

Patent Owner

Godo Kaisha IP Bridge 1's

Demonstrative Slides

***Taiwan Semiconductor Manufacturing Company, Ltd. and
GlobalFoundries U.S., Inc.***

***v.
Godo Kaisha IP Bridge 1***

Inter Partes Review of U.S. Patent No. 6,197,696

IPR2016-01376, -01377, -01378, -01379

Patent Trial and Appeal Board

United States Patent and Trademark Office

September 12, 2017

**Godo Kaisha IP Bridge 1
IPR2016-01376
Exhibit 2041**

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Table of Abbreviations

Abbreviation	Description
Challenged Claims	'696 Patent Claims 10-12, 13-15
P1	IPR2016-01376, Paper 2, Petition for <i>Inter Partes</i> Review of U.S. 6,197,696
P2	IPR2016-01377, Paper 2, Petition for <i>Inter Partes</i> Review of U.S. 6,197,696
P3	IPR2016-01378, Paper 2, Petition for <i>Inter Partes</i> Review of U.S. 6,197,696
P4	IPR2016-01379, Paper 2, Petition for <i>Inter Partes</i> Review of U.S. 6,197,696
Smith1	IPR2016-01376, Ex1002, Declaration of Bruce Smith, Ph.D in Support of Petition for <i>Inter Partes</i> Review of U.S. Patent No. 6,197,696
Smith2	IPR2016-01377, Ex1002, Declaration of Bruce Smith, Ph.D in Support of Petition for <i>Inter Partes</i> Review of U.S. Patent No. 6,197,696
Smith3	IPR2016-01378, Ex1002, Declaration of Bruce Smith, Ph.D in Support of Petition for <i>Inter Partes</i> Review of U.S. Patent No. 6,197,696
Smith4	IPR2016-01379, Ex1002, Declaration of Bruce Smith, Ph.D in Support of Petition for <i>Inter Partes</i> Review of U.S. Patent No. 6,197,696
POR1	IPR2016-01376, Paper 19, Patent Owner's Response
POR2	IPR2016-01377, Paper 19, Patent Owner's Response
POR3	IPR2016-01378, Paper 19, Patent Owner's Response
POR4	IPR2016-01379, Paper 19, Patent Owner's Response

Table of Abbreviations

Abbreviation	Description
Glew1	IPR2016-01376, Ex2009, Expert Declaration of Alexander Glew, Ph.D in Support of Patent Owner's Response to Petition for <i>Inter Partes</i> Review of U.S. 6,197,696
Glew2	IPR2016-01377, Ex2009, Expert Declaration of Alexander Glew, Ph.D in Support of Patent Owner's Response to Petition for <i>Inter Partes</i> Review of U.S. 6,197,696
Glew3	IPR2016-01378, Ex2009, Expert Declaration of Alexander Glew, Ph.D in Support of Patent Owner's Response to Petition for <i>Inter Partes</i> Review of U.S. 6,197,696
Glew4	IPR2016-01379, Ex2009, Expert Declaration of Alexander Glew, Ph.D in Support of Patent Owner's Response to Petition for <i>Inter Partes</i> Review of U.S. 6,197,696
Reply1	IPR2016-01376, Paper 26, Petitioners' Reply
Reply2	IPR2016-01377, Paper 26, Petitioners' Reply
Reply3	IPR2016-01378, Paper 26, Petitioners' Reply
Reply4	IPR2016-01379, Paper 26, Petitioners' Reply
SmithReply1	IPR2016-01376, Ex1049, Rebuttal Declaration of Bruce Smith, Ph.D in Support of Petition for <i>Inter Partes</i> Review of U.S. Patent No. 6,197,696
SmithReply2	IPR2016-01377, Ex1050, Rebuttal Declaration of Bruce Smith, Ph.D in Support of Petition for <i>Inter Partes</i> Review of U.S. Patent No. 6,197,696
SmithReply3	IPR2016-01378, Ex1050, Rebuttal Declaration of Bruce Smith, Ph.D in Support of Petition for <i>Inter Partes</i> Review of U.S. Patent No. 6,197,696
SmithReply4	IPR2016-01379, Ex1050, Rebuttal Declaration of Bruce Smith, Ph.D in Support of Petition for <i>Inter Partes</i> Review of U.S. Patent No. 6,197,696

Table of Abbreviations

Abbreviation	Description
Observations1	IPR2016-01376, Paper 34, Patent Owner's Motion for Observations on Cross Examination of Bruce Smith, Ph.D
Observations2	IPR2016-01377, Paper 34, Patent Owner's Motion for Observations on Cross Examination of Bruce Smith, Ph.D
Observations3	IPR2016-01378, Paper 34, Patent Owner's Motion for Observations on Cross Examination of Bruce Smith, Ph.D
Observations4	IPR2016-01379, Paper 34, Patent Owner's Motion for Observations on Cross Examination of Bruce Smith, Ph.D
MTE1	IPR2016-01376, Paper 30, Petitioner's Motion to Exclude Evidence
MTE2	IPR2016-01377, Paper 30, Petitioner's Motion to Exclude Evidence
MTE3	IPR2016-01378, Paper 30, Petitioner's Motion to Exclude Evidence
MTE4	IPR2016-01379, Paper 30, Petitioner's Motion to Exclude Evidence
Opp1	IPR2016-01376, Paper 37, Patent Owner's Opposition to Petitioner's Motion to Exclude Evidence
Opp2	IPR2016-01377, Paper 37, Patent Owner's Opposition to Petitioner's Motion to Exclude Evidence
Opp3	IPR2016-01378, Paper 37, Patent Owner's Opposition to Petitioner's Motion to Exclude Evidence
Opp4	IPR2016-01379, Paper 37, Patent Owner's Opposition to Petitioner's Motion to Exclude Evidence
POSITA	Person of Ordinary Skill in the Art

Table of Abbreviations

Abbreviation	Description
Scope1	IPR2016-01376, Paper 36, Patent Owner's Identification of Arguments Exceeding the Proper Scope of Reply
Scope2	IPR2016-01377, Paper 36, Patent Owner's Identification of Arguments Exceeding the Proper Scope of Reply
Scope3	IPR2016-01378, Paper 36, Patent Owner's Identification of Arguments Exceeding the Proper Scope of Reply
Scope4	IPR2016-01379, Paper 36, Patent Owner's Identification of Arguments Exceeding the Proper Scope of Reply

Instituted Obviousness Grounds:

IPR	Prior Art References	Claims
IPR2016-01376	Grill in view of Aoyama (as articulated in the -01376 Petition)	13, 15
IPR2016-01377	Grill in view of Aoyama (as articulated in the -01377 Petition)	10-12
IPR2016-01378	Grill in view of Aoyama (as articulated in the -01378 Petition)	13-14
IPR2016-01379	Grill in view of Aoyama and Wetzel (as articulated in the -01379 Petition)	10, 12

Claim Construction

Petitioner’s interpretation of “using the [designated layer[s]] as a mask” is inconsistent with the specification, the law, and the understanding of a POSITA

Petitioner’s Interpretation	Patent Owner’s Construction
<p><i>The construction should exclude the situation where:</i></p> <p>“a buried layer ‘define[s] areas for etching’ whenever it has a vertical sidewall ‘in line and flush with an edge of overlying layer’”</p> <p>Reply1 at 3; Reply2 at 3; Reply3 at 3; Reply4 at 3.</p>	<p>“using the [designated layer[s]] to define areas for etching”</p> <p>POR1 at 7-18; POR2 at 7-18; POR3 at 7-18; POR4 at 7-18.</p>

Patent Owner’s construction is supported by, and Petitioner’s interpretation improperly excludes, “preferred embodiments” of the ‘696 Patent

“DESCRIPTION OF THE PREFERRED EMBODIMENTS”

EX1001 10:19-20, 16:39-18:58, 18:59-20:49, 24:52-27:60.

Modified third embodiment: “Thereafter, as shown in FIG. 16(d), the patterned organic film 354A is dry-etched **using the mask pattern 358 and the patterned second silicon dioxide film 355A** having the openings for forming wiring grooves **as a mask**, thereby forming the wiring grooves 362.”

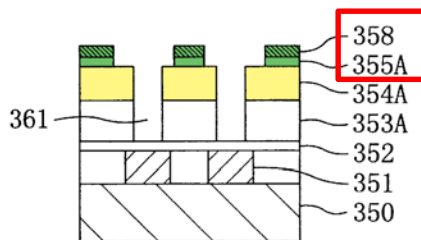


Fig. 16(c)

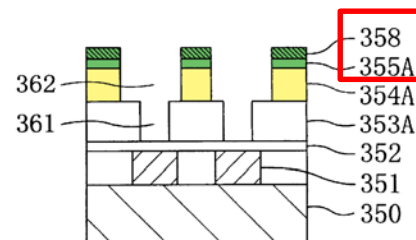


Fig. 16(d)

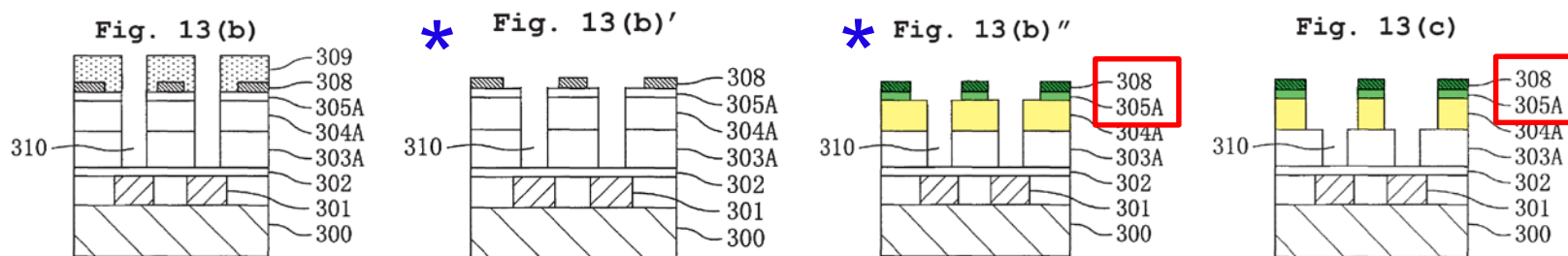
EX1001 19:50-53, Fig. 16(c)-16(d); see also, e.g., **1376**: POR1 at 10-12; Glew1 ¶52; **1377**: POR2 at 10-12; Glew2 ¶52; **1378**: POR3 at 10-12; Glew3 ¶52; **1379**: POR4 at 10-12; Glew4 ¶52.

Patent Owner's construction is supported by, and Petitioner's interpretation improperly excludes, "preferred embodiments" of the '696 Patent (cont.)

"DESCRIPTION OF THE PREFERRED EMBODIMENTS"

EX1001 10:19-20, 16:39-18:58, 18:59-20:49, 24:52-27:60.

Third embodiment: "[A]s shown in FIG. 13(c), the second resist pattern 309 is removed and the patterned second organic-containing silicon dioxide film 305A is dry-etched using the mask pattern 308 as a mask ... Thereafter, the patterned low-dielectric-constant SOG film 304A is **dry-etched using the mask pattern 308 and the patterned second organic-containing silicon dioxide film 305A** having the openings for wiring grooves **as a mask**, thereby forming the wiring grooves 311."



EX1001 17:34-40, Fig. 13(b)-13(c); see also, e.g., **1376:** POR1 at 12-13; Glew1 ¶¶54-58; **1377:** POR2 at 12-13; Glew2 ¶¶54-58; **1378:** POR3 at 12-13; Glew3 ¶¶54-58; **1379:** POR4 at 12-13; Glew4 ¶¶54-58.

* modified from original figure

Patent Owner’s construction is supported by, and Petitioner’s interpretation improperly excludes, “preferred embodiments” of the ‘696 Patent (cont.)

“DESCRIPTION OF THE PREFERRED EMBODIMENTS”

EX1001 10:19-20, 16:39-18:58, 18:59-20:49, 24:52-27:60.

Modified fifth embodiment: “Then, the patterned second organic film 555A is dry-etched **using the mask pattern 559 and the patterned second silicon dioxide film 556B as a mask**”

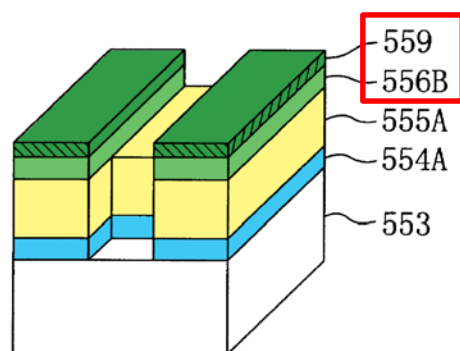


Fig. 28 (b)

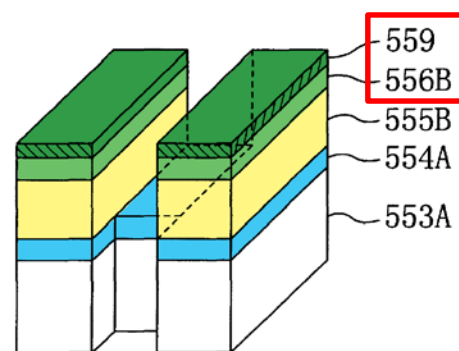


Fig. 29 (a)

EX1001 26:15-19, Fig. 28(b)-29(a); see also, e.g., **1376**: POR1 at 13-14; Glew1 ¶¶61-62; **1377**: POR2 at 13-14; Glew2 ¶¶61-62; **1378**: POR3 at 13-14; Glew3 ¶¶61-62; **1379**: POR4 at 13-14; Glew4 ¶¶61-62.

Patent Owner’s construction is supported by, and Petitioner’s interpretation improperly excludes, “preferred embodiments” of the ‘696 Patent, and Petitioner’s interpretation “disregard[s]” the specification

Petitioner and its expert argue: “IPB cherry-picks three examples where the **specification incorrectly refers** to a buried layer as a ‘mask’ ... ignoring at least seven contrary examples ...”

Reply1 at 8; Reply2 at 8; Reply3 at 8; Reply4 at 8.

“In my opinion, a person of ordinary skill in the art **would have disregarded the misstatements made in the three examples IPB identified where a buried layer is called a “mask” in the specification**. Not only do these examples contradict the common and ordinary meaning of what it means to act as a mask, they also contradict at least seven examples in the specification where a buried layer is not called a ‘mask’:

SmithReply1 ¶27; SmithReply2 ¶27; SmithReply3 ¶21; SmithReply4 ¶21;
see also, e.g., **1376**: Reply1 at 8; **1377**: Reply2 at 8; **1378**: Reply3 at 8; **1379**: Reply4 at 8.

- But this is contrary to the law:

PTAB: “Under the **broadest reasonable interpretation** standard, claim terms are generally given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art, **in the context of the entire disclosure**.”

Apple v. Immersion, IPR2016-01371, Pap.7, 5 (citing *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007)); see also, e.g., **1376**: POR1 at 12 n.11; **1377**: POR2 at 12 n.11; **1378**: POR3 at 12 n.11; **1379**: POR4 at 12 n.11.

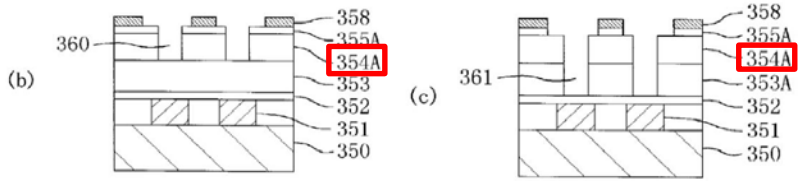
Federal Circuit: “Even under the broadest reasonable interpretation, the Board’s **construction ‘cannot be divorced from the specification** and the record evidence,’ and ‘must be consistent with the one that those skilled in the art would reach.’”

Microsoft v. Proxyconn, 789 F.3d 1292, 1298 (Fed. Cir. 2015) (citations omitted);
see also, e.g., **1376**: POR1 at 14; **1377**: POR2 at 14; **1378**: POR3 at 14; **1379**: POR4 at 14.

Federal Circuit: “As this court has explained before, ‘**a claim interpretation that excludes a preferred embodiment** from the scope of the claim ‘is **rarely, if ever, correct**.’”

Patent Owner’s construction is supported by, and Petitioner’s interpretation improperly excludes, “preferred embodiments” of the ‘696 Patent, and Petitioner’s interpretation “disregard[s]” the specification (cont.)

- And Petitioner and its expert *still can’t agree*:

Petitioner’s Reply	Cross-Examination of Patent Owner’s Expert
<p>“This <u>leaves layer 354A exposed to act as a mask</u> partway through the etch, consistent with the Board’s use of ‘mask.’ See Paper 11, 18 n.7. This does not happen with layer 355 while layer 354 is being etched (see above).”</p> <div></div> <p>1376: Reply1 at 14; 1377: Reply2 at 13-14; 1378: Reply3 at 13-14; 1379: Reply4 at 14.</p>	<p>Q Is film 354A being used as a mask in etching film 353?</p> <p>A <u>It says that in the specification, but 354A is not -- would not be part of the mask</u> that would be etching 353.</p> <p>EX2040 18:3-7.</p>

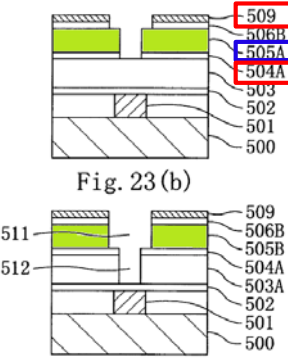
See also, e.g., **1376:** Observations1 ¶2; **1377:** Observations2 ¶2; **1378:** Observations3 ¶2; **1379:** Observations4 ¶2.

Patent Owner’s construction is supported by, and Petitioner’s interpretation improperly ignores, the figures of the ‘696 Patent

Petitioner and its expert argue: “In my opinion, a person of ordinary skill in the art would have disregarded the misstatements made in the *three examples IPB identified* where a buried layer is called a “mask” *in the specification*. Not only do these examples contradict the common and ordinary meaning of what it means to act as a mask, *they also contradict at least seven examples in the specification where a buried layer is not called a ‘mask’:*”

SmithReply1 ¶127; SmithReply2 ¶127; SmithReply3 ¶127; SmithReply4 ¶127; see also, e.g., **1376:** Reply1 at 8-9; **1377:** Reply2 at 8-9; **1378:** Reply3 at 8-9; **1379:** Reply4 at 8-9.

- But Petitioner’s expert admits a layer can act as a mask even when the specification **does not refer to the layer as a mask**:

Cross-Examination of Petitioner’s Expert	‘696 Figures	‘696 Specification
<p>Q You said that film 505A defines the opening in 503 during the etch process. Is that right?</p> <p>A Right. The etch process is directed through the opening in 505A, which will act to mask 503 until 504A is reached. 504A is designed as an etch stop in -- in 512. So 505A does act as – as the mask for 503.</p> <p>EX2040 20:13-20.</p>	 <p>Fig. 23 (b)</p> <p>Fig. 23 (c)</p>	<p>“Then, the patterned second organic film 505A and the first organic film 503 are dry-etched using the mask pattern 509 and the patterned first silicon dioxide film 504A as respective masks, thereby forming a patterned second organic film 505B having wiring grooves 511 and a patterned first organic film 503A having contact holes 512 as shown in FIG. 23(c).”</p> <p>EX1001 24:7-13.</p>

See also, e.g., **1376:** Observations1 ¶3; **1377:** Observations2 ¶3; **1378:** Observations3 ¶3; **1379:** Observations4 ¶3.

Patent Owner’s construction is supported by, and Petitioner’s interpretation improperly ignores, the figures of the ’696 Patent (cont.)

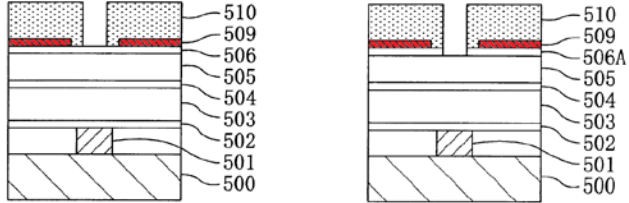
- And Petitioner’s expert *again* admits a layer can act as a mask even when the specification *does not refer to the layer as a mask*:

Cross-Examination of Petitioner’s Expert	’696 Figures	’696 Specification
<p>Q Going back to my question. Is film 605A being used as a mask in etching film 603?</p> <p>A Prior to reaching 604A, the opening in 605 -- in 605A will act to mask etching until that film is removed, until that film is completely removed.</p> <p>EX2040 21:18-22:1.</p>	<p>Fig. 32(a)</p> <p>Fig. 32(b)</p>	<p><i>“Then, the patterned second organic film 605A and the first organic film 603 are dry-etched using the mask pattern 608 and the patterned silicon dioxide film 604A as respective masks, thereby forming a patterned second organic film 605B having wiring grooves 610 and a patterned first organic film 603A having contact holes 611 as shown in FIG. 32(b).”</i></p> <p>EX1001 29:6-12.</p>

See also, e.g., **1376**: Observations1 ¶4; **1377**: Observations2 ¶4; **1378**: Observations3 ¶4; **1379**: Observations4 ¶4.

Patent Owner’s construction is supported by, and Petitioner’s interpretation improperly ignores, the specification of the ‘696 Patent

- The ‘696 specification describes, but does not depict, using mask pattern 509 “as a mask”:

‘696 Specification	‘696 Figures
<p>“Then, as shown in FIG. 22(b), a second resist pattern 510, having openings for forming contact holes, is formed by lithography on the mask pattern 509. Thereafter, the second silicon dioxide film 506 is dry-etched using the second resist pattern 510 and the mask pattern 509 as a mask, thereby forming a patterned second silicon dioxide film 506A having openings for forming contact holes as shown in FIG. 22(c).”</p> <p>EX1001 23:39-46.</p>	 <p>EX1001 Figs. 22(b)-(c).</p>

See also, e.g., **1376**: Reply1 at 8; SmithReply1 ¶123; **1377**: Reply2 at 8; SmithReply2 ¶123; **1378**: Reply3 at 8; SmithReply3 ¶123; **1379**: Reply4 at 8; SmithReply4 ¶123.

Petitioner’s expert argued: “The **statement in IPB’s Preliminary Response that ‘there are other cross-sections in which the second resist pattern and the mask pattern, shown in one cross-section in Figures 22(b) and 22(c), either have edges lined up and flush with one another that are used to etch the second silicon dioxide film (EX1001 at 17:50-62, 19:63-20:8), or are ‘offset’ such that the second resist pattern and the mask pattern are both used to define areas for etching” (Paper 6 at 42) is untrue**, as even Dr. Glew admits. Glew Deposition at 97:12–99:21.”

SmithReply1 ¶124; SmithReply2 ¶124; SmithReply3 ¶124; SmithReply4 ¶124;
see also e.g., **1376**: Reply1 at 8; **1377**: Reply2 at 8; **1378**: Reply3 at 8; **1379**: Reply4 at 8.

- But** Petitioner’s expert admitted during cross-examination (while discussing Grill):

Q So other **cross-sections going into the page might look different than what’s shown in these figures, depending on where that cross-section was taken?**

A Sure.

EX2040 53:2-53:6.

Petitioner’s interpretation of “using the [designated layer[s]] as a mask” is impermissibly narrower than the district court construction under *Phillips*

Federal Circuit: “The *broadest reasonable interpretation* of a claim term may be the same as or broader than the construction of a term under the Phillips standard. But it **cannot be narrower**. Thus, the Board’s construction cannot be the broadest reasonable one.”

Facebook v. Pragmatus AV, 582 Fed.App’x 864, 868-69 (Fed. Cir. 2014) (nonprecedential); *see also, e.g.*, **1376:** POR1 at 14-15; **1377:** POR2 at 14-15; **1378:** POR3 at 14-15; **1379:** POR4 at 14-15.

Petitioner’s Interpretation	District Court’s <i>Phillips</i> Construction
<p><i>The construction should exclude the situation where:</i></p> <p>“a buried layer a buried layer ‘define[s] areas for etching’ whenever it has a vertical sidewall ‘in line and flush with an edge of overlying layer’”</p> <p>Reply1 at 3; Reply2 at 3; Reply3 at 3; Reply4 at 3.</p>	<p>“using the [first resist pattern/second resist pattern and the mask pattern/patterned third insulating film] to define areas for etching”</p> <p>EX3002 22; <i>see also, e.g.</i>, 1376: POR1 14-15; 1377: POR1 14-15; 1378: POR1 14-15; 1379: POR1 14-15.</p>

Petitioner’s interpretation is inconsistent with the understanding of a POSITA

- Claims 10 and 13 of the ’696 patent require, *inter alia*:

“dry-etching the [fourth/third] insulating film **using the second resist pattern and the mask pattern as a mask**, thereby patterning the [fourth/third] insulating film to have the openings for forming contact holes;”

EX1001 34:25-28, 35: 13-16.

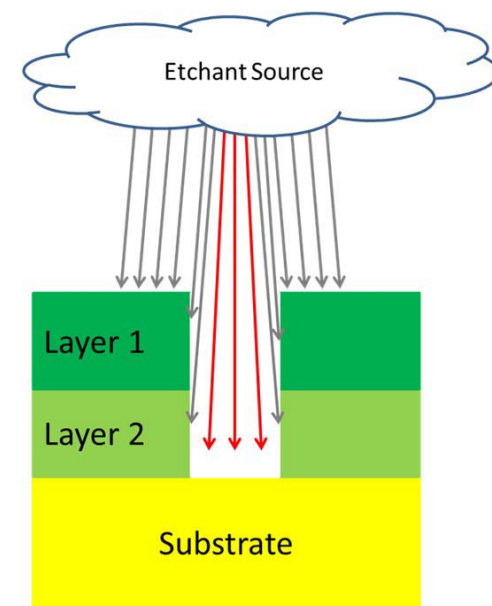
- Patent Owner’s expert Dr. Glew testified:

“A [POSITA] would have understood that in an etching process, **etchant does not flow in a perfectly vertical direction**” and “in an anisotropic process, there is **some amount of etchant that flows in a horizontal direction impacting against sidewalls of a pattern**. Thus, a **mask’s function is not only** to define areas for etching by **blocking the etchant at the mask’s top surface, but also** to define areas for etching by **blocking the etchant through its side surface**.”

Glew1 ¶¶63-64; Glew2 ¶¶63-64; Glew3 ¶¶63-64; Glew4 ¶¶63-64.

“One example of an orientation where two layers act as a mask is when edges of the two layers line up—i.e., are “flush”—and an etchant extends down to a layer that underlies the two layers. In such an orientation, **an interlayer material (the layer that is underlying the top layer) acts as a mask if at least some part of a side surface of the interlayer is exposed such that it substantially blocks the etchant from reaching certain areas, thereby defining an area for etching**.”

Glew1 ¶65; Glew2 ¶65; Glew3 ¶65; Glew4 ¶65.



Glew1 ¶66; Glew2 ¶66; Glew3 ¶66; Glew4 ¶66.

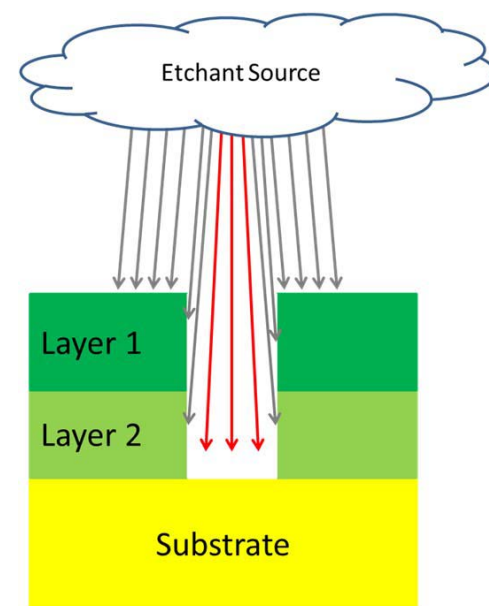
Petitioner’s interpretation is inconsistent with the understanding of a POSITA (cont.)

- As Dr. Glew testified, Patent Owner’s construction is consistent with the extrinsic evidence:

“Contemporaneous dictionary definitions further support [Patent Owner’s] construction of ‘using the [designated layer[s]] as a mask.’ See, e.g., EX2001, 3 (defining masking as ‘[a]pplying a covering or coating on a semiconductor surface to provide a masked area for selective deposition or etching’); EX2002, 3 (**defining a mask as** ‘[a] device ... **used to shield selected portions** of a base during a deposition process,’ and a ‘template used to etch circuit patterns on semiconductor wafers’); EX2003, 4; EX2004, 3 (**defining a mask as** ‘[a]n object, stencil, or other device which is applied or placed upon a surface, so as to permit the selective passing of particles, beams, rays, substances, and so on, to form any desired patterns,’ and the **use** of said object ‘**to selectively shield portions of semiconductor wafers**, or other materials, during manufacturing’).”

“A person or ordinary skill in the art would have understood that **Layer 1 and Layer 2 together act as ‘a pattern of opaque material used to shield selected areas of a surface (as of a semiconductor).’** EX3001 (Merriam Webster Dictionary) 1.”

Glew1 ¶¶47 (citing EX2002 3; EX2003 4; EX2004 4), 67 (citing EX3001 1);
Glew2 ¶¶47 (citing EX2002 3; EX2003 4; EX2004 4), 67 (citing EX3001 1);
Glew3 ¶¶47 (citing EX2002 3; EX2003 4; EX2004 4), 67 (citing EX3001 1);
Glew4 ¶¶47 (citing EX2002 3; EX2003 4; EX2004 4), 67 (citing EX3001 1).



Glew1 ¶¶66; Glew2 ¶¶66; Glew3 ¶¶66; Glew4 ¶¶66.

See also, e.g., **1376**: POR1 at 9, 15-17; **1377**: POR2 at 9, 15-17; **1378**: POR3 at 9, 15-17; **1379**: POR4 at 9, 15-17.

Both Petitioner’s expert and Dr. Glew agree that dry etching (e.g., reactive ion etching) includes lateral flow of etchant and lateral removal

Petitioner and its expert purport to: “disagree with IPB and Dr. Glew when they speculate that a buried layer might be mask because of particles traveling laterally. One of the fundamental requirements for a successful dual damascene technology is the ability to perform highly anisotropic etches that faithfully reproduce specified patterns. The etches at issue here are highly directional, with minimal lateral deviation.”

SmithReply1 ¶111; SmithReply2 ¶111; SmithReply3 ¶111; SmithReply4 ¶11; see also, e.g., **1376:** Reply1 at 4-5; **1377:** Reply2 at 4-5; **1378:** Reply3 at 4-5; **1379:** Reply1 at 4-5.

- **But**, Petitioner’s expert testified:

“A person of ordinary skill in the art would have understood that **reactive ion etching (RIE) is a dry etch.**”

Smith1 ¶199; Smith2 ¶229; Smith3 ¶194; Smith4 ¶231; see also, e.g., **1376:** P1 at 46, 63; Smith1 ¶231; **1377:** P2 at 53 n.4, 54, 66; Smith2 ¶269; **1378:** P3 at 39, 39 n.3; **1379:** P4 at 63, 63 n.6; Smith4 ¶270.

- And on cross examination, Petitioner’s expert agreed that RIE has “**lateral flow of etchant**” and “**lateral removal**”

Both Petitioner’s expert and Dr. Glew agree that dry etching (e.g., reactive ion etching) includes lateral flow of etchant and lateral removal (cont.)

- On cross examination, Petitioner’s expert agreed that RIE has “***lateral flow of etchant***” and “***lateral removal***” (cont.)

Q Can there be ***lateral flow of etchant*** in reactive ion etching?

A The balance between the chemical and physical etching of an ***RIE process*** could allow for a -- could ***allow for chemical species to result in an anisotropy***. In that case that would be ***a lateral effect, a lateral removal, which could be from the flow of -- or the motion of chemical species***.

EX2040 32:16-33:1; see also, e.g., **1376**: Observations1 ¶15; **1377**: Observations2 ¶15; **1378**: Observations3 ¶15; **1379**: Observations4 ¶15.

Q We discussed before how there are ***both neutral and ionic species*** present in reactive ion etching. Is that correct?

A That's right.

...

Q And those neutral species will cause ***lateral removal***. Is that correct?

A They will -- well, it's not that simple. It's not one thing does one -- one species does one thing and another does another. It's the ***combination of the chemically reactive and chemically neutral species, it's the combination of the chemical etch and the physical etch, that result in things like the anisotropy*** of an RIE process.

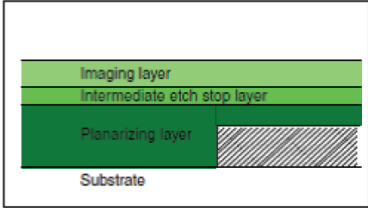
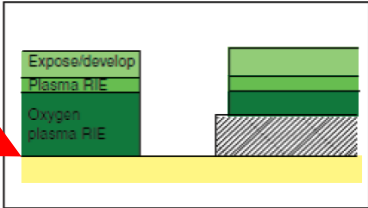
Q So is it your testimony that ***both the neutral and ionic components contribute to lateral removal***?

A ***Yes, they work together***. They work, as I said in my report, synergistically.

EX2040 36:22-37:3, 37:18-38:9; see also, e.g., **1376**: Observations1 ¶16; **1377**: Observations2 ¶16; **1378**: Observations3 ¶16; **1379**: Observations4 ¶16.

Petitioner’s interpretation is inconsistent with Petitioner’s expert’s prior publications

- Petitioner’s expert’s textbook published in 1998 (EX2017) and 2007 (EX2018) states:

Cross-Examination of Petitioner’s Expert	Petitioner’s Expert’s Textbook
<p>Q. So the multilayer resist that we’re talking about here containing the imaging layer, the intermediate etch-stop layer, and the planarizing layer, what -- what does it etch?</p> <p>A. ... After all is said and done, after the exposed developed and the two plasma reactive-ion etch steps, then that layer is defined to etch something underneath that. <i>So in the diagram, that very bottom horizontal line would be whatever that substrate thin film material is. That then would be etched using this process.</i></p> <p>So this doesn't address what would be etched underneath that hasn't been etched yet. <i>This is just defining that multiple layer -- multiple layer resist.</i></p> <p>EX2010 64:5-65:8; see also, e.g., 1376: POR1 at 17-18; Glew1 ¶¶71-72; 1377: POR2 at 17-18; Glew2 ¶¶71-72; 1378: POR3 at 17-18; Glew3 ¶¶71-72; 1379: POR4 at 17-18; Glew4 ¶¶71-72.</p>	<p>Trilayer system</p>   <p>(c)</p> <p>EX2017 0060; EX2018 0018; see also, e.g., 1376: POR1 at 17-18; Glew1 ¶¶71-72; 1377: POR2 at 17-18; Glew2 ¶¶71-72; 1378: POR3 at 17-18; Glew3 ¶¶71-72; 1379: POR4 at 17-18; Glew4 ¶¶71-72.</p>

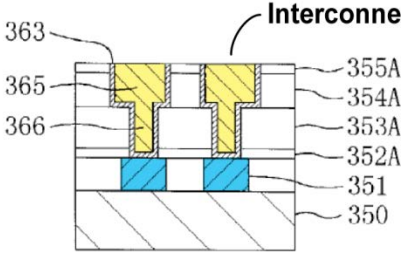
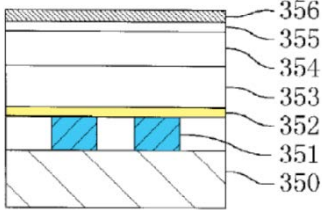
- Other textbooks similarly describe:

“Multi-layer processing techniques, where layers of radiation sensitive (top), non-photosensitive organic, and/or inorganic materials sandwiched together [] become the total patterning layer...”

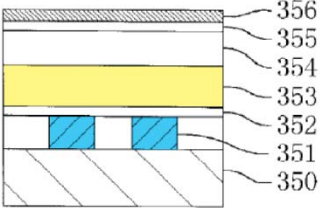
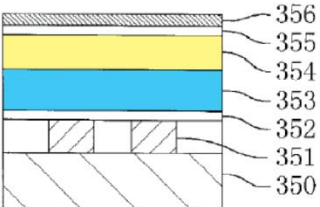
EX2015 0007; see also, e.g., EX2027 0113; **1376:** POR1 at 18; Glew1 ¶¶69, 73; Opp1 at 8-9; **1377:** POR2 at 18; Glew2 ¶¶69, 73; Opp2 at 8-9; **1378:** POR3 at 18; Glew3 ¶¶69, 73; Opp3 at 8-9; **1379:** POR4 at 18; Glew4 ¶¶69, 73; Opp4 at 8-9.

Grill in View of Aoyama [and Wetzel]: Grill Is Not Prior Art to the '696 Patent

Claims 10 and 13 of the '696 patent are fully supported by the '696 Foreign Priority Document and are entitled to a priority date of March 26, 1998

Claim 10	Claim 13	Foreign Priority Document (JP '371) (EX1014)
A method for forming an interconnection structure, comprising the steps of:	A method for forming an interconnection structure, comprising the steps of:	<div></div> <p>See EX1014 ¶¶[0089]-[0090], Fig.17(c); see also, e.g., 1376: POR1 at 21; Glew1 ¶78; 1377: POR2 at 21; Glew2 ¶78; 1378: POR3 at 21; Glew3 ¶78; 1379: POR4 at 21; Glew4 ¶78.</p>
a) forming a first insulating film over lower-level metal interconnects;		<div></div> <p>See EX1014 ¶[0090], Fig.15(a); see also, e.g., 1377: POR2 at 21; Glew2 ¶79; 1379: POR4 at 21; Glew4 ¶79.</p>

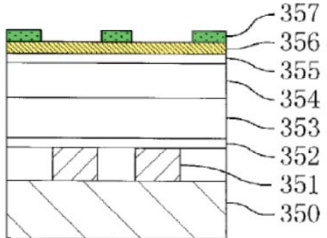
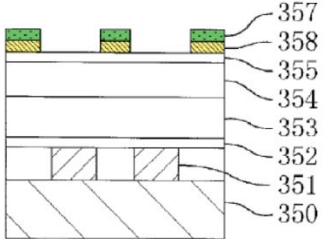
Claims 10 and 13 of the '696 patent are fully supported by the '696 Foreign Priority Document and are entitled to a priority date of March 26, 1998 (cont.)

Claim 10	Claim 13	Foreign Priority Document (JP '371) (EX1014)
b) forming a second insulating film, having a different composition than that of the first insulating film, over the first insulating film;	a) forming a first insulating film over lower-level metal interconnects;	<div></div> <p>See EX1014 ¶[0090], Fig.15(a); <i>see also, e.g., 1376: POR1 at 21; Glew1 ¶179; 1377: POR2 at 21-22; Glew2 ¶180; 1378: POR3 at 21; Glew3 ¶179; 1379: POR4 at 21-22; Glew4 ¶180.</i></p>
c) forming a third insulating film, having a different composition than that of the second insulating film, over the second insulating film;	b) forming a second insulating film, having a different composition than that of the first insulating film, over the first insulating film;	<div></div> <p>See EX1014 ¶[0090], Fig.15(a); <i>see also, e.g., 1376: POR1 at 21-22; Glew1 ¶180; 1377: POR2 at 22; Glew2 ¶181; 1378: POR3 at 21-22; Glew3 ¶180; 1379: POR4 at 22; Glew4 ¶181.</i></p>

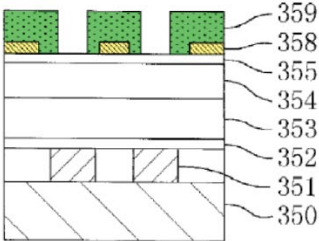
Claims 10 and 13 of the '696 patent are fully supported by the '696 Foreign Priority Document and are entitled to a priority date of March 26, 1998 (cont.)

Claim 10	Claim 13	Foreign Priority Document (JP '371) (EX1014)
d) forming a fourth insulating film, having a different composition than that of the third insulating film, over the third insulating film;	c) forming a third insulating film, having a different composition than that of the second insulating film, over the second insulating film;	<div></div> <p>See EX1014 ¶[0090], Fig.15(a); <i>see also, e.g.,</i> 1376: POR1 at 22; Glew1 ¶81; 1377: POR2 at 22-23; Glew2 ¶82; 1378: POR3 at 22; Glew3 ¶81; 1379: POR4 at 22-23; Glew4 ¶82.</p>
e) forming a thin film over the fourth insulating film;	d) forming a thin film over the third insulating film;	<div></div> <p>See EX1014 ¶[0090], Fig.15(a); <i>see also, e.g.,</i> 1376: POR1 at 23; Glew1 ¶82; 1377: POR2 at 23; Glew2 ¶83; 1378: POR3 at 22; Glew3 ¶82; 1379: POR4 at 23; Glew4 ¶83.</p>

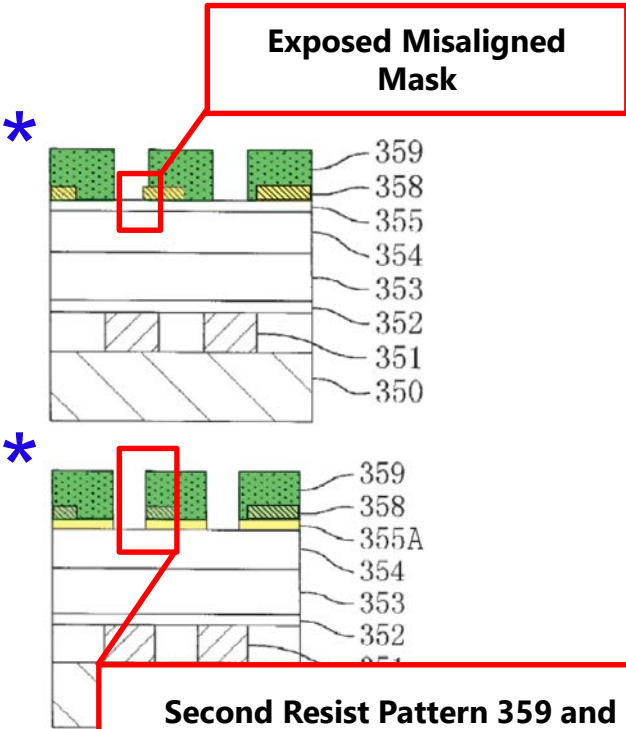
Claims 10 and 13 of the '696 patent are fully supported by the '696 Foreign Priority Document and are entitled to a priority date of March 26, 1998 (cont.)

Claim 10	Claim 13	Foreign Priority Document (JP '371) (EX1014)
f) forming a first resist pattern on the thin film, the first resist pattern having openings for forming wiring grooves;	e) forming a first resist pattern on the thin film, the first resist pattern having openings for forming wiring grooves;	<div></div> <p>See EX1014 ¶[0092], Fig.15(b); <i>see also, e.g., 1376: POR1 at 23; Glew1 ¶83; 1377: POR2 at 23; Glew2 ¶84; 1378: POR3 at 23; Glew3 ¶83; 1379: POR4 at 23; Glew4 ¶84.</i></p>
g) etching the thin film using the first resist pattern as a mask, thereby forming a mask pattern out of the thin film to have the openings for forming wiring grooves;	f) etching the thin film using the first resist pattern as a mask, thereby forming a mask pattern out of the thin film to have the openings for forming wiring grooves;	<div></div> <p>See EX1014 ¶[0092], Fig.15(c); <i>see also, e.g., 1376: POR1 at 23; Glew1 ¶84; 1377: POR2 at 23-24; Glew2 ¶85; 1378: POR3 at 23; Glew3 ¶84; 1379: POR4 at 23-24; Glew4 ¶85.</i></p>

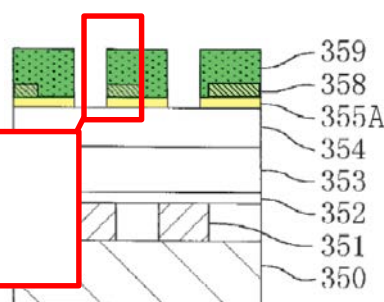
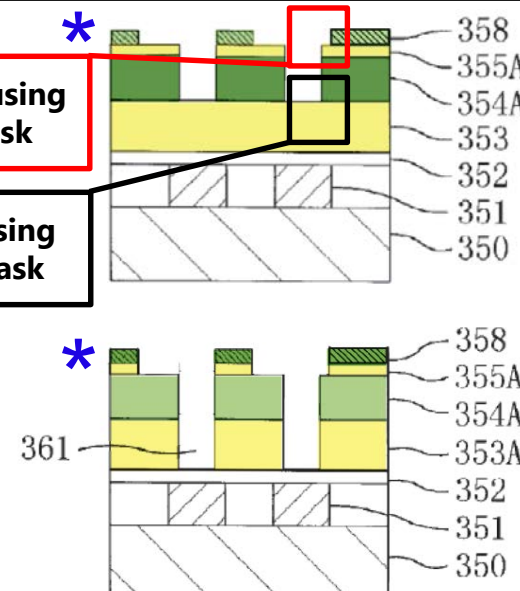
Claims 10 and 13 of the '696 patent are fully supported by the '696 Foreign Priority Document and are entitled to a priority date of March 26, 1998 (cont.)

Claim 10	Claim 13	Foreign Priority Document (JP '371) (EX1014)
h) removing the first resist pattern and then forming a second resist pattern on the fourth insulating film and the mask pattern, the second resist pattern having openings for forming contact holes;	g) removing the first resist pattern and then forming a second resist pattern on the third insulating film and the mask pattern, the second resist pattern having openings for forming contact holes;	<div><p>The diagram shows a cross-section of a semiconductor device. It consists of a substrate (350) with a series of layers. From bottom to top, the layers are: 350 (hatched), 351 (white), 352 (white with diagonal lines), 353 (white), 354 (white), 355 (white), 358 (yellow), and 359 (green). There are three openings in the layers 350 through 355, which are filled with a material (358) and topped with a layer (359). The openings are aligned with the hatched substrate (350).</p></div> <p>See EX1014 ¶[0093], Fig.16(a); <i>see also, e.g.</i>, 1376: POR1 at 23-24; Glew1 ¶185; 1377: POR2 at 24; Glew2 ¶¶186-87; 1378: POR3 at 23-24; Glew3 ¶185; 1379: POR4 at 24; Glew4 ¶¶186-87.</p>

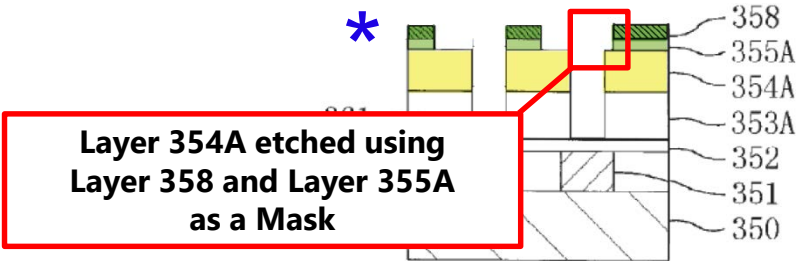
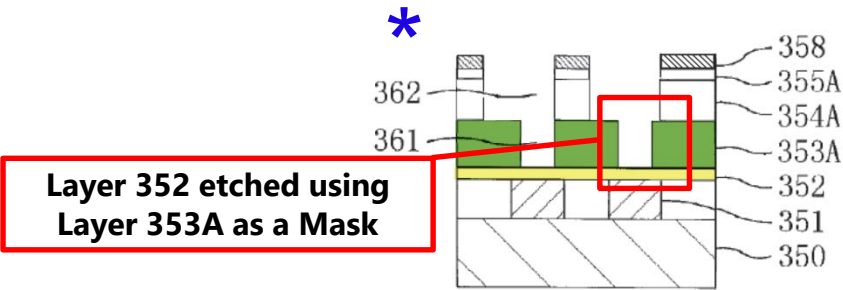
Claims 10 and 13 of the '696 patent are fully supported by the '696 Foreign Priority Document and are entitled to a priority date of March 26, 1998 (cont.)

Claim 10	Claim 13	Foreign Priority Document (JP '371) (EX1014)
i) dry-etching the fourth insulating film using the second resist pattern and the mask pattern as a mask, thereby patterning the fourth insulating film to have the openings for forming contact holes;	h) dry-etching the third insulating film using the second resist pattern and the mask pattern as a mask, thereby patterning the third insulating film to have the openings for forming contact holes;	<div><p>Exposed Misaligned Mask</p><p>Second Resist Pattern 359 and Mask Pattern 358 as a mask to etch layer 355A</p><p>See EX1014 ¶¶[0093]-[0096], Figs.16(a)-(c); <i>see also, e.g.,</i> EX1014 Figs.13(b)-(c), 16(c)-(d), ¶¶[0080]-[0095]; 1376: POR1 at 24-26; Glew1 ¶¶186-91; 1377: POR2 at 24-27; Glew2 ¶¶188-93; 1378: POR3 at 24-26; Glew3 ¶¶186-91; 1379: POR4 at 24-27; Glew4 ¶¶188-93.</p></div>

Claims 10 and 13 of the '696 patent are fully supported by the '696 Foreign Priority Document and are entitled to a priority date of March 26, 1998 (cont.)

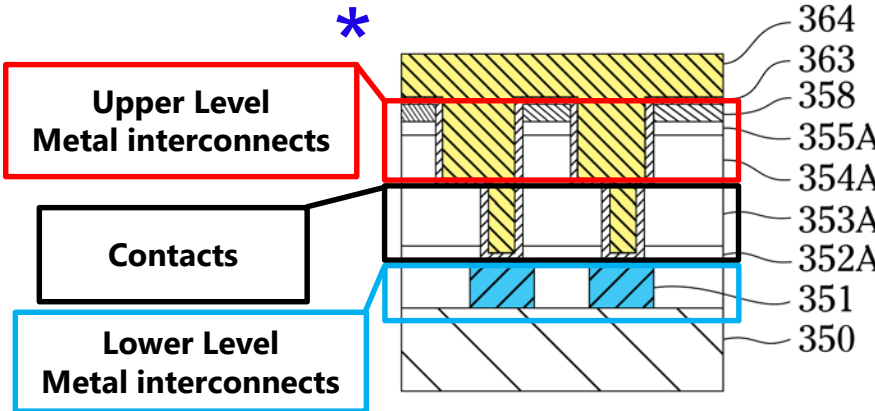
Claim 10	Claim 13	Foreign Priority Document (JP '371) (EX1014)
j) dry-etching the third insulating film using the patterned fourth insulating film as a mask, thereby patterning the third insulating film to have the openings for forming contact holes;	i) dry-etching the second insulating film using the patterned third insulating film as a mask, thereby patterning the second insulating film to have the openings for forming contact holes;	<div><p>e.g., Layer 354 etched using at least Layer 355 as a Mask</p><p>See EX1014 ¶¶[0093], [0096], Fig.16(b); see also, e.g., 1376: POR1 at 27-28; Glew1 ¶¶92-95; 1377: POR2 at 27-28; Glew2 ¶¶94-98; 1378: POR3 at 27-28; Glew3 ¶¶92-95; 1379: POR4 at 27-28; Glew4 ¶¶94-98.</p></div>
k) dry-etching the patterned fourth insulating film and the second insulating film using the mask pattern and the patterned third insulating film as respective masks, thereby forming wiring grooves in the patterned fourth insulating film and patterning the second insulating film to have the openings for forming contact holes;	j) dry-etching the patterned third insulating film and the first insulating film using the mask pattern and the patterned second insulating film as respective masks, thereby forming wiring grooves and contact holes in the patterned third insulating film and the first insulating film, respectively; and	<div><p>Layer 355A etched using Layer 358 as a Mask</p><p>Layer 353 etched using Layer 354A as a Mask</p><p>See EX1014 ¶[0094], Figs.16(b)-(c); see also, e.g., 1376: POR1 at 28-29, 29 n.6; Glew1 ¶¶96-97; 1377: POR2 at 28-30; Glew2 ¶¶99-101; 1378: POR3 at 28-29; Glew3 ¶¶96-97; 1379: POR4 at 28-30; Glew4 ¶¶99-101.</p></div>

Claims 10 and 13 of the '696 patent are fully supported by the '696 Foreign Priority Document and are entitled to a priority date of March 26, 1998 (cont.)

Claim 10	Claim 13	Foreign Priority Document (JP '371) (EX1014)
l) dry-etching the patterned third insulating film and the first insulating film using the mask pattern and the patterned second insulating film as respective masks, thereby forming the wiring grooves and the contact holes in the patterned third insulating film and the first insulating film, respectively; and		<div><p>Layer 354A etched using Layer 358 and Layer 355A as a Mask</p></div> <div><p>Layer 352 etched using Layer 353A as a Mask</p></div> <p>See EX1014 ¶¶[0095], [0097], Figs.16(c)-17(a); see also, e.g., 1377: POR2 at 30-32; Glew2 ¶¶102-106; 1379: POR4 at 30-32; Glew4 ¶¶102-106.</p>

* modified from original figure

Claims 10 and 13 of the '696 patent are fully supported by the '696 Foreign Priority Document and are entitled to a priority date of March 26, 1998 (cont.)

Claim 10	Claim 13	Foreign Priority Document (JP '371) (EX1014)
m) filling in the wiring grooves and the contact holes with a metal film, thereby forming upper-level metal interconnects and contacts connecting the lower- and upper-level metal interconnects together.	k) filling in the wiring grooves and the contact holes with a metal film, thereby forming upper-level metal interconnects and contacts connecting the lower- and upper-level metal interconnects together.	<div><p>See EX1014 ¶[0098], Fig.17(b)-(c); see also, e.g., 1376: POR1 at 29-31; Glew1 ¶¶98-101; 1377: POR2 at 32-33; Glew2 ¶¶107-109; 1378: POR3 at 29-31; Glew3 ¶¶98-101; 1379: POR4 at 32-33; Glew4 ¶¶102-106.</p></div>

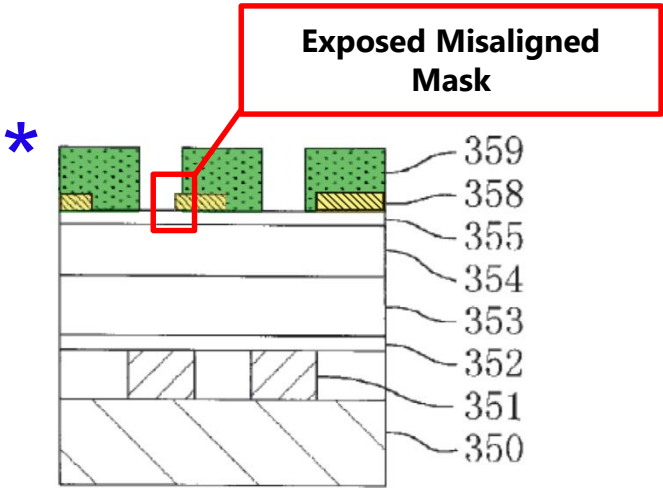
* modified from original figure

Step i) of claim 10 and step h) of claim 13 are fully supported by the '696 Foreign Priority Document (JP '371)

Claim 10	Claim 13
i) <i>dry-etching</i> the fourth insulating film <i>using the second resist pattern and the mask pattern as a mask</i> , thereby patterning the fourth insulating film to have the openings for forming contact holes;	h) <i>dry-etching</i> the third insulating film <i>using the second resist pattern and the mask pattern as a mask</i> , thereby patterning the third insulating film to have the openings for forming contact holes;

- The '696 foreign priority document discloses:

"If there is a concern that the second resist pattern 359 has been misaligned with the first resist pattern 357, then the mask pattern 358 should be dry-etched using the second resist pattern 359 as a mask before the second silicon dioxide film 355 is dry-etched using the second resist pattern 359 as a mask. That is to say, ***if the mask pattern 358 is exposed to the openings of the second resist pattern 359 for the formation of contact holes because of the misalignment of the second resist pattern 359 with the first resist pattern 357, then the mask pattern 358 is dry-etched using the second resist pattern 359 as a mask. In this manner, the openings of the mask pattern 358 are expanded to include the openings for the formation of wiring grooves and contact holes.***"



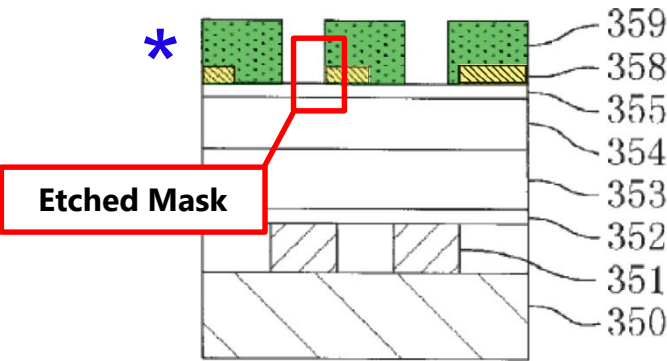
Glew1 ¶¶88-89; Glew2 ¶¶90-91; Glew3 ¶¶88-89; Glew4 ¶¶90-91;
see also, e.g., EX1014 [0093]-[0096], Fig. 16(a);
1376: POR1 at 25-26; 1377: POR2 at 25-26;
1378: POR3 at 25-26; 1379: POR4 at 25-26.

Step i) of claim 10 and step h) of claim 13 are fully supported by the '696 Foreign Priority Document (JP '371) (cont.)

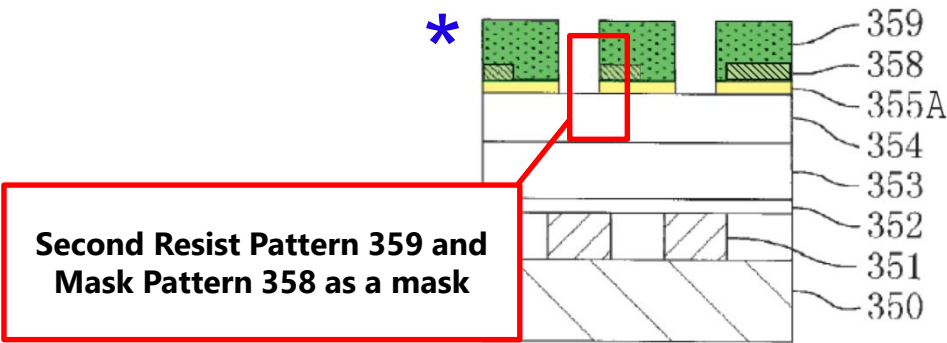
- Dr. Glew testified that:

"[T]he layers **after 'the mask pattern 358 is dry-etched'** using the second resist pattern 359 as a mask'" would appear as:

"[W]hen the underlying third insulating film (355) is thereafter etched, **both the second resist pattern (359) and the mask pattern (358) necessarily define the areas for etching of the third insulating film (355)**. As such, etching of the '[fourth/third] insulating film [355]' is done 'using the second resist pattern [359] and the mask pattern [358] as a mask' as required by step (h) of claim 13. EX1014 ¶[0093]."



Glew1 ¶¶88-89; Glew2 ¶¶90-91; Glew3 ¶¶88-89; Glew4 ¶¶90-91; see also, e.g., EX1014 [0093]-[0096], Fig. 16(a); **1376**: POR1 at 25-26; **1377**: POR2 at 25-26; **1378**: POR3 at 25-26; **1379**: POR4 at 25-26.



Glew1 ¶¶90-91; Glew2 ¶¶92-93; Glew3 ¶¶90-91; Glew4 ¶¶92-93; see also, e.g., EX1014 [0093]-[0096]; **1376**: POR1 at 25-26; **1377**: POR1 at 26-27; **1378**: POR3 at 25-26; **1379**: POR4 at 26-27.

- Thus, Dr. Glew testified that the '696 foreign priority document:

"[D]iscloses a step of dry-etching the [fourth/third] insulating film (e.g., second silicon dioxide film 355) **using the second resist pattern (e.g., second resist pattern 359) and the mask pattern (e.g., mask pattern 358) as a mask**, thereby patterning the [fourth/third] insulating film (e.g., second silicon dioxide film 355) to have the openings for forming contact holes."

* modified from original figure

Glew1 ¶86; Glew2 ¶88; Glew3 ¶86; Glew4 ¶88; see also, e.g., EX1014 ¶¶[0093]-[0096]; **1376**: POR1 at 24; **1377**: POR2 at 24-25; **1378**: POR3 at 24; **1379**: POR4 at 24-25.

Step i) of claim 10 and step h) of claim 13 are fully supported by the '696 Foreign Priority Document (JP '371) (cont.)

Petitioner argues: “The *specification identifies layer 359, not layer 358, as the mask for etching layer 355 above*. EX2012, 39:12-16 ([T]he mask pattern 358 should be dry-etched using the second resist pattern 359 as a mask before the second silicon dioxide film 355 is dry-etched using the second resist pattern 359 as a mask.)”

Reply1 at 11; Reply2 at 11; Reply3 at 11; Reply4 at 11.

- But as discussed in slides 15-16, Petitioner’s expert admitted during cross-examination that a layer can be a mask even if not called a mask by the '696 patent specification

See also, e.g., **1376**: Observations1 ¶¶13-4; **1377**: Observations2 ¶¶13-4; **1378**: Observations3 ¶¶13-4; **1379**: Observations4 ¶¶13-4.

Petitioner and its expert argue: “IPB suggests that a buried layer acts as a mask even when it has nothing to do with the etch.”

SmithReply1 ¶129; SmithReply2 ¶129; SmithReply3 ¶129; SmithReply4 ¶129; see also, e.g., **1376**: Reply1 at 10-12; **1377**: Reply2 at 10-12; **1378**: Reply3 at 10-12; **1379**: Reply4 at 10-12.

- As discussed previously in slides 9-23, Petitioner’s interpretation of this term is incorrect
- As Dr. Glew testified:

“**[A]n interlayer material** (the layer that is underlying the top layer) **acts as a mask if** at least some part of **a side surface** of the interlayer is exposed such that it **substantially blocks the etchant** from reaching certain areas, thereby defining an area for etching.”

Step j) of claim 10 and step i) of claim 13 are fully supported by the '696 Foreign Priority Document

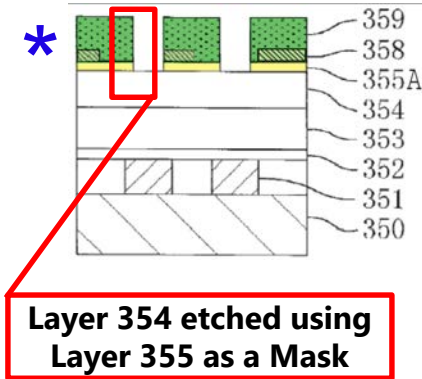
Claim 10	Claim 13
j) dry-etching the third insulating film using the patterned fourth insulating film as a mask , thereby patterning the third insulating film to have the openings for forming contact holes;	i) dry-etching the second insulating film using the patterned third insulating film as a mask , thereby patterning the second insulating film to have the openings for forming contact holes;

Dr. Glew testified that:

"The '371 application's third embodiment variant discloses a step of dry-etching the [third/second] insulating film (e.g., organic film 354) **using the patterned [fourth/third] insulating film (e.g., patterned second silicon dioxide film 355A) as a mask**, thereby patterning the [third/second] insulating film to have the openings for forming contact holes."

Glew1 ¶92; Glew2 ¶94; Glew3 ¶92; Glew4 ¶94; see also, e.g., EX1014 ¶¶[0093]-[0096].

"[L]ayer 354 is etched 'using' at least layer 355 ('the patterned third insulating film') 'as a mask' because (1) pattern 359 and layer 355 together define areas for patterning of layer 354 and (2) layer 355 acts as a mask after the removal of layer 359 in the aforementioned sequential etching process. That layer 355 is used as a mask for etching layer 354 is further supported by the '371 application's disclosure that 'the second resist pattern 359 is removed during the step of etching the organic film 354.' EX1014 ¶[0093] (indicating that layer 355A acts as a mask during the patterning of layer 354 due to the removal of resist 359)."



Glew1 ¶¶93-95; Glew2 ¶¶96-98; Glew3 ¶¶93-95; Glew4 ¶¶96-98 See also, e.g., EX1014 ¶[0093]; **1376:** POR1 at 27-28; Observations1 ¶1 (Smith testified he interprets "removed during" to mean "at least partially removed during"); **1377:** POR2 at 27-28; Observations2 ¶1 (same); **1378:** POR3 at 27-28; Observations3 ¶1 (same); **1379:** POR4 at 27-28; Observations4 ¶1 (same).

Step j) of claim 10 and step i) of claim 13 are fully supported by the '696 Foreign Priority Document (cont.)

Petitioner argues: "JP '371 states that only layer 359 is the mask for etching layer 354"

Reply1 at 13; Reply2 at 13; Reply3 at 13; Reply4 at 13.

- But as discussed in slides 15-16, Petitioner's expert admitted during cross-examination that a layer can be a mask even if not called a mask by the '696 patent specification
See also, e.g., 1376: Observations1 ¶¶3-4; 1377: Observations2 ¶¶3-4; 1378: Observations3 ¶¶3-4; 1379: Observations4 ¶¶3-4.
- As discussed previously in slides 9-23, Petitioner's interpretation of the term "using the [designated layer[s]] as a mask" is incorrect

Petitioner failed to meet its burden to show in the Petition that Grill was prior art to the claims of the '696 patent

- Petitioner attempted improperly to incorporate by reference into its Petition, arguments from Petitioner’s expert’s declaration about Grill’s priority:**

Petitioner argues: “Although Petitioner need not show Grill is supported by the '628 application unless Patent Owner shows the challenged claims antedate Grill, **Dr. Smith provides a provisional claim chart in his declaration**, showing support for Grill’s claim 28 in the '628 application.”

P1 at 29 n.3; P2 at 32 n.2; P3 at 25 n.2; P4 at 29 n.3; see also, e.g., **1376:** Smith1 ¶153; **1377:** Smith2 ¶179; **1378:** Smith3 ¶153; **1379:** Smith4 ¶173.

- But, the PTAB and the Rules state:

PTAB: “[W]e **do not consider arguments not made in the Petition** itself.”

ZTE (USA) v. Elecs. & Telecomms. Research Inst., IPR2015-00029, Pap.12, 6; see also, e.g., **1376:** POR1 at 33 n.17; **1377:** POR2 at 36 n.17; **1378:** POR3 at 33 n.17; **1379:** POR4 at 36 n.17.

Rule 42.24(a)(1): “The following **word counts** or page limits **for petitions** and motions apply and include any statement of material facts to be admitted or denied in support of the petition or motion. The word count or page limit does not include a table of contents, a table of authorities, mandatory notices under §42.8, a certificate of service or word count, or appendix of exhibits or claim listing.
(i) Petition requesting inter partes review: 14,000 words.”

1376: POR1 at 33 n.17; **1377:** POR2 at 36 n.17; **1378:** POR3 at 33 n.17; **1379:** POR4 at 36 n.17.

- Patent Owner was deprived of an opportunity to respond to Petitioner’s new Reply arguments and evidence

See Reply1 at 14:8-22:15; Reply2 at 14:7-22:15; Reply3 at 14:6-22:15; Reply4 at 14:8-22:15; see also, e.g., **1376:** Scope1 at 1; EX1036; EX1037; EX1038; SmithReply1 ¶¶37-54; POR1 at 2 n.3, 8 n.7, 19, 32-33, 33 n.17; **1377:** Scope2 at 1, EX1037, EX1038, EX1039; SmithReply2 ¶¶37-54; POR2 at 2 n.3, 8 n.7, 19, 36, 36 n.17; **1378:** Scope3 at 1; EX1037, EX1038, EX1039; SmithReply3 ¶¶37-54; POR3 at 2 n.3, 8 n.7, 19, 32-33, 33 n.17; **1379:** Scope4 at 1; EX1037, EX1038, EX1039; SmithReply4 ¶¶37-54 POR4 at 2 n.3, 8 n.7, 19, 35-36, 36 n.17.

Petitioner fails to show (even with its improper new arguments and evidence on Reply) that Grill’s claims are supported by Grill’s Provisional Application

Federal Circuit: “A reference patent is **only entitled to claim the benefit of the filing date** of its provisional application **if the disclosure of the provisional application provides support** for the claims in the reference patent in compliance with § 112, ¶ 1.”

Dynamic Drinkware, LLC v. Nat’l Graphics, Inc., 800 F.3d 1375, 1381 (Fed. Cir. 2015); *see also, e.g.*, **1376:** POR1 at 32-34, 46; **1377:** POR2 at 35-37, 50; **1378:** POR3 at 32-34, 46; **1379:** POR4 at 34-36, 49.

- Dr. Glew responded to Petitioner’s expert’s testimony that was improperly incorporated into the Petition:

“Dr. Smith has failed to show, under either of these **express or inherent standards**, that the '628 provisional discloses **“transferring** the via pattern in the patterned first hard mask layer into the second dielectric layer, **while concurrently removing** said via patterned second layer of resist,” as required by Grill’s Claim 28.”

Glew1 ¶112; Glew2 ¶122; Glew3 ¶112; Glew4 ¶122; *see also, e.g.*, **1376:** POR1 at 31-47; **1377:** POR2 at 34-50; **1378:** POR3 at 31-47; **1379:** POR4 at 33-50.

Petitioner fails to show that “*transferring* said via pattern ... into said second dielectric layer, *while concurrently removing* ... said second layer of resist,” as recited in claim 28, is disclosed in Grill’s provisional application

- Claim 28 recites:

“*transferring* said via pattern in said patterned first hard mask layer into said second dielectric layer, *while concurrently removing* said via-patterned second layer of resist,”

EX1005 13:47-50.

Petitioner and its expert argue: “As I understand it, claim 28 recites the phrase ‘*while concurrently removing*,’ which indicates the **removal process need not be completed** for the claim element to be satisfied.”

SmithReply1 ¶46 n.1; SmithReply2 ¶46 n.1; SmithReply3 ¶46 n.1; SmithReply4 ¶46 n.1;
see also, e.g., **1376:** Reply1 at 15; **1377:** Reply2 at 15; **1378:** Reply3 at 15; **1379:** Reply4 at 15.

- **But Claim 28 also separately recites:**

“*transferring, at least partially concurrently*, said via pattern into said first dielectric layer to form via cavities corresponding to said via pattern, and said wiring pattern into said second dielectric layer to form wiring cavities corresponding to said wiring pattern”

EX1005 13:54-58.

- **And Petitioner’s expert admitted** on cross-examination that:

“Q What is the difference between **concurrently** and **partially concurrently**?

A In the case of **partially concurrently**, since the etching is being done in two layers, the first dielectric and the second dielectric, simply -- that simply said, **concurrently, it wouldn't cover the situation where one layer is removed before another layer is completely removed.**

Q Okay.

A If in the first instance there is a situation where not -- for instance, not all the photoresist is gone during the concurrent removal, one would know that an overetch would strip the photoresist. So I don't think “partially concurrently” is appropriate in the first instance.”

Petitioner fails to show that “transferring said via pattern ... into said second dielectric layer, while concurrently removing ... said second layer of resist,” as recited in claim 28, is expressly or inherently disclosed in Grill’s provisional application

Petitioner argues: “a POSITA would have known any process for patterning/etching layer 12 concurrently removes layer 62.”

“Even **without this explicit teaching, a POSITA would have understood** photoresist layer 62 is removed while patterning carbon-based layer 12 because of their similar etch properties.”

Reply1 at 21; Reply2 at 21; Reply3 at 20-21; Reply4 at 21.

- But, Dr. Glew testified that:

Grill’s provisional application “fails to provide a disclosure of any timing for when the removal of the photoresist happens (e.g., it might occur before or after the transfer of the pattern). Because alternatives exist to the concurrent removal of the photoresist layer or residuals of a photoresist layer, the concurrent removal is not the only way to remove the photoresist layer in Grill.”

Glew1 ¶1115; Glew2 ¶1125; Glew3 ¶1115; Glew4 ¶1125; see also, e.g., **1376**: POR1 at 36-37; 39-40; **1377**: POR2 at 39-40, 43; **1378**: POR3 at 36-37; 39-40; **1379**: POR4 at 38-40; 42-43.

- And, Grill’s **non**-provisional application **expressly added** the emphasized sentence below—underscoring its absence from the **provisional**, and that removal need not be “concurrently” (cf. “typically”)

The via level pattern is then transferred into dielectric 12 by an etching process such as reactive ion etching, to produce the structure of FIG.5F. **Patterned second resist layer 62 is absent from FIG.5F because it is typically removed by the etching process used to pattern dielectric 12.”**

Compare EX1005 7:62-66 with EX1017 15; see also, e.g., EX2011 15; **1376**: POR1 at 36; **1377**: POR2 at 39-40; **1378**: POR3 at 36; **1379**: POR4 at 39.

Petitioner improperly interprets that “*transferring* said via pattern ... into said second dielectric layer, *while concurrently removing* ... said second layer of resist” to include transferring “after the second dielectric layer is removed”

- Claim 28 recites:

“transferring said via pattern in said patterned first hard mask layer into said second dielectric layer, ***while concurrently removing*** said via-patterned second layer of resist,”

EX1005: 13:47-50.

- But, **Petitioner’s expert** admitted during cross-examination that he **understands** ***“concurrently removing” to include removing “after*** the second dielectric layer is removed”:

Q ...Is it your testimony that ***in the situation described in Claim 28, some of the second layer of resist will be removed after the via pattern is transferred?***

A If there is photoresist removing -- photoresist remaining, it would be removed in the same pattern transfer step, in the same etch chemistry, that is used to etch the second dielectric layer, by continuing on with that etch process until all the photoresist is removed.

Q And that's after the via pattern is transferred?

A Well, it's during the same operation. ***It's after the second dielectric layer is removed in that via pattern -- via pattern opening***, but it's still part of the same process. It's part of that transferring process.

Q So that's after the via pattern is transferred, though. Is that right?

A It's after -- no. It's still part of the transfer step. ***It's after the second dielectric layer is completely etched***, its transfer step is complete through the continuation of that etch process until the second layer photoresist is gone.

EX2040 48:8-49:9; see also, e.g., **1376**: Observations1 ¶¶7-8; **1377**: Observations2 ¶¶7-8; **1378**: Observations3 ¶¶7-8; **1379**: Observations4 ¶¶7-8.

Petitioner fails to show that “transferring said via pattern ... into said second dielectric layer, while concurrently removing ... said second layer of resist,” as recited in claim 28, is expressly or inherently disclosed in Grill’s provisional application (cont.)

- Claim 28 recites:

“**transferring** said via pattern in said patterned first hard mask layer into said second dielectric layer, **while concurrently** removing said via-patterned second layer of resist,”
EX1005 13:47-50.

“**transferring, at least partially concurrently**, said via pattern into said first dielectric layer to form via cavities corresponding to said via pattern, and said wiring pattern into said second dielectric layer to form wiring cavities corresponding to said wiring pattern”
EX1005 13:53-57.

- **Petitioner’s expert asserted** during cross-examination that the reason the two limitations use different language is that the **second limitation refers to “etching of two films” while the first limitation only refers to etching one film** (i.e., “**transferring** [a] pattern” **and** “**removing**” a layer are “**not etching of two films**”):

Q So what is the **difference between at least partially concurrently and concurrently in those two passages in Column 13?**
A I think **partially concurrently**, in the second instance [EX1005 13:53-57], is useful because it applies to the **etching of two films**. It says, the etching happens in the same process, at least together for some amount of time, partially concurrently. Since the **first instance** [EX1005 13:47-50] **is the removal of the photoresist**, I think partial – partial concurrently wouldn't be necessary in that case.
Q You said you think partially concurrently wouldn't be necessary in that case?
A No, **because it's not etching of two films in that first instance.**

EX2040 43:21-44:13; see also, e.g., **1376**: Observations1 ¶19; **1377**: Observations2 at ¶19; **1378**: Observations3 at ¶19; **1379**: Observations4 at ¶19.

- **But Petitioner’s expert also argues** a form of “**removing**” is “over**etch**[ing]”:

“[T]hose of ordinary skill in the art would have already understood from their training that it would be common for layer 354 to be patterned before **completely removing the remnants of second resist pattern** 359. This technique, **called ‘overetch’** was known by those of ordinary skill in the art to be used where a via etch takes place over a stepped structure”

Petitioner fails to show that “transferring said via pattern ... into said second dielectric layer, while concurrently removing ... said second layer of resist,” as recited in claim 28, is expressly or inherently disclosed in Grill’s provisional application (cont.)

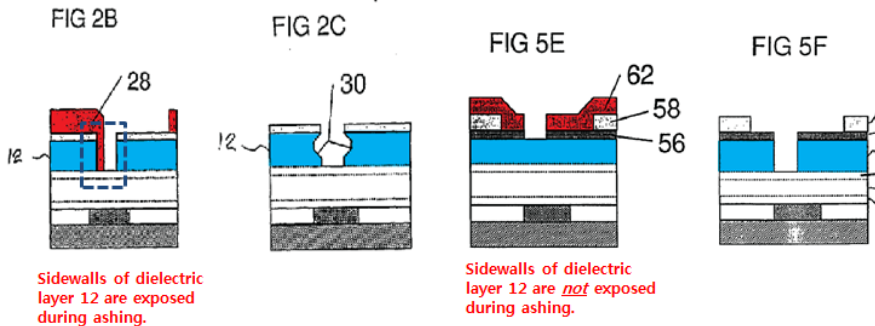
Petitioner and its expert argue: “A person of ordinary skill in the art would have further understood that the photoresist layer 62 is not removed prior to etching layer 12. ... On the other hand, ***if the photoresist is stripped with a wet checmical [sic] treatment before etching layer 12, the problems described with regard to Figures 2C result.*** '682 application at 4, Figs. 2C, 2D. This would damage the exposed interlayer dielectric layer 12 and make it difficult to control the via dimension.”

- But **Petitioner never addressed Dr. Glew’s testimony that:**

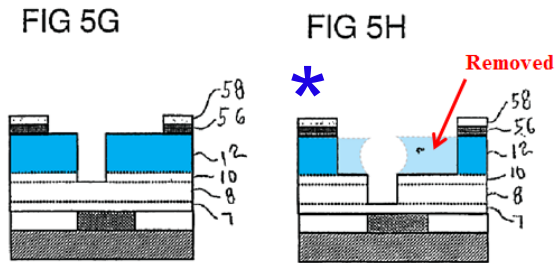
“[T]he ‘**undercut**’ problem of Figures 2C-2D occurs when the sidewalls are exposed during ashing. See EX1017 13, Figs.2B-2D. **However**, Figure 5E clearly shows that **no sidewalls have yet been formed**. See EX1017, Figs.5E-5F (annotated to show that dielectric layer 12 (blue) sidewalls are not exposed until Fig. 5F):”

“Dr. Smith fails to address that **any damage or undercutting to the exposed portion of layer 12** that may result from removing the resist prior to etching (Figs.5E-5F) **would not impact layer 12 of the finished structure because any damaged portion of layer 12 would be ultimately removed** during the subsequent etch.”

Smith1 App. B B-10; Smith2 App. B B-10; Smith3 App. B B-10; Smith4 App. B B-10;
see also, e.g., **1376** P1 at 28-29 n.3; **1377**: P2 at 31-32 n.2;
1378: P3 at 25 n.2; **1379**: P4 at 28-29 n.3.



Glew1 ¶¶128-129; Glew2 ¶¶138-139; Glew3 ¶¶128-129; Glew4 ¶¶138-139.



Glew1 ¶¶130-131; Glew2 ¶¶140-141; Glew3 ¶¶130-131; Glew4 ¶¶140-141.
See also, e.g., **1376**: POR1 at 42-47; **1377**: POR2 at 46-50;
1378: POR3 at 42-47; **1379**: POR4 at 45-50.

Grill in View of Aoyama [and Wetzel] Does Not Render Obvious Any Challenged Claims

A POSITA would not have combined Grill and Aoyama as proposed by Petitioner because doing so would render Grill unsatisfactory for its intended purpose of forming a dual relief pattern

- Grill discloses:

“The **present invention relates to lithographic methods for forming a dual relief pattern** in a substrate, and the application of such methods to fabricating multilevel interconnect structures in semiconductor chips by a Dual Damascene process in which dual relief cavities formed in a dielectric are filled with conductive material to form the wiring and via levels. ...”

EX1005, Abstract.

“The **present invention relates to** improved methods for defining and transferring two patterns (or a single **dual relief pattern**) to one or more layers of dielectric in a single block of lithography and/or etching steps. The invention comprises two preferred modifications of a prior art "twice patterned single mask layer" Dual Damascene process and two preferred embodiments of a fabrication process for a dual pattern hard mask which may be used to **form dual relief cavities** for Dual Damascene applications.”

EX1005 2:41-50.

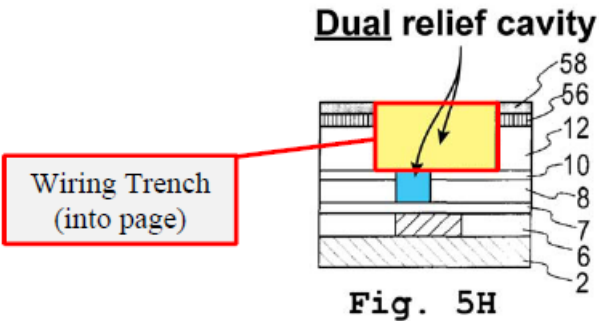
“FIELD OF THE INVENTION

The **present invention relates to lithographic methods for forming a dual relief pattern** in a substrate, and the application of such methods to fabricating multilevel interconnect structures in semiconductor chips.”

EX1005 1:10-15.

“[T]his combination of via and wiring level patterns should be viewed as **a special case of the general category of dual relief patterns** in which all features of a smaller area (via) pattern substantially overlap with the features of a larger area (wiring) pattern.”

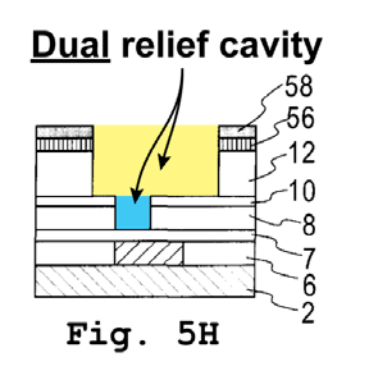
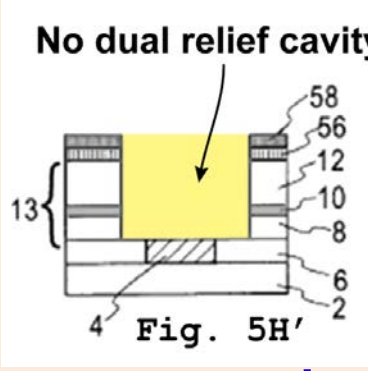
EX1005 7:25-29.



A POSITA would not have combined Grill and Aoyama as proposed by Petitioner because doing so would render Grill unsatisfactory for its intended purpose of forming a dual relief pattern (cont.)

- Dr. Glew testified that:

"The **modification of Grill** proposed by Petitioner would **eliminate the dual-relief patterns and dual-relief cavities** of Grill."

Grill	Petitioner's Proposed Combination
 <p>Dual relief cavity</p> <p>Fig. 5H</p>	 <p>No dual relief cavity *</p> <p>Fig. 5H'</p> <p>* modified from original figure</p>

Glew1 ¶144; Glew2 ¶154; Glew3 ¶144; Glew4 ¶154; see also, e.g., **1376**: POR1 at 52; **1377**: POR2 at 55-56; **1378**: POR3 at 52; **1379**: POR4 at 55.

Federal Circuit: "Indeed, if the [prior art were modified as proposed], it would be **rendered inoperable for its intended purpose**. ... In effect, [the reference] teaches away from the board's proposed modification."

In re Gordon, 733 F.2d 900, 902 (Fed.Cir. 1984); see also, e.g., *Plas-Pak Indus. v. Sulzer Mixpac*, 600 F.App'x 755, 757-59 (Fed. Cir. 2015); **1376**: POR1 at 3, 50; **1377**: POR2 at 3, 53; **1378**: POR3 at 3, 50; **1379**: POR 4 at 3, 53.

PTAB: "If the proposed modification or combination of the prior art **would change the principle of operation** of the prior art invention being modified, **then** the teachings of the references are **not sufficient to render the claims prima facie obvious**."

A POSITA would not have combined Grill and Aoyama as proposed by Petitioner because doing so would render Grill unsatisfactory for its intended purpose of forming a dual relief pattern (cont.)

Petitioner argues: "IPB's contrary argument [that Grill's dual relief pattern is along the width of the wire pattern] neglects the three-dimensional aspect of dual relief patterns like the one on the right."

Reply1 at 24; Reply2 at 24; Reply3 at 24; Reply4 at 24.

- But Petitioner's expert testified on cross-examination:

Q. Okay. So **can you point me in Grill to where it shows -- it shows a three-dimensional view?**
A. Well, the description of how these processes flow, for instance, figure 5A through H, which I describe in detail in my disclosure, the opening for the contact level would be placed in the wiring levels below and above it but only in areas where the contact is made in between it.
So there is no figure, there's no depiction of that other direction, but that is what's understood in the description of the processes or one would understand from the description of the processes.

EX2010: 81:5-18; see also, e.g., **1376:** POR1 at 51; Glew1 ¶140; **1377:** POR2 at 54-55; Glew2 ¶150; **1378:** POR3 at 51; Glew3 ¶140; **1379:** POR4 at 54; Glew4 ¶150.

- Dr. Glew testified that:

"The **modification of Grill** proposed by Petitioner would **eliminate the dual-relief patterns and dual-relief cavities** of Grill."

Dual relief cavity

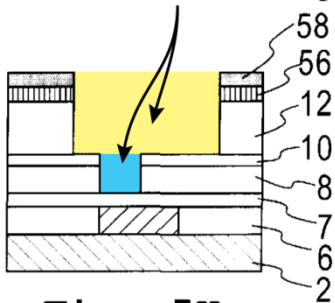


Fig. 5H

No dual relief cavity

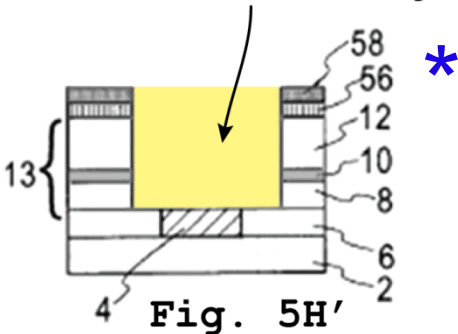
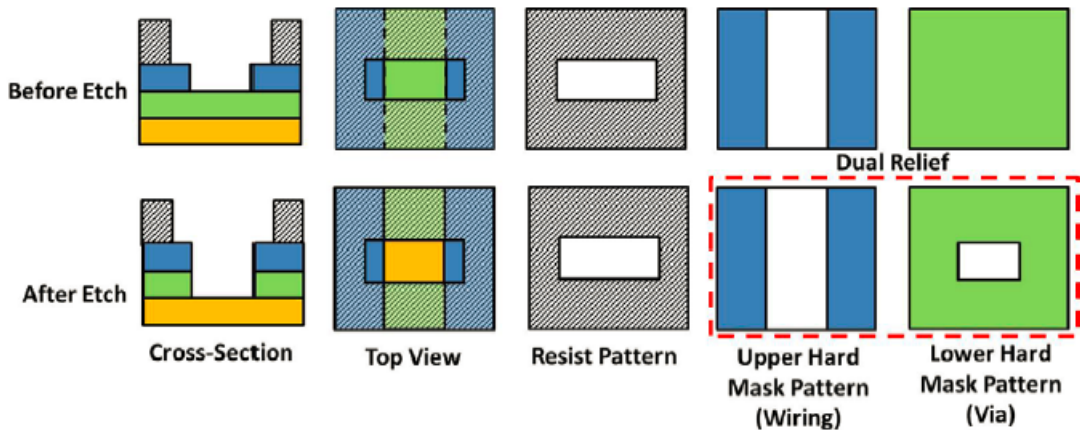


Fig. 5H'

Glew1 ¶144; Glew2 ¶154; Glew3 ¶144; Glew4 ¶154; see also, e.g., **1376:** POR1 at 52; **1377:** POR2 at 55-56; **1378:** POR3 at 52; **1379:** POR4 at 55.

A POSITA would not have combined Grill and Aoyama as proposed by Petitioner because doing so would render Grill unsatisfactory for its intended purpose of forming a dual relief pattern (cont.)

Petitioner and its expert argue: “Grill states, ‘all features of a smaller area (via) pattern substantially overlap with the features of a larger area (wiring) pattern.’ Grill at 7:22–30. In the Grill-Aoyama combination I discussed in my declaration dated July 11, 2016, the via pattern substantially (even completely) overlaps the wiring pattern. ... The **dual relief pattern collectively refers to the openings in the blue layer (a wiring pattern) and the green layer (a via pattern).**”



SmithReply1 ¶157; SmithReply2 ¶157; SmithReply3 ¶157; SmithReply4 ¶157; see also, e.g., 1376: Reply1 at 24; 1377: Reply2 at 24; 1378: Reply3 at 24; 1379: Reply4 at 24.

- But Petitioner’s expert testified on cross-examination that **he interprets “features” to refer to “openings”** and **“substantially overlap” to include “completely” overlap**

A POSITA would not have combined Grill and Aoyama as proposed by Petitioner because doing so would render Grill unsatisfactory for its intended purpose of forming a dual relief pattern (cont.)

- Petitioner’s expert testified on cross-examination that *he interprets “features” to refer to “openings” and “substantially overlap” to include “completely” overlap* (cont.)

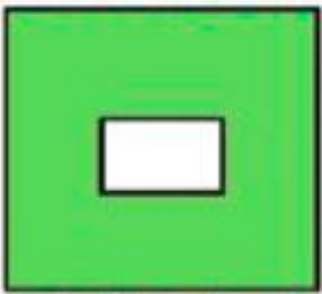
Q So the features that are being referred to are openings. Is that your testimony?
A It is the openings -- well, these are -- this is a dual relief pattern, which, yes, these are the openings in these two layers. The single pattern is the two openings.
Q So those features are the -- the features that you're referring to are the openings?
A In this case, referring to that figure, *the features I'm referring to in that last sentence is the dual relief pattern, which collectively refers to those openings*, yes.
Q In that second sentence of the paragraph, you say, substantially, even completely. Do you see that?
A I see that.
Q So *your understanding of the term "substantially" there would encompass also the term "completely"*?
A Sure, *yeah. That's right.*

EX2040: 51:4-52:1; see also, e.g., 1376: Observations1 ¶10; 1377: Observations2 ¶10; 1378: Observations3 ¶10; 1379: Observations4 ¶10.

- **But Petitioner’s** and its expert’s **interpretation** of Grill’s sentence **would eliminate the dual-relief pattern:**

“dual relief patterns in which all features openings of a smaller area (via) pattern substantially completely overlap with the features openings of a larger area (wiring) pattern.”

Observations1 ¶10; Observations2 ¶10; Observations3 ¶10; Observations4 ¶10.



A POSITA would not have combined Grill and Aoyama in view of Grill's teaching away from systems that expose underlying carbon-based layers to photoresist stripping processes

Petitioner argued: "*A POSITA would have further found it obvious to combine Grill's two hard masks with Aoyama's widened through-hole pattern without modifying the Grill process.*"

P1 at 56; P2 at 41-42; P3 at 49; P4 at 57-58; see also, e.g., **1376:** Smith1 ¶163; **1377:** Smith2 ¶189; **1378:** Smith3 ¶163; **1379:** Smith4 ¶185.

- But Grill teaches away from exposing carbon-based materials to stripping processes:

"While this 'twice patterned single mask layer' process has the virtue of simplicity, **difficulties in reworking** the second lithography step **may occur if the interconnect dielectric and the photoresist stencil used to pattern the hard mask have similar etch characteristics**. Such would be the case with **an organic photoresist and a carbon-based interconnect dielectric such as DLC.**" EX1005 2:26-32.

"FIG. 2C shows the structure of FIG. 2B **after removal of misaligned patterned resist layer 28 by a process such as ashing or wet chemical etching. Sidewalls 30 of dielectric 12 are clearly undercut.** ... However, it will be a problem for cases in which the dimensions of the first and second patterns are similar, as shown in FIG. 2D, since the undercut sidewall profile will persist in the final structure. **Such undercutting makes critical dimension (CD) control more difficult and produces cavities that are more difficult to line with a conductive liner** and fill with a conductive wiring material 22." EX1005 5:15-28.

See also, e.g., EX1005 2:26-32, 5:9-28; **1376:** POR1 at 64, 67; Glew1 ¶175; **1377:** POR2 at 68, 71; Glew2 ¶185; **1378:** POR3 at 64, 67; Glew3 ¶175; **1379:** POR4 at 67, 70; Glew4 ¶185.

- And, Petitioner's expert confirmed on cross examination that Aoyama's etch stopper is carbon-based

"It [stopper film 45] is an etch stopper made of carbon that functions as an etch stopper when doing the wiring etch."

EX2010 106:12-20; see also, e.g., EX1018 15:60-63; **1376:** Glew1 ¶171 n.12; POR1 at 62 n.26; **1377:** Glew2 ¶181 n.12; POR2 at 69 n.26; **1378:** Glew3 ¶171 n.12; POR3 at 65 n.26; **1379:** Glew4 ¶181 n.12; POR4 at 68 n.26.

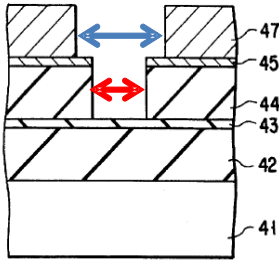
A POSITA would not have combined Grill and Aoyama in view of Grill’s teaching away from systems that expose underlying carbon-based layers to photoresist stripping processes (cont.)

- Dr. Glew testified that:

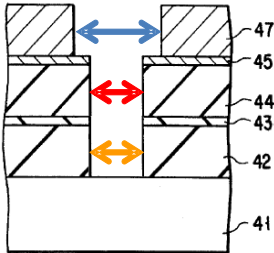
“Petitioner has improperly ignored that *part of Aoyama’s misalignment solution is its use of carbon etch stopper film 45.*”

“Without the carbon etch stopper film 45, Aoyama would end up with a result that is even worse than the problem it was trying to solve. Instead of a wider wiring groove at the through-hole only during instances of misalignment, Aoyama would always end up with a wider wiring groove at the through-hole, regardless of misalignment.”

Glew1 ¶¶171-174; Glew2 ¶¶181-184; Glew3 ¶¶171-174; Glew4 ¶¶181-184; see also, e.g., 1376: POR1 at 65-67; 1377: POR2 at 69-71; 1378: POR3 at 65-67; 1379: POR4 at 68-70.

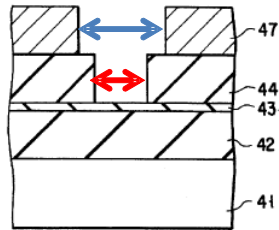


Aoyama’s Figure 18B



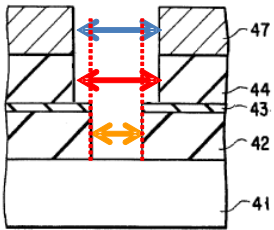
Aoyama’s Figure 18B etch result

*



Aoyama’s Figure 18B without etch stopper 45

*



Aoyama’s Figure 18B etch result without etch stopper 45

Federal Circuit: “In its consideration of the prior art, however, the *district court erred ... in considering the references in less than their entirety, i.e., in disregarding disclosures in the references that diverge from and teach away from the invention at hand.* In re Kuderna, 426 F.2d 385, 165 USPQ 575 (CCPA 1970).”

W.L. Gore v. Garlock, 721 F.2d 1540, 1550 (Fed. Cir. 1983); see also, e.g., 1376: POR1 at 72; 1377: POR2 at 76; 1378: POR3 at 72; 1379: POR4 at 75.

A POSITA would not have combined Grill and Aoyama in view of Grill's teaching away from systems that expose underlying organic layers to photoresist stripping processes (cont.)

Petitioner in Reply cites to new references other than Aoyama: "Via patterns wider than the wiring groove were well-known and did not require carbon etch stops. EX1039 [U.S. Pat. No. 4,832,789 ("Cochran")], 2:64-3:45, FIGS. 1-4; EX1040 [U.S. Pat. No. 4,855,252 ("Peterman")], 3:39-45, FIGS. 5-6; EX1049, ¶¶66-68."

Reply1 at 27-28; Reply2 at 27-28; Reply3 at 27-28; Reply4 at 28.

- But this is improper:

Federal Circuit: "It is of the *utmost importance* that petitioners in the IPR proceedings adhere to the requirement that the *initial petition identify 'with particularity' the 'evidence that supports the grounds for the challenge to each claim.'* 35 U.S.C. § 312(a)(3). ... See Office Patent Trial Practice Guide, 77 Fed.Reg. at 48,767 ("Examples of indications that a new issue has been raised in a reply include new evidence necessary to make out a prima facie case for the ... unpatentability of an original ... claim, and new evidence that could have been presented in a prior filing."). In these circumstances, we find that the Board did not err in *refusing the reply brief* as improper under 37 C.F.R. § 42.23(b) *because [Petitioner] relied on an entirely new rationale* to explain why one of skill in the art would have been motivated to combine Tsien or Ju with a modification of Zavgorodny."

Intelligent Bio-System v. Illumina Cambridge, 821 F.3d 1359, 1369-70 (Fed. Cir. 2016);
 see also, e.g., **1376:** POR1 at 2 n.3, 8 n.7, 19, 32-33, 49, 53 n.22, 54 n.23, 62; **1377:** POR2 at 2 n.3, 8 n.7, 19, 35-36, 52-53, 57 n.22, 58 n.23, 66;
1378: POR3 at 2 n.3, 8 n.7, 19, 32-33, 49, 53 n.22, 54 n.23, 62; **1379:** POR4 at 2 n.3, 8 n.7, 19, 35-36, 52, 56 n.22, 57 n.23, 65

A POSITA would not have combined Grill and Aoyama in view of Grill’s teaching away from systems that use photoresist patterns that are “thicker over via areas”

Petitioner argued: “A POSITA would have further found it obvious to combine Grill’s two hard masks with Aoyama’s widened through-hole pattern without modifying the Grill process.”

P1 at 56; P2 at 41-42; P3 at 49; P4 at 57-58; see also, e.g., 1376: Smith1 ¶163; 1377: Smith2 ¶189; 1378: Smith3 ¶163; 1379: Smith4 ¶185.

- But Grill discloses:

“An additional problem encountered with this [prior art] technique is that **resist layer 26 is necessarily thicker over the via areas**. For positive-tone resist systems, this **thicker resist will require higher dose exposures, with consequent loss in CD control**.”

EX1005 5:28-33.

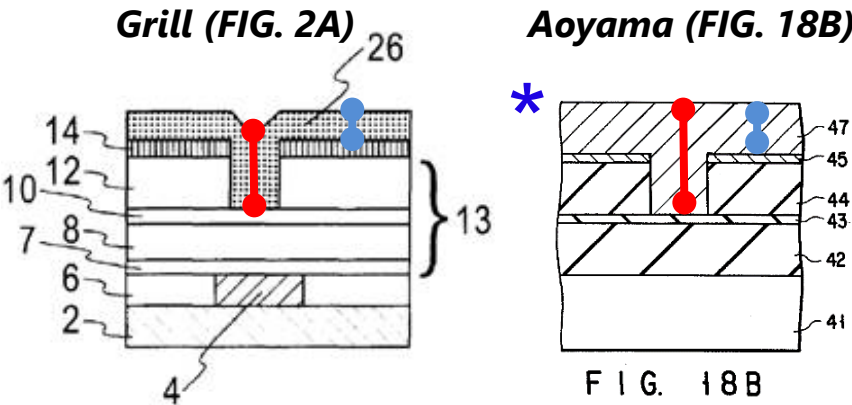
EX1005 5:28-33; see also, e.g., 1376: POR1 at 64, 71; Glew 1 ¶¶180-181; 1377: POR2 at 68, 75; Glew2 ¶¶190-191; 1378: POR3 at 64, 71; Glew 3 ¶¶180-181; 1379: POR3 at 67, 74; Glew4 ¶¶190-191.

- And Dr. Glew testified and Petitioner’s expert acknowledged that Aoyama’s photoresist would be “thicker over the via [hole]”:

Dr. Glew: “[T]he thickness of the deposited resist layer 47, prior to exposure and developing, would be thicker over the intended via than over second insulating film 44.”

Petitioner’s Expert:
Q. Okay. And to be clear, that would mean that **layer 47 would -- would be thicker over the – the hole than it would be elsewhere**; is that correct?
A. It could very well be, yes.

EX2010 108:21-109:3; see also, e.g., 1376: Glew1 ¶180; 1377: Glew2 ¶190; 1378: Glew3 ¶180; 1379: Glew4 ¶190.



Glew1 ¶180; Glew2 ¶190; Glew3 ¶180; Glew4 ¶190;
see also, e.g., 1376: POR1 at 71-73; 1377: POR2 at 75-77;
1378: POR3 at 71-73; 1379: POR4 at 74-76.

A POSITA would not have combined Grill and Aoyama in view of Grill’s teaching away from systems that use photoresist patterns that are “thicker over via areas” (cont.)

- Dr. Glew further testified:

“A person of ordinary skill, as well as Petitioner’s expert, Dr. Smith, would have understood that widely varied exposure requirements between thicker resists over via holes, and shallower patterns would have created problems for dimensional control.”

Glew1 ¶181; Glew2 ¶191; Glew3 ¶181; Glew4 ¶191.

“Petitioner never attempted to address this warning in Grill against the very result that Petitioner’s proposed borrowing from Aoyama would cause—i.e., underexposure of thicker photo resist patterns over vias or overexposure of thinner portions of resist. This problem raised by Grill (and consistent with Petitioner’s expert’s own publication) would defeat Grill’s approach to misalignment.”

Glew1 ¶182; Glew2 ¶192; Glew3 ¶182; Glew4 ¶192.

“Thus, because Grill teaches away from aspects of the claimed invention required of Aoyama, a person of ordinary skill in the art would not have been motivated to combine the references to arrive at the claimed invention, nor would a person of ordinary skill in the art have expected the combination to work as intended.”

Glew1 ¶183; Glew2 ¶193; Glew3 ¶183; Glew4 ¶183.

See also, e.g., **1376:** POR1 at 71-73; **1377:** POR2 at 75-77; **1378:** POR3 at 71-73; **1379:** POR4 at 74-76.

- And the law states:

Federal Circuit: “A reference may be said to ***teach away when a person of ordinary skill***, upon reading the reference, would be discouraged from following the path set out in the reference, or ***would be led in a direction divergent from the path that was taken by the applicant.***”

Harris v. Fed. Express, 502 F.App’x 957, 968 (Fed. Cir. 2013) (citation omitted).

Federal Circuit: “If references taken in ***combination would produce a ‘seemingly inoperative device,’*** we have held that such ***references teach away*** from the combination and thus cannot serve as predicates for a prima facie case of obviousness.”

McGinley v. Franklin Sports, Inc., 262 F.3d 1339, 1354 (Fed. Cir. 2001).

See also, e.g., **1376:** POR1 at 71-73; **1377:** POR2 at 75-77; **1378:** POR3 at 71-73; **1379:** POR4 at 74-76.

A POSITA would not have combined Grill and Aoyama in view of Grill's teaching away from systems that use photoresist patterns that are "thicker over via areas" (cont.)

Petitioner in Reply now argues: "IPB's argument is baseless because *hard mask layer 58 in FIG. 5D above is only about 20 nm to 50 nm thick (see EX1005, 8:24-31)*, and *photoresist layer 62 would have been about 1000 to 2000 nm thick*, making the thickness variation about 1-5%. EX1049, ¶173."

Reply1 at 30; Reply2 at 30; Reply3 at 30; Reply4 at 31.

- But Petitioner's expert admitted during cross-examination that the thicknesses cited are from Grill's Fig. 6, not Fig. 5:

Q Can you turn to Column 8, Lines 24 to 31.

A Okay.

Q This portion of Grill is describing Figure 6A. Is that correct?

A That's what it -- the paragraph starts off saying Figure 6A shows, so, yes, I believe that's true.

Q Is it your testimony that this passage, **Column 8, 24 to 31, describes Figure 5?**

A No. It says Figure 6A.

EX2040 53:7-16; see also, e.g., **1376:** Observations1 ¶12; **1377:** Observations2 ¶12; **1378:** Observations3 ¶12; **1379:** Observations4 ¶12.

Beyond the Scope of Proper Reply and Petitioners' Motion to Exclude

Petitioner's Arguments Beyond the Scope of Proper Reply

- New arguments and evidence attempting to show Aoyama's etch stop layer could be something other than carbon
 - **See, e.g., 1376:** Reply1 at 22:16-23:2; 27:15-28:5; EX1039; EX1040; SmithReply1 ¶¶66-68; *see also* Scope1; Scope2; Scope3; Scope4.
- Arguments regarding priority claim of Grill not made in the Petition
 - **See, e.g., 1376:** Reply1 at 14:8-22:15; 17 (sentence beginning "Layer 58..." and the citation that follows), 19 (sentence beginning "Photoresist layer 62 ..." and the citations that follow); EX1036; EX1037; EX1038; Smithreply1 ¶¶37-54; *see also* Scope1; Scope2; Scope3; Scope4.

Federal Circuit: "It is of the utmost importance that petitioners in the IPR proceedings adhere to the requirement that the ***initial petition identify "with particularity" the "evidence that supports the grounds for the challenge to each claim."*** ... See Office Patent Trial Practice Guide, 77 Fed.Reg. at 48,767 ("Examples of indications that a new issue has been raised in a reply include new evidence necessary to make out a prima facie case for the ... unpatentability of an original ... claim, and new evidence that could have been presented in a prior filing."). In these circumstances, we find that the Board did not err in ***refusing the reply brief as improper*** under 37 C.F.R. § 42.23(b) ***because [Petitioner] relied on an entirely new rationale*** to explain why one of skill in the art would have been motivated to combine Tsien or Ju with a modification of Zavgorodny."

Intelligent Bio-System v. Illumina Cambridge, 821 F.3d 1359, 1369-70 (Fed. Cir. 2016); *see also, e.g., 1376:* POR1 at 2 n.3, 8 n.7, 19, 32-33, 49, 53 n.22, 54 n.23, 62; **1377:** POR2 at 2 n.3, 8 n.7, 19, 35-36, 52-53, 57 n.22, 58 n.23, 66; **1378:** POR3 at 2 n.3, 8 n.7, 19, 32-33, 49, 53 n.22, 54 n.23, 62; **1379:** POR4 at 2 n.3, 8 n.7, 19, 35-36, 52, 56 n.22, 57 n.23, 65.

Petitioner seeks to exclude clearly relevant documents contrary to Petitioner’s arguments and expert testimony

- **Petitioner moved to exclude** exhibits EX2015, EX2018, and EX2019 under FRE 401, 402, 403
See MTE1 at 2, MTE2 at 2, MTE3 at 2, MTE4 at 2.
- But **EX2018 and EX2019 are excerpts from the 2007 edition of Petitioner’s expert’s textbook, which was also published in 1998, contradicting Petitioner’s arguments** regarding the construction “using the [designated layer[s]] as a mask” and demonstrating that a POSITA would not have been motivated to combine Grill with Aoyama’s resist pattern, which used a thicker resist pattern over the via hole.
See Opp1 at 5-7, 9-11; Opp2 at 5-7, 9-11; Opp3 at 5-7, 9-11; Opp4 at 5-7, 9-11.
- And **EX2015 is an excerpt of a 2001 edition of the Helbert textbook also published in 1991 (EX2027) contradicting Petitioner’s arguments** regarding the construction “using the [designated layer[s]] as a mask”
See Opp1 at 3-5, 8-9; Opp2 at 3-5, 8-9; Opp3 at 3-5, 8-9; Opp4 at 3-5, 8-9.
- Both editions of the textbooks provide the **same disclosures showing this was true for nearly a decade spanning the ‘696 Foreign priority date**
- EX2018 was also used during the deposition of Petitioner’s Expert
EX2010 49:6-50:9 (introducing EX2018 at Smith Ex. 3); see also, e.g., Opp1 at 5 n.4; Opp2 at 5 n.4; Opp3 at 5 n.4; Opp4 at 5 n.4.

PTAB: “It is well settled that **references that have publication dates after the critical date may be cited** to show that the state of the art at or around the time of the invention.”

Liberty Mutual v. Progressive, CBM2012-00002, Pap. 66, at 64, citing *Eli Lilly and Co. v. Barr Labs., Inc.*, 251 F.3d 955, 969-70 (Fed. Cir. 2001), *In re Wilson*, 311 F.2d 266, 268-269 (CCPA 1962).

PTAB: “Proceedings **before the Board** are not jury trials; in the absence of a jury, the **risk of unfair prejudice against which Rule 403 guards is diminished, if not eliminated entirely.**”

Neste Oil Oyj v. Reg Synthetic Fuels, LLC, IPR2013-00578, Pap. 53 at 10-11 (citations omitted); see also *SK Innovation Co. v. Celgard, LLC*, IPR2014-00679, Pap. 58, at 50; *Corning Inc. v. DSM IP Assets B.V.*, IPR2013-00053, Pap. 66, at 19.

See also **1376:** Opp1 at 2-3, 9; **1377:** Opp2 at 2-3, 9; **1378:** Opp3 at 2-3, 9; **1379:** Opp4 at 2-3, 9.