
KENNETH E. MORGAN, and JOSEPH A. SMART

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Appeal 2010-010299  
Application 11/431,090  
Technology Center 2800

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*Before* CARL W. WHITEHEAD, JR., ERIC S. FRAHM, and  
ANDREW J. DILLON, *Administrative Patent Judges*.

WHITEHEAD, JR., *Administrative Patent Judge*.

DECISION ON APPEAL

## STATEMENT OF THE CASE

Appellants are appealing claims 8-15, 17, 24, 25, 27, and 28. Appeal Brief 2. We have jurisdiction under 35 U.S.C. § 6(b) (2012).

We affirm-in-part.

### *Introduction*

The invention is directed to an aluminum nitride single-crystal substrate. Appeal Brief 3.

### *Illustrative Claim*

8. An aluminum nitride single-crystal substrate having a diameter greater than about 25 mm, a thickness of less than about 1 mm, a dislocation density less than about  $10,000 \text{ cm}^{-2}$ , and a surface substantially all of which has a single crystalline orientation.

### *Rejections on Appeal*

Claim 8 stand rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. Answer 4.

Claims 8-10, 14, 27, and 28 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Letertre (U.S. Patent Application Publication Number 2004/0187766 A1; published September 30, 2004). Answer 4-5.

Claims 11-14 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Letertre and D'Evelyn (U.S. Patent Application Publication Number 2004/0245535 A1; published December 9, 2004). Answer 5-6.

Claims 15, 24, and 25 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Letertre and Saxler (U.S. Patent Application Publication Number 2006/0244011 A1; published November 2, 2006). Answer 6-7.

Claim 17 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Letertre. Answer 7.

### *Issues on Appeal*

Is claim 8 properly rejected under 35 U.S.C. §112, first paragraph, for failing to comply with the written description requirement?

Does Letertre teach an aluminum nitride single-crystal substrate having a surface that has a substantially single crystalline orientation?

### ANALYSIS

#### *35 U.S.C. § 112, first paragraph, Written Description Requirement*

Appellants argue that claim 8 complies with the written description requirement of 35 U.S.C. § 112, first paragraph, and that supports for Appellants' position is found within Appellants' Specification, paragraphs [0017], [0088], and [0092]. Appeal Brief 5-6. Further, Appellants argue the Examiner has ignored the language within the Specification – “substrates having surfaces of any desired crystallographic orientation.” Appeal Brief 6 (emphasis and footnote omitted). Paragraph [0017] of Appellants' Specification is reprinted below:

[0017] Furthermore, bulk AlN [Aluminum Nitride] crystals grown using various embodiments of the claimed fabrication methods may have a radial dimension

exceeding 10-15 mm and a length exceeding 5 mm. Also, the claimed invention facilitates fabrication of AlN crystals having very low dislocation densities - under  $10,000 \text{ cm}^{-2}$ , typically, about  $1,000 \text{ cm}^{-2}$  or less, and, in some embodiments, being substantially devoid of dislocation defects. These bulk crystals, in turn, enable the fabrication of high-quality AlN substrates having surfaces of any desired crystallographic orientation by slicing them out of properly oriented bulk crystals. Possible orientations include the c-face which is cut parallel to the (0001) plane, the a-face which is cut parallel to the (1120) plane, and the m-face which is cut parallel to the (1010) plane.

The Examiner finds that:

The typical use of the terminology is that single crystal has a single crystal orientation throughout, including on its [sic] surface. Both the reference applied and the instant specification are “single crystal,” also called “monocrystalline.[”] However, applicant’s specification describes single crystal devices as having a “mosaicity.” We understand this to mean, not the polycrystalline distinct orientation regions of differently orientations (a position that would be absurd, since polycrystalline materials are altogether distinct class of materials from monocrystalline), but that a single crystal has some small amount of orientation variation across it, but small enough not to break its single crystal nature. The specification indicates “it is possible to reduce this, but not eliminate it entirely.” This statement means that applicant’s “single crystalline” has within it some “mosaicity.” This statement is made specifically about the instant specification, so clearly limits the specification from having no “mosaicity.”

During the prosecution of the application, the statement was added to the claim “and a surface,

substantially all of which has a single crystal orientation.” Since the specification clearly states that a single crystal [] of the instant invention “cannot eliminate the mosaicity effect entirely”, but says nothing more about how the mosaicity effect is reduced, or whether the reduction is that the surface is entirely mosaic, but the average orientations are more close together than usual, or whether the size of the orientation regions are larger than usual, the specification as filed did not support the statement “substantially all of which has a single crystal orientation”, because it gave no guidance as to how the mosaicity effect was reduced in the instant invention.

Answer 8-9.

We agree with the Examiner’s findings. While we also agree with Appellants’ arguments that paragraph [0017] contains the language “substrates having surfaces of any desired crystallographic orientation,” however, we do not find that the language provides the proper written description for claim 8 as required by 35 U.S.C. § 112, first paragraph. The parameters of the language “substrates having surfaces of any desired crystallographic orientation” and thus, the parameters of the claimed crystal orientation of the substrate’s surface, are limited by the physical properties of the materials employed, as well as the methods employed to form the claimed substrate. Appellants’ Specification does not disclose how one of ordinary skill in the art would be able to produce “a surface substantially all of which has a single crystalline orientation” as recited in claim 8 from a material which admittedly has dislocation densities. *See* Specification, paragraph [0017].

Therefore we sustain the Examiner 35 U.S.C. § 112, first paragraph rejection of independent claim 8.

*35 U.S.C. § 102(b), Anticipation rejection*

The Examiner finds that Letertre discloses in Figures 1-6 along with associated text:

An aluminum nitride (AlN) single-crystal substrate having a diameter greater than about 25 mm (paragraph [0022]), a thickness of less than about 1 mm (paragraph [0031], “more preferably between 100  $\mu\text{m}$  and 1 mm”), a dislocation (defect) density less than about 10,000  $\text{cm}^{-2}$  ([0031] and [0047]), and a surface substantially all of which has a single crystalline orientation (0031, a crystal of monocrystalline material - monocrystalline is single crystalline).

Answer 5.

Appellants contend that:

Letertre’s method is utterly incapable of producing an aluminum nitride single-crystal substrate having an entire surface with a single crystalline orientation, as recited in independent claim 8, despite the fact he refers to his constructs as “monocrystalline,” and despite his disclosure that “care is taken to ensure that . . . the covered surface has a single surface crystal orientation.”[]

As disclosed in the instant application and emphasized in the Declaration of Leo J. Schowalter, Ph.D. submitted on August 28, 2008 (the “Schowalter Declaration” of an expert in crystal physics and co-inventor of the instant invention, attached in the Evidence Appendix hereto), growth from an assembly of seed crystals, even if their crystalline orientations are substantially aligned, results in crystals exhibiting mosaicity, i.e., regions with slightly different orientations.[] While the mosaicity effect may be reduced by choosing appropriate growth conditions, it cannot be eliminated entirely.[] Thus, structures formed by the method of Letertre will have regions of slightly different

crystalline orientations, in direct contrast to structures recited in independent claim 8. Indeed, a single crystallographic orientation seems inconsistent with the method Letertre does teach, as he clearly describes producing a structure with multiple crystalline orientations, at least at the borders between the individual films 4 in assembly 10.

Appeal Brief 8-9 (internal footnotes omitted).

We find Appellants' arguments to be persuasive. Letertre cannot anticipate claim 8 because the claim language requires a substrate to have "a surface substantially all of which has a single crystalline orientation" while having "a dislocation density less than about  $10,000 \text{ cm}^{-2}$ " and it is evident that the two conditions or limitations cannot mutually exist in the same construct. *See* claim 8; Appeal Brief 8-9. We note that Appellants' Specification discloses embodiments of the instant invention that exhibit certain mosaicity and the Schowalter Declaration exemplifies that the very existence of such a condition in Letertre would render Letertre "utterly incapable" of producing a surface as claimed. *See* Specification, paragraph [0112]; *see also* Appeal Brief 8-9. If the mosaicity condition renders Letertre incapable of producing the claimed surface then without a superseding method, the instant invention cannot produce the claimed surface as Appellants contend.

For the reasons stated above, we reverse the Examiner's anticipation rejection of claim 8, as well as, claims 9, 10, 14, 27, and 28 dependent therefrom.

*35 U.S.C. § 103(a), Obviousness rejections*

We reverse the Examiner's obviousness rejections of dependent claims 11-15, 17, 24, and 25 since neither D'Evelyn nor Saxler addresses the deficiency of Letertre as set forth above.

DECISION

The written description requirement rejection of claim 8 is affirmed.  
The anticipation rejection of claims 8-10, 14, 27, and 28 is reversed.  
The obviousness rejections of claims 11-15, 17, 24, and 25 are reversed.

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). *See* 37 C.F.R. § 41.50(f).

AFFIRMED-IN-PART

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