

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

RENESAS ELECTRONICS CORPORATION and
RENESAS ELECTRONICS AMERICA, INC.,
Petitioner,

v.

LONE STAR SILICON INNOVATIONS, LLC,
Patent Owner.

Case IPR2017-01868
Patent 6,326,231 B1

Before JENNIFER MEYER CHAGNON, JOHN F. HORVATH, and
ELIZABETH M. ROESEL, *Administrative Patent Judges*.

ROESEL, *Administrative Patent Judge*.

DECISION
Institution of *Inter Partes* Review
37 C.F.R. § 42.108

This case concerns U.S. Patent No. 6,326,231 B1. Ex. 1001 (“the ’231 patent”). Renesas Electronics Corporation and Renesas Electronics America, Inc. (collectively, “Renesas” or “Petitioner”) filed a Petition requesting *inter partes* review of claims 1–5 and 7 of the ’231 patent. Paper 1 (“Pet.”). Thereafter, Lone Star Silicon Innovations, LLC (“Lone Star” or “Patent Owner”) disclaimed claims 1–3, 6–9, 13, 15, and 16 of the ’231 patent by filing a statutory disclaimer pursuant to 37 C.F.R. § 1.321(a). Ex. 3001. Patent Owner waived the right to file a Preliminary Response. Paper 5.

We have authority to determine whether to institute an *inter partes* review. 35 U.S.C. § 314; 37 C.F.R. § 42.4(a). An *inter partes* review may not be instituted “unless the Director determines . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” 35 U.S.C. § 314(a). Applying that standard, we institute an *inter partes* review of claims 4 and 5 of the ’231 patent (the “challenged claims”) for the reasons and on the grounds set forth below. We do not institute an *inter partes* review of claims 1–3 and 7 because they have been statutorily disclaimed. *See* 37 C.F.R. § 42.107(e) (“No *inter partes* review will be instituted based on disclaimed claims.”).

The following findings of fact and conclusions of law are not final, but are made for the sole purpose of determining whether Petitioner meets the threshold for initiating review. Any final decision shall be based on the full trial record, including any response timely filed by Patent Owner.

I. BACKGROUND

A. *Related Matters*

Pursuant to 37 C.F.R § 42.8(b)(2), the parties identify the following patent infringement lawsuits involving the '231 patent:

Lone Star Silicon Innovations, LLC v. Micron Technology, Inc.,
No. 3:17-cv-05458 (N.D. Cal. filed Oct. 7, 2016);

Lone Star Silicon Innovations, LLC v. Nanya Technology Corp., No. 3:17-cv-04032 (N.D. Cal. filed Oct. 7, 2016); and

Lone Star Silicon Innovations, LLC v. Renesas Electronics Corp., No. 3:17-cv-03981 (N.D. Cal. filed Dec. 20, 2016).¹

Pet. 2; Paper 3, 2 (Patent Owner Mandatory Notices).

Pursuant to 37 C.F.R § 42.8(b)(2), the parties identify the following *inter partes* review proceeding involving the '231 patent: *Micron Technology, Inc. v. Lone Star Silicon Innovations, LLC*, Case IPR2017-01565. Pet. 2; Paper 3, 2.

Patent Owner identifies other *inter partes* review proceedings involving Renesas as Petitioner and Lone Star as Patent Owner and states that the patents involved in the other proceedings are not related to the '231 patent. Paper 3, 1.

¹ The above-listed lawsuits were filed in the Eastern District of Texas on the dates listed and later transferred to the Northern District of California. On January 20, 2018, the lawsuits were dismissed on the basis that plaintiff, Lone Star, lacks standing. *In re Lone Star Silicon Innovations LLC*, No. 17-cv-03980 WHA, 2018 WL 500258 (N.D. Cal. Jan. 20, 2018). The '231 patent is not among the patents the district court identifies as currently asserted by Lone Star. *Id.* at *1. Lone Star has filed a notice of appeal to the Federal Circuit.

B. Asserted Grounds of Unpatentability

The Petition asserts five grounds of unpatentability, three of which challenge either or both of non-disclaimed claims 4 and 5. These grounds are as follows:

Reference(s)	Statutory Basis	Claim(s)
Shibata ²	35 U.S.C. § 102(b)	4 and 5
Foote '007 ³	35 U.S.C. § 102(e)	5
Konjuh ⁴ and Ogawa ⁵	35 U.S.C. § 103(a)	4 and 5

Pet. 14–15.

Petitioner supports its challenges with a Declaration of Dean Neikirk, Ph.D. Ex. 1007.

C. The '231 Patent (Ex. 1001)

The '231 patent, titled “Use of Silicon Oxynitride ARC for Metal Layers,” was issued December 4, 2001 from Application No. 09/207,562, filed December 8, 1998. Ex. 1001, at (21), (22), (45), (54).

² Japanese Patent Application Publication No. H08-191068, published July 23, 1996 (Ex. 1010), with English translation (Ex. 1011).

³ U.S. Patent No. 6,903,007 B1, filed May 15, 1997 and issued June 7, 2005. Ex. 1013.

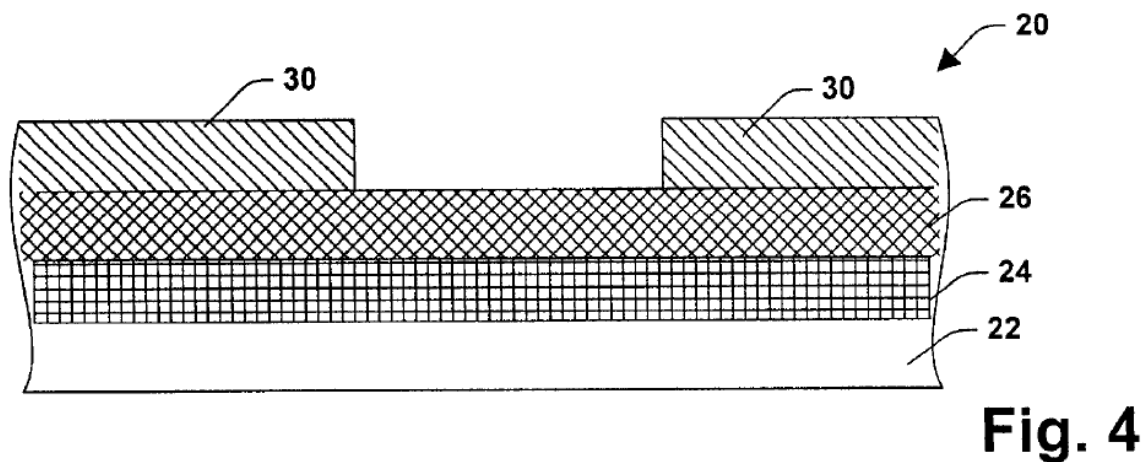
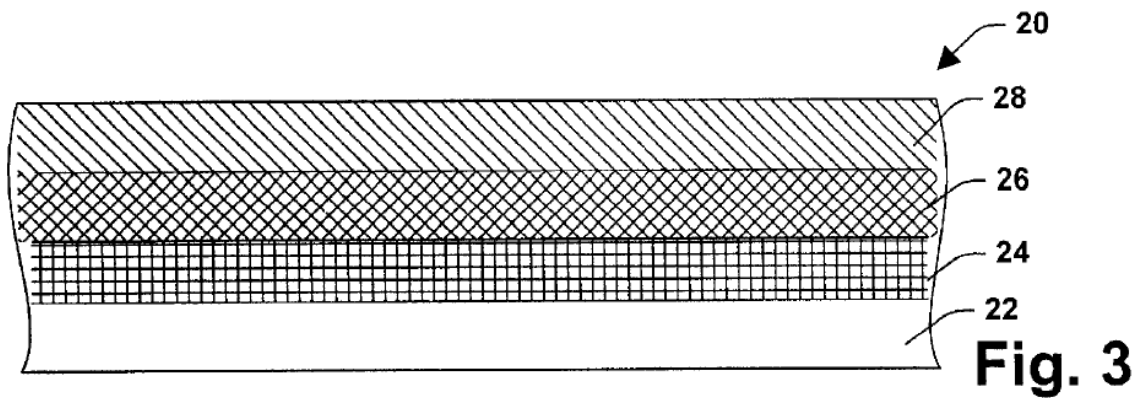
⁴ US 6,051,282, filed June 4, 1998 and issued April 18, 2000. Ex. 1015. Konjuh is asserted as prior art under 35 U.S.C. § 102(e). Pet. 15.

⁵ T. Ogawa, et al., *Practical Resolution Enhancement Effect by New Complete Anti-Reflective Layer in KrF Excimer Laser Lithography*, SPIE Optical/Laser Microlithography, v. 1927, pp. 263-274 (1993). Ex. 1016. Ogawa is asserted as prior art under 35 U.S.C. § 102(b). Pet. 15.

According to the '231 patent, it is known to provide an antireflection coating ("ARC") between a substrate and a photoresist layer in order to prevent reflection of activating radiation into the photoresist. *Id.* at 1:58–61. The '231 patent discusses problems with known ARCs, including incompatibility between nitrogen-containing ARCs and deep ultraviolet (UV) photoresists. *Id.* at 2:36–38. One problem identified in the '231 patent is that nitrogen migrates from the ARC into the photoresist, desensitizing the photoresist to UV light and inhibiting development of the photoresist, which results in "extremely poor pattern definition." *Id.* at 2:38–43.

To address this and other problems, the '231 patent provides "a silicon oxynitride ARC that is compatible with deep UV photoresists since a thin oxide layer prevents nitrogen from the silicon oxynitride layer from contacting an overlying photoresist." *Id.* at 2:49–54. The '231 patent discloses a method of forming a silicon oxynitride ARC over a metal layer, where the method comprises the steps of depositing a silicon oxynitride layer over the metal layer and forming an oxide layer over the silicon oxynitride layer. *Id.* at (57), 1:5–10, 2:63–3:5. According to the '231 patent, "[a]fter a silicon oxynitride layer is formed, a thin oxide layer is formed over the top surface of the silicon oxynitride layer to form the oxide-silicon oxynitride ARC." *Id.* at 4:40–42. The '231 patent states that the oxide layer prevents nitrogen atoms from migrating from the silicon oxynitride layer to the photoresist. *Id.* at 7:60–65.

Figures 3 and 4 of the '231 patent are reproduced below:



Figures 3 and 4 illustrate a method for manufacturing a semiconductor device. Figure 3 shows semiconductor structure 20, including semiconductor substrate layer 22, aluminum layer 24, silicon oxynitride ARC 26, and photoresist 28. Ex. 1001, 6:60–7:13. According to the '231 patent, the silicon oxynitride ARC 26 is formed using a two-step process, namely, forming a silicon oxynitride layer by CVD techniques followed by exposing the silicon oxynitride layer to oxygen plasma to form an oxide layer. *Id.* at 7:1–7. As shown in Figure 4, photoresist 28 is patterned using photolithographic techniques resulting in the formation of resist pattern 30, which may be used as an etch mask for patterning silicon oxynitride ARC 26 and aluminum layer 24. *Id.* at 7:14–26.

D. Challenged Claims

The '231 patent was issued with 20 claims, including independent claims 1 and 15, which have been disclaimed. Independent claim 1 and challenged claims 4 and 5 are reproduced below:

1. A method of forming a silicon oxynitride antireflection coating over a metal layer, comprising:

providing a semiconductor substrate comprising the metal layer over at least part of the semiconductor substrate;

depositing a silicon oxynitride layer on the metal layer having a thickness from about 100 Å to about 1500 Å; and

forming an oxide layer having a thickness from about 5 Å to about 50 Å over the silicon oxynitride layer to provide the silicon oxynitride antireflection coating,

wherein the oxide layer forms a barrier to migration of nitrogen atoms from the silicon oxynitride layer.

Ex. 1001, 8:26–38.

4. The method of claim 1, wherein the oxide layer is formed by contacting the silicon oxynitride layer with oxygen plasma.

5. The method of claim 1, wherein the oxide layer is formed by contacting the silicon oxynitride layer with N₂O plasma.

Id. at 8:50–55.

II. DISCUSSION

A. Claim Construction

Petitioner asserts that the '231 patent will expire during this proceeding and that we should apply the claim construction standards applicable in district court. Pet. 11 (citing Ex. 1009). Petitioner proposes an express construction for the phrase “depositing a silicon oxynitride layer on

the metal layer.” *Id.* Petitioner contends that other claim terms should be construed to have their plain and ordinary meaning, but does not provide express constructions for those terms. *Id.*

The ’231 patent will expire within 18 months from the October 17, 2017, entry of the Notice of Filing Date Accorded to Petition (Paper 4). *See* 37 C.F.R. § 42.100(b) (“A party may request a district court-type claim construction approach to be applied if a party certifies that the involved patent will expire within 18 months from the entry of the Notice of Filing Date Accorded to Petition.”). Accordingly, to the extent there are any claim construction disputes, we will apply the claim construction standards applicable in district court. *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc); *In re Rambus, Inc.*, 694 F.3d 42, 46 (Fed. Cir. 2012) (“[T]he Board’s review of the claims of an expired patent is similar to that of a district court’s review.”); *Black & Decker, Inc. v. Positec USA, Inc.*, 646 F. App’x 1019, 1024 (Fed. Cir. 2016) (holding that in an *inter partes* review, “[c]laims of an expired patent are given their ordinary and customary meaning in accordance with our opinion in [*Phillips*]”).

Under the *Phillips* standard, claim terms are given their ordinary and customary meaning, i.e., they are construed as they would have been understood by a person of ordinary skill in the art at the time of the invention, in light of the language of the claims, the specification, and the prosecution history of record. *Phillips*, 415 F.3d at 1312–19; *Thorner v. Sony Comput. Entm’t Am. LLC*, 669 F.3d 1362, 1365–66 (Fed. Cir. 2012). Unlike in a district court proceeding, however, there is no presumption of validity in Board proceedings, and we do not apply a rule of construction with an aim to preserve the validity of claims.

After reviewing the Petition, we determine that no claim term requires express claim constructions for purposes of this Decision. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy”).

B. Level of Ordinary Skill in the Art

Petitioner’s declarant, Dr. Neikirk, testifies that a person of ordinary skill in the art (“POSA”) would have had a graduate degree in physics, material science, electrical engineering, or a related degree, with some emphasis in semiconductor device fabrication, or an undergraduate degree in one of these fields and two to three years’ experience in semiconductor device design and fabrication. Ex. 1007 ¶ 68. Dr. Neikirk further testifies that a POSA would have had at least a basic understanding, through education or experience, of the materials that comprise photoresist layers and antireflection layers and how those materials interact with each other. *Id.*

For purposes of this Decision, we accept Dr. Neikirk’s definition of a POSA. We also rely on the cited prior art references as reflecting the level of ordinary skill in the art at the time of the invention. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

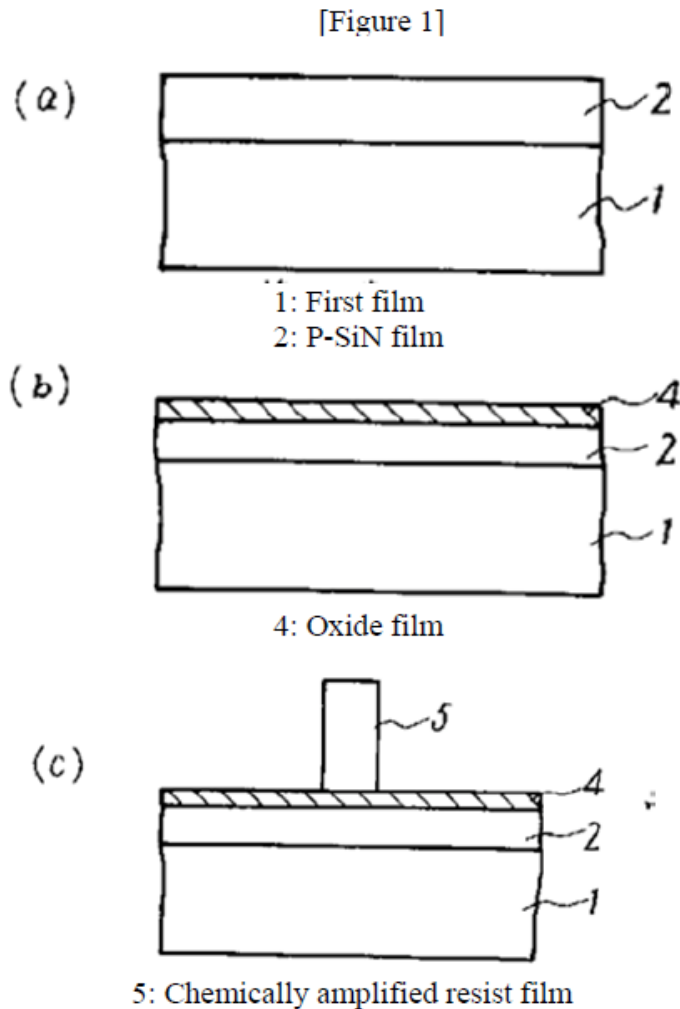
C. Prior Art References

1. Shibata (Ex. 1011)

Shibata is a Japanese patent publication titled, “Method for manufacturing a semiconductor device.” Ex. 1011, at (54). Shibata’s objective is to improve the accuracy of patterning a chemically amplified resist. *Id.* at (57), ¶ 1. The disclosed method relates to a semiconductor

device having a first film of high reflectance material, such as aluminum or tungsten, formed on a semiconductor substrate; a plasma nitride (“P-SiN”) or plasma oxynitride (“P-SiON”) antireflection film formed on the first film; and a chemically amplified resist film formed on the antireflection film. *Id.* ¶¶ 2–4, Figs. 5(a), (b). According to Shibata, a conventional method for manufacturing this device produces “tugging” on the side of the resist film that is in contact with the P-SiN or P-SiON antireflection film. *Id.* ¶ 3. The “tugging” is illustrated in Figure 5(b), which shows a patterned resist film that is wider at its base than at its top. *Id.* at Fig. 5(b). Shibata’s disclosed method aims to improve the accuracy of resist film patterning. *Id.* ¶¶ 5, 6. The method includes the following step: “plasma treatment using a gas having oxidizing power is applied to the upper surface of the plasma nitride film or plasma oxynitride film to form an oxide film.” *Id.* ¶ 7.

Figure 1 of Shibata is reproduced below:



Shibata Figure 1 illustrates a process for manufacturing a semiconductor device. Ex. 1011 ¶ 13.

Shibata Figure 1(a) shows P-SiN or P-SiON antireflection film 2 laminated on first film 1 on a semiconductor substrate (not shown). *Id.* ¶¶ 13, 14, 17, 19, 20. Antireflection film 2 has a thickness of 100–1000 angstroms. *Id.* ¶ 2 (describing conventional semiconductor device); *id.* ¶ 13 (referring to description of conventional device for parts 1–3); *see also id.* ¶ 17 (describing example P-SiN film having a thickness of 450 angstroms).

Shibata Figure 1(b) shows oxide film 4 on the upper surface of film 2. *Id.* ¶ 15. Shibata discloses that oxide film 4 has a thickness of 40–100 angstroms and is formed by plasma treatment with a gas having oxidizing power, such as nitrous oxide or oxygen. *Id.* ¶¶ 13, 15, 17, 18, 21. Shibata Figure 3 is a table showing various plasma treatment conditions and the resulting oxide film thicknesses, which range from 35 to 70 angstroms.

Shibata Figure 1(c) shows patterned resist film 5 formed on oxide film 4. *Id.* ¶¶ 13, 15. According to Shibata, formation of oxide film 4 removes nitrogen atoms from the upper part of P-SiN or P-SiON film 2, thereby preventing the reaction of nitrogen atoms with resist film 5, which improves the patterning precision of the resist. *Id.* at (57), ¶¶ 10, 18–20, 27.

2. *Foote '007 (Ex. 1013)*

Foote '007 is a U.S. patent titled, “Process for forming bottom anti-reflection coating for semiconductor fabrication photolithography which inhibits photoresist footing.” Ex. 1013, at (54). Foote '007 discloses an anti-reflection coating formed between a material layer to be patterned on a semiconductor structure and an overlying photoresist layer. *Id.* at (57), 4:59–62. The anti-reflection coating includes a silicon oxynitride anti-reflective layer and a barrier layer grown on the anti-reflective layer. *Id.* at (57), 4:66–5:2. The barrier layer is formed using nitrous oxide plasma discharge to convert a surface portion of the anti-reflective layer into silicon dioxide. *Id.* at (57), 5:1–4, 5:7–17. The barrier layer inhibits footing by preventing chemical interaction between the anti-reflective layer and the photoresist layer. *Id.* at (57), 3:1–6, 5:5–7; *see also id.* at 2:55–66, Fig. 4 (describing and illustrating “footing” problem). Foote '007 discloses that the barrier layer is thick enough to inhibit interaction between an anti-

reflective layer and an overlying photoresist layer and to thereby prevent footing, but thin enough to be removed without causing undercutting of a gate oxide layer. *Id.* at 4:49–58, 14:5–13.

Figures 5a to 5h of Foote '007 illustrate a process for patterning a material layer using an anti-reflective layer or coating. Figure 5c is reproduced below:

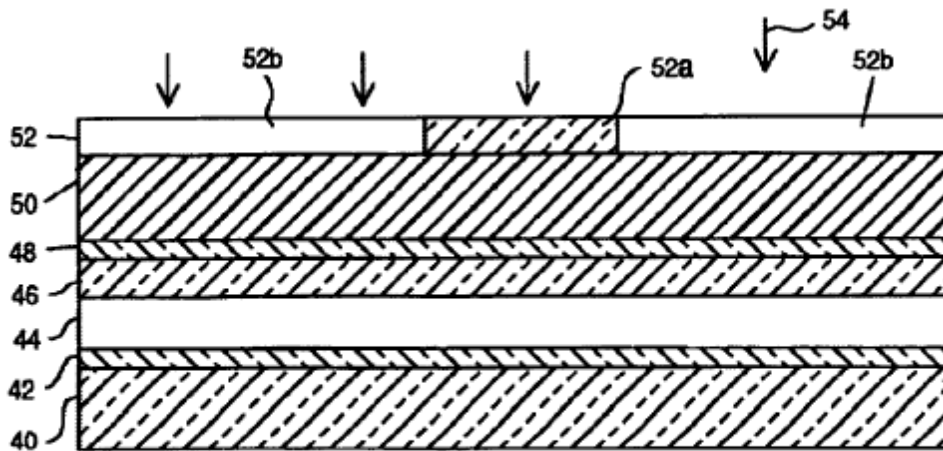


Fig. 5c

Foote '007 Figure 5c depicts a semiconductor structure at an intermediate step in a fabrication process. Ex. 1013, 6:22–26, 7:8–15. Figure 5c shows silicon substrate 40, gate oxide layer 42, polysilicon material layer 44, anti-reflective layer 46, silicon dioxide barrier layer 48, photoresist layer 50, and photolithographic mask 52, including opaque area 52a and transparent areas 52b. *Id.* at 6:27–30, 6:55, 7:8–12. In the example illustrated in Figures 5a to 5h, layer 44 is polysilicon. According to Foote '007, the disclosed process “can be applied to patterning any suitable semiconductor, metal, or other material layer.” *Id.* at 6:31–35. Foote '007 further discloses that anti-reflective layer 46 may be formed of silicon oxynitride having a thickness of

200 to 400 angstroms. *Id.* at 6:36–38, 6:44–48. Foote '007 discloses that silicon dioxide barrier layer 48 is grown on anti-reflective layer 46 using a nitrous oxide (N₂O) plasma discharge to convert a surface portion of the anti-reflective layer into silicon dioxide. *Id.* at 6:55–58. According to Foote '007, silicon dioxide barrier layer 48 has a thickness on the order of 10 to 40 angstroms. *Id.* at 7:4–7.

3. *Konjuh (Ex. 1015)*

Konjuh is a U.S. patent titled, “Surface treatment of antireflective layer in chemical vapor deposition process.” Ex. 1015, at (54). Konjuh discusses known antireflective layers, including the antireflective layer of Ogawa, which is incorporated by reference into Konjuh. *Id.* at 1:6–40 (background of the invention); *id.* at 1:26–32 (discussing Ogawa).

Figure 1 of Konjuh is reproduced below:

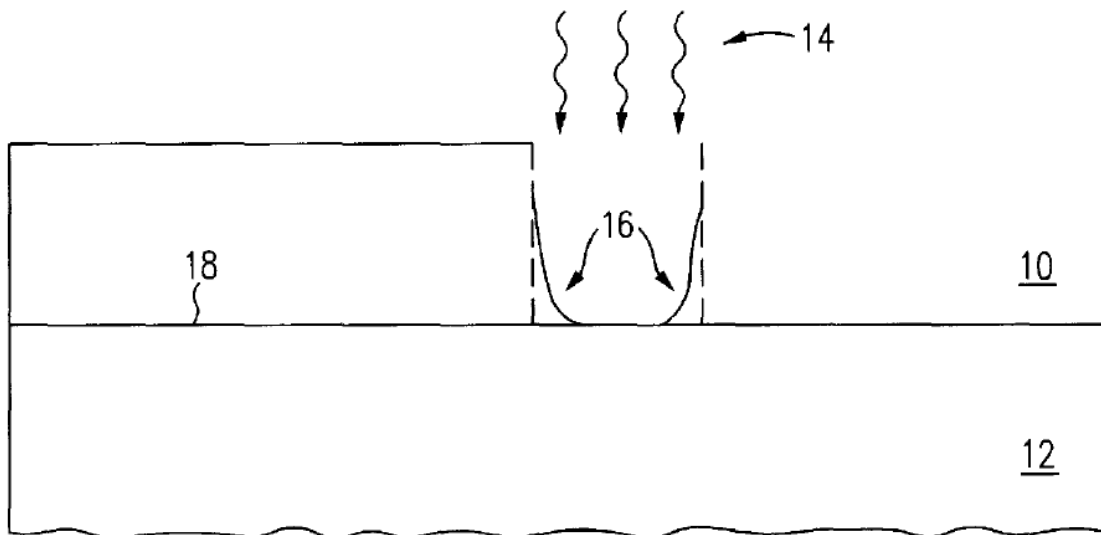


FIG. 1
(PRIOR ART)

Konjuh Figure 1 illustrates a problem that occurs in a conventional process for patterning a photoresist. Ex. 1015, 1:50–63, 2:16–17. Figure 1 shows substrate 12 and silicon oxynitride antireflective layer 18 overlying photoresist layer 10 to be patterned using deep ultraviolet radiation 14. *Id.* at 1:50–55. According to Konjuh, amines at the interface between photoresist layer 10 and antireflective layer 18 interfere with development of the photoresist, resulting in “footing” 16, which in turn interferes with the patterning of substrate 12. *Id.* at 1:58–63, 2:39–47.

To address this problem, Konjuh discloses forming a surface layer on an antireflective layer to counteract the effect of amines on an overlying photoresist layer. Ex. 1015, at (57), 2:37–39. According to Konjuh, the surface layer provides a barrier to migration of amines from the antireflective layer into the photoresist layer. *Id.* at 2:45–47.

Konjuh discloses forming a surface layer on a silicon oxynitride antireflective layer by a chemical vapor deposition (“CVD”) process. *Id.* at (57), 1:66–2:10, 2:48–51. More specifically, Konjuh discloses that the surface layer is formed by introducing an oxygen-containing gas, such as N₂O, into a CVD chamber in the presence of radio frequency power, after the antireflective layer has been formed. *Id.* Konjuh discloses that this process forms a layer of silicon oxide (SiO₂) at the surface of the antireflective layer. *Id.* at 2:58–59.

Konjuh discloses that, in some cases, pure oxygen can be substituted for nitrous oxide as the processing gas. In particular, Konjuh discloses:

For example, in some embodiments other oxygen-containing gases such as pure oxygen can be substituted for N₂O. Pure oxygen is not desirable, however, in processes where silane or another gas which reacts with oxygen in the absence of a

plasma is used before or after the formation of the surface layer. In such cases the chamber would have to be flushed of the reactive gas before the oxygen is introduced.

Id. at 4:7–14.

4. *Ogawa (Ex. 1016)*

Ogawa is an article titled, “Practical resolution enhancement effect by new complete anti-reflective layer in KrF excimer laser lithography.”

Ex. 1016, 263. Ogawa discloses that the anti-reflective layer (“ARL”) is a type of hydro silicon oxynitride film ($\text{SiO}_x\text{N}_y\text{:H}$), which can be applied to tungsten silicide (W-Si) and aluminum silicon (Al-Si) substrates using plasma enhanced chemical vapor deposition. *Id.*

According to Ogawa, reflections from the interface between a photoresist and a substrate cause thin film interference effects, which are “serious issues for device production with deep UV lithography.” *Id.* Ogawa states that these issues can be solved with “a newly developed high performance ARL.” *Id.* The ARLs are hydro silicon oxynitride films ($\text{SiO}_x\text{N}_y\text{:H}$) for tungsten silicide (W-Si) and aluminum silicon (Al-Si) substrates. *Id.* at 263–64.

Figures 1(a) and 1(b) of Ogawa are reproduced below:

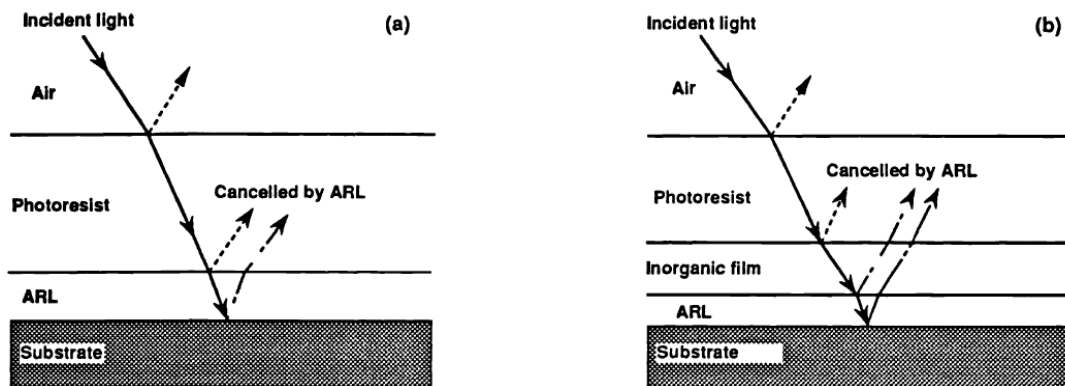


Figure 1. Schematic illustration of anti-reflective mechanism for 3 layer structure (Photoresist/ARL/Substrate) in (a), and 4 layer structure (Photoresist/Inorganic film/ARL/Substrate) in (b).

Ogawa Figures 1(a) and (b) are schematic illustrations of the anti-reflective mechanism for three- and four-layer structures, respectively. Ex. 1016, 268. Figure 1(a) shows a three-layer structure, including a substrate, an antireflective layer, and a photoresist layer. *Id.* at 264, 268. Figure 1(b) shows a four-layer structure, including a substrate, an antireflective layer, an inorganic film, a photoresist layer. *Id.* The substrate in each of Figures 1(a) and 1(b) is described as a “high reflective substrate.” *Id.* at 264. Ogawa identifies the “inorganic film” in Figure 1(b) as silicon oxide (SiO₂). *Id.*

D. Anticipation Based on Shibata

Petitioner contends that Shibata discloses all elements of claims 1, 4, and 5 of the '231 patent. Pet. 32–39. Petitioner provides a claim chart identifying disclosures in Shibata for each element of claims 1, 4, and 5. *Id.* Petitioner also relies on the testimony of its declarant, Dr. Neikirk. *Id.*; Ex. 1007 ¶¶ 163–193, 202–213.

As noted above, Patent Owner waived a Preliminary Response.

Having reviewed Petitioner’s claim chart and the disclosures of Shibata relied upon by Petitioner, we are persuaded based on the record now before us that Petitioner’s evidence and argument are sufficient to support its contention that Shibata discloses all elements of claims 1, 4, and 5. Accordingly, we are persuaded that Petitioner has shown a reasonable likelihood of prevailing on its contention that claims 4 and 5 of the '231 patent are unpatentable as anticipated by Shibata.

E. Anticipation Based on Foote '007

Petitioner contends that Foote '007 discloses all elements of claims 1 and 5 of the '231 patent. Pet. 43–48, 50. Petitioner provides a claim chart identifying disclosures in Foote '007 for each element of claims 1 and 5. *Id.*

Petitioner also relies on the testimony of Dr. Neikirk. *Id.*; Ex. 1007 ¶¶ 240–267, 278–281.

As noted above, Patent Owner waived a Preliminary Response.

Having reviewed Petitioner’s claim chart and the disclosures of Foote ’007 relied upon by Petitioner, we are persuaded based on the record now before us that Petitioner’s evidence and argument are sufficient to support its contention that Shibata discloses all elements of claims 1 and 5.

Accordingly, we are persuaded that Petitioner has shown a reasonable likelihood of prevailing on its contention that claim 5 of the ’231 patent is unpatentable as anticipated by Foote ’007.

F. Obviousness Based on Konjuh and Ogawa

Petitioner contends that claims 1, 4, and 5 are unpatentable as obvious over Konjuh and Ogawa. Pet. 51–58. Regarding motivation to combine, Petitioner contends “a person of skill would recognize that Konjuh’s ARL finds application with substrates that contain metal, such as the tungsten silicide and aluminum silicon substrates described by Ogawa.” *Id.* at 51. Petitioner provides an annotated version of Konjuh Figure 1 illustrating Petitioner’s contention regarding how a POSA would have combined the teachings of Konjuh and Ogawa. *Id.* Petitioner provides a claim chart identifying disclosures in Konjuh and Ogawa for each element of claims 1, 4, and 5. *Id.* at 52–58. Petitioner also relies on the testimony of Dr. Neikirk. *Id.*; Ex. 1007 ¶¶ 282–310, 321–329.

As noted above, Patent Owner waived a Preliminary Response.

Having reviewed the Petition, the disclosures of Konjuh and Ogawa, and the cited testimony of Dr. Neikirk, we are not persuaded that Petitioner’s arguments and evidence are sufficient to support its contention that each

element of claims 1, 4, and 5 is disclosed or suggested by Konjuh and Ogawa. In particular, we are not persuaded that Petitioner's arguments and evidence regarding Konjuh and Ogawa are sufficient to demonstrate claim 1's recitation of "a semiconductor substrate comprising the metal layer over at least part of the semiconductor substrate." Ex. 1001, 8:28–29.

Referring to its annotated version of Konjuh Figure 1, Petitioner contends that the combination of Konjuh and Ogawa teaches "a substrate 12 (blue), formed either of tungsten silicide or aluminum silicon [and] an ARL 18 (green) formed on the substrate 12 (blue)." Pet. 51. For the element of claim 1 that recites "providing a semiconductor substrate comprising the metal layer over at least part of the semiconductor substrate," Petitioner's claim chart asserts:

The prior art teaches an integrated circuit structure that includes a substrate 12 (blue) formed of either tungsten silicide (W-Si) or aluminum silicon (Al-Si). Tungsten silicide and aluminum silicon both are metals.

Id. As support for this contention, Petitioner quotes Ogawa's abstract, including the disclosure that an antireflective layer "can be applied to tungsten silicide (W-Si) and even to aluminum silicon (Al-Si) substrates." *Id.* at 53 (emphasis omitted).

Claim 1 of the '231 patent recites both a "metal layer" and a "semiconductor substrate." Ex. 1001, 8:28–29. Petitioner identifies Ogawa's tungsten silicide or aluminum silicon as a "metal layer." Pet. 53; *see also* Ex. 1007 ¶ 293 (Dr. Neikirk: "Tungsten silicide and aluminum silicon both are metals."). Petitioner's arguments regarding Konjuh and Ogawa do not, however, identify a prior art teaching of a semiconductor substrate. More particularly, although Petitioner contends that it would have

been obvious to combine Konjuh's antireflective layer with Ogawa's tungsten silicide and aluminum silicon substrates (Pet. 51), Petitioner does not identify a prior art teaching of a substrate that comprises both a metal layer and a semiconductor substrate. Nor does Petitioner provide argument or evidence sufficient to show that it would have been obvious to modify the teaching of Ogawa to add a semiconductor substrate such that Ogawa's tungsten silicide or aluminum silicon metal layer is over at least part of the semiconductor substrate, as recited in claim 1.

The foregoing deficiency in Petitioner's contentions for independent claim 1 is not remedied by Petitioner's contentions for dependent claims 4 and 5.

Accordingly, we determine that Petitioner has not shown a reasonable likelihood of prevailing on its contention that claims 4 and 5 are unpatentable as obvious over Konjuh and Ogawa.

III. CONCLUSION

For the reasons stated above, we institute an *inter partes* review as set forth in the Order. At this stage of the proceeding, the Board has not made a final determination with respect to the patentability of any challenged claim or any underlying factual or legal issues.

IV. ORDER

It is

ORDERED that, pursuant to 35 U.S.C. § 314(a), an *inter partes* review of the '231 patent is instituted on the following grounds of unpatentability asserted in the Petition:

claims 4 and 5 as anticipated under 35 U.S.C. § 102(b) by Shibata;

and

claim 5 as anticipated under 35 U.S.C. § 102(e) by Foote '007;

FURTHER ORDERED that pursuant to 35 U.S.C. § 314(a), *inter partes* review of the '231 patent is hereby instituted commencing on the entry date of this Order, and pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of trial; and

FURTHER ORDERED that the *inter partes* review is limited to the grounds identified above, and no other ground of unpatentability is authorized.

IPR2017-01868
Patent 6,326,231 B1

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