

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

WESTERN DIGITAL TECHNOLOGIES, INC.,
Petitioner,

v.

GODO KAISHA IP BRIDGE 1,
Patent Owner.

IPR2024-01386
Patent 9,608,198 B2

Before SHEILA F. McSHANE, MONICA S. ULLAGADDI, and
JOHN D. HAMANN, *Administrative Patent Judges*.

ULLAGADDI, *Administrative Patent Judge*.

DECISION
Denying Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

Western Digital Technologies, Inc. (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting an *inter partes* review of claims 1–6 (“the challenged claims”) of U.S. Patent No. 9,608,198 B2 (Ex. 1009, “the ’198 patent”), accompanied by the supporting declaration of Dr. Jeffrey Bokor (Ex. 1024). Godo Kaisha IP Bridge 1 (“Patent Owner”) filed a Preliminary Response. Paper 8 (“Prelim. Resp.”).

We have authority to determine whether to institute an *inter partes* review. *See* 35 U.S.C. § 314 (2018); 37 C.F.R. § 42.4(a) (2024). The standard for instituting an *inter partes* review is set forth in 35 U.S.C. § 314(a), which provides that an *inter partes* review may not be instituted “unless the Director determines . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” Having considered the parties’ arguments and the evidence of record, we determine that, for the reasons discussed herein, Petitioner does not demonstrate a reasonable likelihood that it would prevail with respect to at least one of the challenged claims. We thus decline to institute an *inter partes* review.

II. BACKGROUND

A. *Real Parties-in-Interest*

Petitioner identifies Western Digital Technologies, Inc., and related entity Western Digital Corporation, as the real parties-in-interest. Pet. 70. Patent Owner identifies Godo Kaisha IP Bridge 1 as the real party-in-interest. Paper 4, 1.

B. *Related Matters*

The parties both identify *Godo Kaisha IP Bridge 1 v. Western Digital Technologies, Inc.*, No. 24-cv-00342 (D. Del.); *Godo Kaisha IP Bridge 1 v.*

Seagate Technology LLC, No. 24-cv-00341 (D. Del.); *Godo Kaisha IP Bridge 1 v. Western Digital Technologies, Inc.*, No. 3:24-cv-06555 (N.D. Cal.); and *Godo Kaisha IP Bridge 1 v. Seagate Technology LLC*, No. 24-cv-3691 (D. Minn.) as related matters. Pet. 70; Paper 4, 2; Paper 6, 1; Paper 9, 2.

Patent Owner identifies patents and patent applications that are in the same family as the '198 patent as related matters. Paper 4, 1–2. Pending patent applications in this family include:

U.S. Patent Application No. 18/232,576, filed on August 10, 2023 and published on December 21, 2023; and

U.S. Patent Application No. 18/642,280, filed on April 22, 2024 and published on August 22, 2024.

C. The '198 Patent

The '198 patent is titled “Magnetic Tunnel Junction Device.” Ex. 1009, code (54). The '198 patent concerns a magnetic tunnel junction (“MTJ”) device with a high magnetoresistance and a method of manufacturing the same. *Id.* at 1:32–44. According to the '198 patent, “[m]agnetoresistive random access memories (MRAMs) refer to a large-scale integrated memory circuit that is expected to replace the currently widely used DRAM[s] [dynamic random access memory].” *Id.* at 1:35–38. The '198 patent explains that an MTJ device is the most important part of the MRAM. *Id.* at 1:43–45. The '198 patent further states that “a MTJ device comprises a tunneling junction structure in which a tunnel barrier (to be hereafter also referred to as a ‘barrier layer’) made of an oxide is sandwiched between a first and a second electrode made of a ferromagnetic metal.” *Id.* at 1:45–49.

According to the '198 patent,

[t]he inventors tried an approach to deposit a MTJ device in which the tunnel barrier comprises a single-crystal (001) of magnesium oxide (MgO) or a poly-crystalline MgO in which the (001) crystal plane is preferentially oriented. It is the inventors' theory that, because magnesium oxide is a crystal (where the atoms are arranged in an orderly fashion), as opposed to the conventional amorphous Al—O barrier, the electrons are not scattered and the coherent states of electrons are con[s]erved during the tunneling process.

Id. at 5:26–34.

The '198 patent states that “[i]n a preferred embodiment, the band discontinuity value (the height of the tunnel barrier) between the bottom of the conduction band of the MgO(001) layer and the Fermi energy of the Fe(001) layer is smaller than an ideal value of a perfect single-crystal without defect.” *Id.* at 3:12–16. The '198 patent explains that “[t]hese features increase the magnetoresistance and thereby allow the output voltage of the MTJ device to be increased,” and that “[b]y using any of the aforementioned MTJ devices as a load for a single transistor, a non-volatile memory can be formed.” *Id.* at 3:16–19.

D. Illustrative Claim

Of challenged claims 1–6, claim 1 is independent. For purposes of the issues raised at this stage of the proceeding, claim 1 is illustrative and is reproduced below.

1. 1[pre] A tunnel barrier layer disposed between a first ferromagnetic material layer and a second ferromagnetic material layer that are disposed over a substrate,
1[a] wherein the tunnel barrier layer comprises a poly-crystalline magnesium oxide layer in which a (001) crystal plane is preferentially oriented,

1[b] wherein the first ferromagnetic material layer is composed of an Fe—Co alloy of BCC^[1] which alloy comprises Fe, Co, and B,

1[c] wherein the first ferromagnetic material layer is located between the tunnel barrier layer and the substrate.

Ex. 1009, 10:6–14 (bracketed designations added by Petitioner (*see* Pet. xiv)).

E. Asserted Grounds

Petitioner presents the following challenges. Pet. 26.

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1, 4–6	103(a) ²	Bowen, ³ Sunai ⁴
2, 3	103(a)	Bowen, Sunai, Soukup ⁵
1, 4–6	103(a)	Nagahama, ⁶ Sunai
2, 3	103(a)	Nagahama, Sunai, Soukup

¹ “BCC” stands for body-centered cubic.

² The Leahy-Smith America Invents Act, Pub. L. No. 112–29, 125 Stat. 284 (2011) (“AIA”), included revisions to 35 U.S.C. § 103 that became effective after the effective filing date of the challenged claims. *See* Ex. 1009, codes (22), (30), (63). Therefore, we apply the pre-AIA version of 35 U.S.C. § 103(a).

³ Bowen et al., *Large magnetoresistance in Fe/MgO/FeCo(001) epitaxial tunnel junctions on GaAs(001)*, 79 Appl. Phys. Letters 1655–57 (2001) (Ex. 1026, “Bowen”).

⁴ Japanese Unexamined Patent Application Publication No. 2002–204004, published July 19, 2002 (Ex. 1029). A certified translation, to which we cite, is provided (Ex. 1030, “Sunai”).

⁵ Soukup et al., *Voltage-Current Characteristics for Electrical Conduction Through Thin MgO Films*, 41 J. Appl. Phys. 3229–36 (1970) (Ex. 1028, “Soukup”).

⁶ European Patent Pub. No. EP 1391942 A1, published February 25, 2004, to Nagahama et al. (Ex. 1027, “Nagahama”).

III. ANALYSIS

A. Legal Standards

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when in evidence, objective evidence of nonobviousness.⁷ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. Level of Ordinary Skill in the Art

In determining the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (citing *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962 (Fed.Cir.1986)).

According to Petitioner, one of ordinary skill in the art as of 2004 would have had

a Ph.D. in electrical engineering, physics, materials science, or a related field, and at least one year of experience in the

⁷ Patent Owner presents no objective evidence of nonobviousness at this stage of the proceeding.

research, design, and/or development of magnetic/spintronic devices, or the equivalent, or a Master's degree in electrical engineering, physics, materials science, or a related field, and four years of experience in the research, design, and/or development of magnetic/spintronic devices, or the equivalent.

Pet. 28–29 (citing Ex. 1024 ¶ 25). Petitioner further states that “[l]ess work experience may be compensated by a higher level of relevant education, and vice versa” and that “[t]his level of ordinary skill would be the same if the relevant time period were around the March 12, 2004 or October 28, 2004 Japanese priority applications, or the March 10, 2005 PCT filing date.” *Id.* at 29 (citing Ex. 1024 ¶¶ 24–25). Patent Owner states that “[f]or purposes of this Preliminary Patent Owner Response only, Patent Owner does not challenge Petitioner’s POSA [person of ordinary skill in the art] definition because the Petition fails even if Petitioner’s POSA definition is adopted.” Prelim. Resp. 20 (citing Pet. 28–29).

To resolve the institution question, we adopt Petitioner’s proposal regarding the level of one of ordinary skill in the art. The level of ordinary skill in the art is also reflected by the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

C. Claim Construction

In *inter partes* review proceedings such as this one, we construe claims using the same claim construction standard that would be used in a civil action under 35 U.S.C. § 282(b), as articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), and its progeny. *See* 37 C.F.R. § 42.100(b). Petitioner states that “the claim terms should be given their plain and ordinary meaning and no claim construction is necessary to find the claims unpatentable.” Pet. 25. Patent Owner does not directly

address claim construction at this stage of the proceeding. *See generally* Prelim. Resp.

We need not construe any claim term to resolve the institution question, and therefore, do not expressly define any claim term in our Decision. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“[W]e need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

D. Asserted Obviousness over Bowen and Sunai

Petitioner argues that claims 1 and 4–6 would have been obvious in view of Bowen and Sunai. Pet. 26–36, 46–47. For the reasons that follow, we are not persuaded that Petitioner sufficiently demonstrates a reasonable likelihood that it would prevail in showing that at least one claim would have been obvious in view of Bowen and Sunai.

1. Overview of Bowen (Ex. 1026)

Bowen relates to the magnetoresistance of magnetic tunnel junctions. Ex. 1026, 1655. Bowen states that “[u]p to now, most studies have been performed on MTJs with a layer of amorphous alumina as insulating barrier between the ferromagnetic electrodes, yielding large and reproducible tunneling magnetoresistance (TMR).” *Id.* According to Bowen, “much work has been expended to characterize the growth and electrical behavior of ultrathin MgO layers.” *Id.*

Bowen explains that “[t]o check the continuity of the layers and the sharpness of the interfaces, a specific multilayered Fe/MgO test structure was grown in conditions described above with nominally constant

80-Å-thick Fe metallic layers separated by increasingly thin MgO layers, from 80 to 20 Å.” *Id.*

2. Overview of Sunai (Exs. 1029, 1030)

Sunai relates to “a magnetoresistance effect element, a magnetic memory, a magnetic head, and a magnetic reproducing device.” Ex. 1030

¶ 1. Sunai seeks to “provide a magnetoresistance effect element, magnetic memory, magnetic head, and magnetic reproducing device that can maintain a sufficiently high magnetoresistance ratio and prevent an increase in the reversal magnetic field even when the size is reduced.” *Id.*, code (57).

Sunai teaches a magnetoresistance effect element comprising a first ferromagnetic layer that maintains the direction of magnetization when a predetermined external magnetic field is not applied, a second ferromagnetic layer that can change the direction of magnetization when the external magnetic field is not applied, and a first tunnel barrier layer interposed between the first ferromagnetic layer and the second ferromagnetic layer, wherein the first ferromagnetic layer, the first tunnel barrier layer, and the second ferromagnetic layer form a ferromagnetic tunnel junction. *Id.* ¶ 11. Sunai teaches that “the composition of the ferromagnetic material contained in the second ferromagnetic layer is expressed by the general formula $(\text{CoFe})_{100-x}\text{Y}_x$ or the general formula $(\text{CoFeNi})_{100-x}\text{Y}_x$, where Y is at least one element selected from the group consisting of B, Si, Zr, P, Mo, Al, and Nb.” *Id.*

3. Analysis of Claim 1

For the reasons that follow, we are not persuaded that Petitioner sufficiently demonstrates that the combination of Bowen and Sunai teaches limitation 1[b], which recites “wherein the first ferromagnetic material layer

is composed of an Fe—Co alloy of BCC which alloy comprises Fe, Co, and B.”

a) Petitioner’s Contentions in the Petition

According to Petitioner, limitation “1[b] does not specify any molecular composition or stoichiometry of the claimed alloy of ‘Fe, Co, and B,’ and thus any bcc CoFeB alloy satisfies it.” Pet. 32 (citing Ex. 1009, 10:13–15; Ex. 1024 ¶ 122). Petitioner contends “Bowen taught that the Fe layer is on a first side of the MgO barrier layer.” *Id.* at 33 (citing Ex. 1026, 1655 (“Fe bottom electrode”), 1656, Abstract, Fig. 1; Ex. 1024 ¶¶ 113, 121). According to Petitioner, “Bowen explained that the ‘Fe₅₀Co₅₀ and **Fe layers are bcc structured** with sharp diffraction lines for both azimuths.” *Id.* (citing Ex. 1026, 1655, Fig. 1; Ex. 1024 ¶ 123).

Petitioner further contends that “[o]ne of skill would have found it obvious to replace Bowen’s first ferromagnetic material layer (Fe layer) with a CoFeB ferromagnetic layer as taught by Sunai to increase TMR.” *Id.* (citing Ex. 1030 ¶¶ 24–29; Ex. 1024 ¶ 124). According to Petitioner, “[a] skilled artisan knew that using CoFeB electrodes improved TMR” and that “CoFeB was known to increase TMR compared to CoFe.” *Id.* at 34 (citing Ex. 1024 ¶¶ 126, 128; Ex. 1030 ¶¶ 27, 28; Ex. 1035, 3274). Citing additional evidence, Petitioner contends that “[o]ther researchers obtained similar results.” *Id.* (citing Ex. 1055,⁸ 2269–70 (Petitioner asserts that the cited portion of Wang teaches that “the ‘benefit of using CoFeB is multifold’

⁸ Wang et al., *70% TMR at Room Temperature for SDT Sandwich Junctions With CoFeB as Free and Reference Layers*, 40 IEEE Trans. Magn. 2269-2271 (2004) (Ex. 1055, “Wang”).

including ‘a higher TMR value’”); Ex. 1056⁹ ¶¶ 39 (Petitioner asserts that the cited portion of Hosomi teaches that “[w]hen the ‘ferromagnetic layer’ is ‘comprised of a CoFeB alloy’ it ‘exhibits a larger TMR ratio’”), 78, 103, 104, Fig. 7; Ex. 1024 ¶ 128).

Petitioner also contends that “it was known that use of CoFeB **adjacent to crystalline MgO** produced bcc CoFeB crystalline structures.” Pet. 35 (citing Ex. 1060, 310; Ex. 1062,¹⁰ 18:55–59 (Petitioner asserts that the cited portion of Park “describ[es] the effect of using CoFeB adjacent to MgO crystal structure as the MgO ‘provides a template for the formation of a thin crystalline ferromagnetic layer which has the bcc structure of CoFe and is oriented in the same (100) direction as the MgO layer’”); Ex. 1009, 4:39–41 (Petitioner asserts that the cited portion of the ’198 patent discloses that “MgO (001), (100), (010) planes are the same’)) (emphasis added). “Thus,” Petitioner contends, “substitution of CoFeB for Fe would still produce **a bcc CoFeB structure.**” *Id.* (emphasis added).

b) Patent Owner’s Contentions in the Preliminary Response

Patent Owner disputes Petitioner’s position that it would have been obvious to substitute Sunai’s CoFeB ferromagnetic layer for Bowen’s first ferromagnetic layer (*see* Pet. 33–35) because

Sunai teaches that its CoFeB layer was **amorphous** (not crystalline) **because boron inhibited and suppressed crystallization** and Sunai sought to avoid crystallization in the CoFeB layer because that would have **undesirably resulted in “significantly lower” TMR**. These teachings directly refute Petitioner’s assertion that Sunai would have motivated a POSA

⁹ U.S. Patent Publication No. 2004/0136232 A1 to Hosomi et al., filed Sept. 26, 2003, published July 15, 2004 (Ex. 1056, “Hosomi”).

¹⁰ U.S. Patent No. 7,270,896 B2 to Parkin, filed July 2, 2004, issued Sept. 18, 2007 (Ex. 1062, “Parkin”).

to modify Bowen to “increase TMR” by using a ferromagnetic layer with a crystalline “**bcc CoFeB crystalline structure[]**.” Sunai is explicit that such crystallization would have had the opposite effect and would have “significantly lower[ed]” TMR.

Prelim. Resp. 25 (citing Ex. 1030 ¶¶ 24, 25, 30; Pet. 33, 35 (parentheticals omitted)) (emphases added).

c) Discussion

The cited portions of Sunai disclose that “the composition of the ferromagnetic layer 4 is represented by the general formula (CoFe) 100-x Y_x” in which “Y is at least one element selected from the group consisting of B, Si, Zr, P, Mo, Al, and Nb” and in which “x is a number satisfying inequality 0<x<100, preferably a number satisfying inequality 3<x<16.” Ex. 1030 ¶ 24. Sunai further discloses that “if the film thickness t of the ferromagnetic layer 4 is reduced, **crystallization is inhibited according to the above material containing element Y**, so the ferromagnetic layer 4 can be formed as a continuous film.” *Id.* ¶ 25 (emphasis added). Sunai also discloses that “**the addition of the element Y** suppresses the diffusion or movement of atoms that reach the film formation surface during the film formation process, **thereby suppressing crystallization**” and that, “[c]onversely, if the element Y is not added, the atoms that reach the film formation surface diffuse or move relatively freely, making crystallization more likely to occur.” *Id.* ¶ 30 (emphasis added).

Thus, the cited teachings of Sunai *support* Patent Owner’s position that, even if adding boron into a ferromagnetic layer of CoFe results in a higher TMR as taught by Sunai, the addition suppresses crystallization.

As to the issue of the teaching of the BCC structure of the alloy, not only does Petitioner’s challenge applying Bowen and Sunai fail to demonstrate a teaching or even a suggestion of a CoFeB alloy with a BCC

lattice structure as recited in limitation 1[b], the other underlying evidence cited by Petitioner does not either. Only one of Petitioner's cited pieces of underlying evidence refers to a BCC lattice structure, Parkin, but Parkin's BCC structure is disclosed with respect to a CoFe layer, and *not* a CoFeB layer. Ex. 1062, 18:55–59 (“The simple cubic crystalline MgO layer thus provides a template for the formation of a thin crystalline ferromagnetic layer which has the bcc structure **of CoFe** and is oriented in the same (100) direction as the MgO layer.” (emphasis added)).

As discussed above, in Petitioner's proposed challenge, Petitioner also contends that because the ferromagnetic layer is “adjacent” to the MgO layer and because the MgO layer is crystalline, that the ferromagnetic layer is also crystalline. *See* Pet. 35. Petitioner's Declarant, Dr. Bokor, testifies that “using CoFeB adjacent to MgO crystalline layers produced **bcc crystalline structures of CoFeB** . . . because of **the template effect** of the MgO barrier on the CoFeB electrodes.” Ex. 1024 ¶ 129 (emphasis added). According to Dr. Bokor, “[o]ne of skill was aware that CoFeB would adopt the crystalline structure of an adjoining layer.” *Id.*

But Dr. Bokor's position is not sufficiently supported by the cited underlying evidence. Dr. Bokor cites portions of Jimbo¹¹ and testifies that

Jimbo deposited CoFeB by sputtering, and then “[t]he annealing was performed for 1 hour.” Jimbo observed that CoFeB started to form a crystalline structure “first after annealing at 250°C and becomes still higher at 300°C.” **Jimbo's CoFeB adopted the fcc(111)^[12] structure** of the adjoining Au fcc(111) top layer. Jimbo found the MR ratio was “enhanced by the annealing.”

¹¹ Jimbo et al., *Thermal stability of spin valves using amorphous CoFeB*, 165 J. Magnetism & Magnetic Materials 308–311 (1997) (Ex. 1060, “Jimbo”).

¹² “fcc” stands for face-centered cubic.

Id. (citing Ex. 1060, 308, 311) (emphasis added). The cited portions of Jimbo do not teach a CoFeB having a *BCC* lattice-structured crystalline property. Dr. Bokor further testifies that

[o]ne of skill was aware that MgO would crystallize in a cubic structure with the (001), (100), and (010) crystalline planes being the same. **One of skill would have been aware that CoFeB would adopt the (001) crystalline structure of an adjoining MgO (001) layer.** This was true in Jimbo despite a lattice mismatch between the Au and CoFeB. One of skill in the art would expect CoFeB to crystallize in the same crystalline plane of an adjoining MgO layer because of the closer lattice match between CoFeB and MgO.

Id. ¶ 129 (citing Ex. 1024 § VII.E.1; Ex. 1060, 308, 309, Fig. 1; Ex. 1046, 1 (Dr. Bokor testifying that Mathon¹³ teaches “‘only a small lattice mismatch of about 3.5%’ between in-plane distances of Fe and O”)) (emphasis added). However, Dr. Bokor does not sufficiently explain, nor are we able to ascertain, why a MgO (001) layer¹⁴ would be expected to crystallize adjoining CoFeB in a BCC lattice structure.

Other underlying evidence cited by Petitioner does not support its challenge, as discussed below.

¹³ Mathon et al., *Theory of tunneling magnetoresistance of an epitaxial Fe/MgO/Fe(001) junction*, 63 Phys. Rev. 220403 (2001) (Ex. 1046, “Mathon”).

¹⁴ Petitioner relies upon Bowen for its MgO(001) single crystal barrier layer teaching, and then asserts that a person of ordinary skill would have understood that polycrystalline MgO(001) could be used in place of the single crystal MgO(001) layer. Pet. 31–32. Accordingly, under Petitioner’s asserted combination, the barrier layer would be polycrystalline MgO(001).

Wang¹⁵ discloses that “[t]he benefit of using CoFeB is multifold: a higher TMR value, a lower coercivity (H_c), and a lower coupling field (H_{coupl}) for the free layer, which are all desirable for sensor applications.” Ex. 1055, 2269–70. Wang also discloses that “[e]xamination of the microstructure using HRTEM [High-resolution transmission electron microscopy] reveals that **amorphous CoFeB** does not support any crystalline grain growth of the CrMnPt [Chromium Manganese Platinum] layer, for which a correct crystal structure and large enough grains are needed to provide pinning to the CoFeB layer beneath it [11].” *Id.* at 2270 (emphasis added). Wang also discloses “an **amorphous CoFeB layer** promote[s] only amorphous-like CrMnPt growth, also supported by electron microdiffraction patterns, for which no pinning is observed.” *Id.* (emphasis added).

Hosomi discloses that “when the ferromagnetic layer constituting an information recording layer is comprised of an amorphous [sic] layer, an increase of the inverted magnetic field H_c due to reduction in size of the element, namely, reduction in size of the shorter axis can be avoided.” Ex. 1056 ¶ 39. Hosomi further discloses that “[e]specially, an **amorphous layer comprised of a CoFeB alloy** or an alloy containing a CoFeNiB alloy and an alloying element exhibits a larger TMR ratio and has high magnetic anisotropy, but it can improve the sensitivity in the direction of the auxiliary magnetic field.” *Id.* (emphasis added). Hosomi also discloses that “both the ferromagnetic layers 5, 7 are made of an FeCoB or FeCoNiB material containing B so as to have **an amorphous structure.**” *Id.* ¶ 67 (emphasis added).

¹⁵ Wang et al., *70% TMR at Room Temperature for SDT Sandwich Junctions With CoFeB as Free and Reference Layers*, 40 IEEE Trans. Magn. 2269–2271 (2004) (Ex. 1055, “Wang”).

added). Hosomi further discloses that “by virtue of containing a ferromagnetic material having **an amorphous structure**, the element can realize improvement of the spin polarizability, namely, **improvement of the TMR ratio.**” *Id.* ¶ 68 (emphasis added); *see id.* ¶ 104 (“it is found that the TMR element having an information recording layer containing Fe, Co, and B is lowered in the coercive force while maintaining a high TMR ratio”).

Accordingly, neither Wang nor Hosomi teach or suggest a CoFeB alloy with a BCC structure, and instead indicate the alloy would be in an amorphous state. Thus, further in light of Petitioner’s citations to multiple pieces of underlying evidence tending to show that a CoFeB layer would have an amorphous structure, Petitioner has not sufficiently demonstrated why a CoFeB layer would behave the same way as a CoFe layer (as disclosed in Parkin), and have a BCC crystalline structure.

In view of the above, Petitioner has not sufficiently shown that the combination of Bowen and Sunai or the cited underlying evidence discloses that either the MgO or the ferromagnetic layer have a BCC lattice structure, nor does Petitioner sufficiently explain why a POSA would have understood that they—either or both the MgO and the CoFeB layer—had the claimed BCC structure as in limitation 1[b].

4. Remaining Claims 4–6

We have reviewed Petitioner’s showing with respect to dependent claims 4–6 and determine that Petitioner does not sufficiently demonstrate that its showing for any of these claims cures the deficiency discussed above in Section III.D.3 with respect to independent claim 1. Thus, Petitioner does not sufficiently show that it is reasonably likely to prevail, with respect to any of claims 4–6, on its obviousness challenge applying Bowen and Sunai.

E. Asserted Obviousness over Nagahama and Sunai

Petitioner argues that claims 1 and 4–6 would have been obvious in view of Nagahama and Sunai. Pet. 47–54, 60–62. For the reasons that follow, we are not persuaded that Petitioner sufficiently demonstrates a reasonable likelihood that it would prevail in showing that at least independent claim 1 would have been obvious in view of Nagahama and Sunai.

1. Overview of Nagahama (Ex. 1027)

Nagahama relates to a tunnel magnetoresistive element. Ex. 1027, code (57). Nagahama discloses a tunnel magnetoresistive element that includes an underlayer (nonmagnetic or antiferromagnetic metal film), an ultrathin ferromagnetic layer disposed on the underlayer, an insulating layer disposed on the ultrathin ferromagnetic layer, and a ferromagnetic electrode disposed on the insulating layer. *Id.*

Nagahama discloses “a (001)-highly-oriented lower ferromagnetic electrode layer, a (001)-highly-oriented MgO barrier layer, and a (001)-highly-oriented upper ferromagnetic electrode layer on [an] MgO double underlayer.” *Id.* ¶ 73. According to Nagahama, “by preparing a tunnel magnetoresistive element including the (001)-highly-oriented MgO barrier layer overlying the MgO double underlayer, a still larger magnetoresistive effect was produced.” *Id.* ¶ 74.

2. Analysis of Claim 1

As set forth above, limitation 1[b] of claim 1 recites “wherein the first ferromagnetic material layer is composed of an Fe—Co alloy of BCC which alloy comprises Fe, Co, and B.” Petitioner contends that “[c]laim 1[b] does not specify any molecular composition or stoichiometry of the claimed alloy ‘comprising Fe, Co, B,’ and thus any bcc CoFeB alloy satisfies it.” Pet. 51

(citing Ex. 1009, 10:13–15; Ex. 1024 ¶ 122). Petitioner further contends that “Nagahama disclosed a ‘(001)-highly-oriented lower ferromagnetic electrode’ formed on a first (lower) side of the tunnel barrier layer.” *Id.* at 48 (citing Ex. 1027 ¶ 73). According to Petitioner, “Nagahama discloses various examples of this ‘lower ferromagnetic electrode’ material, including Fe, Co, Ni, or an alloy of these metals.” *Id.* at 49 (citing Ex. 1027 ¶¶ 28, 31, 61, 68, Fig. 17 (reference numeral 223)).

Petitioner contends that “[o]ne of skill would have found it obvious to replace Nagahama’s lower ferromagnetic electrode material with CoFeB as taught by Sunai.” Pet. 51 (citing Ex. 1030 ¶¶ 25–29; Ex. 1024 ¶ 195).

Patent Owner contends that “Petitioner’s reasons to combine Nagahama with Sunai (*e.g.*, ‘Nagahama-Sunai’) fail for substantially the same reasons that Ground 1 fails.” Prelim. Resp. 37; *see id.* at 37–43. Patent Owner contends that “Petitioner’s evidence fails to support Petitioner’s assertion that its Nagahama-Sunai combination has a BCC CoFeB layer” and that this deficiency “is fatal to Ground 2.” *Id.* at 39.

Patent Owner further contends that:

As explained above, Sunai’s CoFeB layer is amorphous. Petitioner does not dispute that Sunai’s CoFeB layer lacks a crystalline structure. But Petitioner alleges that the Nagahama ferromagnetic layer—which is “replace[d]” in the Nagahama-Sunai combination—does have a crystalline BCC structure. Petitioner alleges that “[d]espite replacing the material as recommended by Sunai, one of skill would have heeded Nagahama’s recommendation” that the ferromagnetic layer “remain” as “body-centered cubic lattice [*i.e.*, BCC]” as taught by Nagahama.

Petitioner asserts that its combination yields a BCC **crystalline** CoFeB layer rendering claim 1 obvious as a “combination of familiar elements.” That is simply untrue.

Petitioner presents no evidence of a BCC crystalline CoFeB structure. The hindsight in Petitioner's rationale is apparent.

Id. (citing Pet. 52–53; Pet. § V.A.1.a.ii; Ex. 1030 ¶¶ 24, 25, 30).

3. Analysis of the Parties' Arguments

For substantially similar reasons to those discussed above in Section III.D.3, we find Patent Owner's arguments persuasive. That is, we determine that the combination of Nagahama and Sunai does not teach or suggest limitation 1[b] of claim 1. In this ground, Petitioner relies on Nagahama's polycrystalline MgO (001) layer (*see* Pet. 50) instead of Bowen's MgO barrier layer, and relies on Sunai in substantially the same fashion as in Petitioner's challenge applying the combination of Bowen and Sunai. For the reasons discussed above, the combination of Nagahama and Sunai, even when considered in light of underlying evidence in Jimbo, Parkin, Wang, and Hosomi, does not teach or suggest CoFeB having a crystalline, BCC lattice structure.

4. Remaining Claims 4–6

We have reviewed Petitioner's showing with respect to dependent claims 4–6 and determine that Petitioner does not sufficiently demonstrate that its showing for any of these claims cures the deficiencies discussed above in Section III.E.3 with respect to independent claim 1. Thus, Petitioner does not sufficiently show that it is reasonably likely to prevail, with respect to any of claims 4–6, on its obviousness challenge applying Nagahama and Sunai.

F. Remaining Grounds and Claims

With regard to Petitioner's obviousness challenge to claims 2 and 3 applying Bowen, Sunai, and Soukup and its obviousness challenge to claims 2 and 3 applying Nagahama, Sunai, and Soukup, Petitioner's showings do

not cure the deficiencies noted above with respect to its challenge to claims 1 and 4–6 over Bowen and Sunai, nor with respect to its challenge to claims 1 and 4–6 over Nagahama and Sunai. As such, we are not persuaded that Petitioner sufficiently demonstrates a reasonable likelihood of prevailing with respect to dependent claims 2 or 3, or any of the challenged claims.

IV. CONCLUSION

After considering the evidence and arguments presented in the current record, we determine that Petitioner has not demonstrated a reasonable likelihood of prevailing on its assertions that any of claims 1–6 of the '198 patent is unpatentable on any asserted ground.

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that an *inter partes* review is not instituted.

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