

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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TAIWAN SEMICONDUCTOR MANUFACTURING COMPANY  
LIMITED and GLOBALFOUNDRIES U.S. INC.,  
Petitioners,

v.

GODO KAISHA IP BRIDGE 1,  
Patent Owner.

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Case IPR2016-01264  
Patent 6,538,324 B1

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Before JUSTIN T. ARBES, MICHAEL J. FITZPATRICK, and  
JENNIFER MEYER CHAGNON, *Administrative Patent Judges*.

FITZPATRICK, *Administrative Patent Judge*.

FINAL WRITTEN DECISION  
*35 U.S.C. § 318(a)*

## I. INTRODUCTION

### A. Procedural History

The original sole petitioner in this *inter partes* review, Taiwan Semiconductor Manufacturing Company Limited (“Taiwan Semiconductor”), filed a Petition to institute an *inter partes* review of claims 1–3, 5–7, and 9 of U.S. Patent No. 6,538,324 B1 (Ex. 1001, “the ’324 patent”) pursuant to 35 U.S.C. § 311(a). Paper 2 (“Pet.”). Patent Owner, Godo Kaisha IP Bridge 1, filed a Preliminary Response under 35 U.S.C. § 313. Paper 6 (“Prelim. Resp.”). In a December 21, 2016, Decision, we instituted an *inter partes* review. Paper 7 (“Inst. Dec.”). During the *inter partes* review, Global Foundries U.S. Inc. (“Global Foundries”) was joined as co-petitioner. Paper 24. Taiwan Semiconductor and Global Foundries are hereafter referred to collectively as “Petitioner.”

Patent Owner filed a Patent Owner Response (Paper 14, “PO Resp.”) to which Petitioner filed a Reply (Paper 19, “Reply”). Patent Owner also filed a contingent Motion to Amend (Paper 16, “Amend Mot.”), against which Petitioner filed an Opposition (Paper 20, “Amend Opp.”), and in further support of which Patent Owner filed a Reply (Paper 25, “Amend Reply”). Patent Owner filed Observations on the cross-examination of Sanjay K. Banerjee, Ph.D. (Paper 28) to which Petitioner filed a Response (Paper 37). Both sides filed Motions to Exclude. *See* Papers 29 and 31 (motions), 36 and 38 (oppositions), and 40 and 41 (replies). Both sides requested a hearing for oral arguments (Papers 30, 32), and a consolidated hearing for this *inter partes* review and related Case IPR2016-01249 was held August 7, 2017. *See* Paper 45 (“Tr.”).

As discussed below, Petitioner has shown by a preponderance of the evidence that all of the challenged claims are unpatentable. Patent Owner's Motion to Amend is dismissed as moot in light of our deciding an identical motion to amend Patent Owner presented in Case IPR2016-01249. The Motions to Exclude are dismissed as moot.

### B. Related Matters

Petitioner has filed a separate petition for an *inter partes* review of the '324 patent, which petition challenges the same claims as the instant Petition. Pet. 52; Paper 4, 1; *see also* Case IPR2016-01249.

Patent Owner has asserted the '324 patent in *Godo Kaisha IP Bridge 1 v. OmniVision Technologies, Inc.*, No. 1-16-cv-00290 (D. Del.) and *Godo Kaisha IP Bridge 1 v. Broadcom Ltd.*, No. 2-16-cv-00134 (E.D. Tex.). Pet. 51–52; Paper 4, 2. Patent Owner notified the Board that, in the latter lawsuit, the district court dismissed all claims and counterclaims with prejudice. Paper 34, 1.

### C. The '324 Patent

The '324 patent “relates to a semiconductor integrated circuit including a copper wiring layer, and more particularly to a barrier film which prevents copper diffusion from such a copper wiring layer.” Ex. 1001, 1:7–10. A primary problem in the prior art, as noted by the '324 patent, is that it was difficult to make a diffusion-barrier film that effectively prevents copper diffusion while also being sufficiently adhesive to copper. *Id.* at 2:58–61. According to the '324 patent, a crystalline metal film was known to provide “high adhesion” but poor prevention of copper diffusion.

*Id.* at 3:14–20. On the other hand, it was known that an amorphous metal nitride film would provide a better barrier to copper diffusion since it “does not have the paths through which copper is diffused,” but it would suffer from poor adhesion to copper. *Id.* at 3:21–33.

The '324 patent describes a two-layered barrier film in which an amorphous metal nitride layer prevents copper diffusion and a crystalline metal layer containing nitrogen provides the desired adhesion. *Id.* at 5:1–8, 6:6–8.

#### D. The Challenged Claims

Of the challenged claims, claims 1 and 5 are independent. Claim 1 is illustrative and reproduced below.

1. A barrier film preventing diffusion of copper from a copper wiring layer formed on a semiconductor substrate, comprising a multi-layered structure of first and second films,
  - said first film being composed of crystalline metal containing nitrogen therein,
  - said second film being composed of amorphous metal nitride,
  - said barrier film being constituted of common metal atomic species,
  - said first film being formed on said second film,
  - said first film in direct contact with said second film,
  - said first film containing nitrogen in a smaller content than that of said second film.

### E. Grounds of Unpatentability Tried

We instituted trial on two grounds of unpatentability, as follows:

References	Basis <sup>1</sup>	Claims
Zhang (Ex. 1004) <sup>2</sup> and Ding (Ex. 1005) <sup>3</sup>	§ 103(a)	1–3, 5–7, and 9
Zhang, Ding, and Sun (Ex. 1007) <sup>4</sup>	§ 103(a)	1–3, 5–7, and 9

Inst. Dec. 17.

The '324 patent has an actual filing date of June 19, 2000, and claims the benefit of a foreign (Japanese) application filed June 24, 1999. Ex. 1001, at [22] and [30]. Neither party addresses whether the challenged claims are entitled to the benefit of the June 24, 1999, filing date of the Japanese application. Patent Owner does not dispute that Ding, Zhang, and Sun are prior art to the challenged claims. *See generally* PO Resp. On the record presented, Ding is prior art under § 102(e), Zhang is prior art under at least § 102(a) and (e), and Sun is prior art under at least § 102(b).

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<sup>1</sup> The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, took effect on March 18, 2013. Because the application from which the '324 patent issued was filed before that date, our citations to 35 U.S.C. §§ 102 and 103 are to their pre-AIA versions.

<sup>2</sup> U.S. Patent No. 5,893,752 to Zhang, filed December 22, 1997, and issued April 13, 1999.

<sup>3</sup> U.S. Patent No. 6,887,353 B1 to Ding, filed December 19, 1997, and issued May 3, 2005.

<sup>4</sup> Sun et al., “Properties of reactively sputter-deposited Ta – N thin films,” *Thin Solid Films*, Vol. 236 (1993), pp. 347–351.

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