

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

**RESONAC HARD DISK CORPORATION and
RESONAC CORPORATION,**
Petitioners,

v.

MR TECHNOLOGIES GMBH,
Patent Owner.

Case No. IPR2026-00016
U.S. Patent No. 12,020,734

PETITION FOR *INTER PARTES* REVIEW OF

U.S. PATENT NO. 12,020,734

CHALLENGING CLAIMS 1-2 and 4-12

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PETITIONERS' EXHIBIT LIST

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Ex-1001	U.S. Patent No. 12,020,734 (“the ’734 Patent”)
Ex-1002	File History of the ’734 Patent
Ex-1003	Declaration of Dr. Jian-Gang Zhu
Ex-1004	CV of Dr. Jian-Gang Zhu
Ex-1005	U.S. Patent No. 8,329,321 (“Takenoiri”)
Ex-1006	U.S. Patent No. 6,834,026 (“Fullerton”)
Ex-1007	W. K. Shen et al., <i>Composite perpendicular magnetic recording media using [Co/PdSi]_n as a hard layer and FeSiO as a soft layer</i> . Journal of applied physics 97.10 (2005) (“Shen”)
Ex-1008	D. Suess et al., <i>Exchange Spring Recording Media for Areal Densities Up to 10 Tbit/in²</i> , Journal of Magnetism and Magnetic Materials 290 (2005): 551-554. (“Suess 2004”)
Ex-1009	A. Yu Dobin et al., <i>Domain wall assisted magnetic recording</i> . Applied Physics Letters 89.6 (2006). (“Dobin”)
Ex-1010	Reserved
Ex-1011	D. Suess et al., <i>Exchange spring media for perpendicular recording</i> . Applied Physics Letters 87.1 (2005). (“Suess 2005”)
Ex-1012	U.S. Patent No. 9,928,864 (“the ’864 Patent”)
Ex-1013	File History of the ’864 Patent
Ex-1014	Reserved
Ex-1015	Reserved
Ex-1016	U.S. Patent No. 5,536,570 (“Osato”)

Ex-1017	C. M. Christensen, <i>The rigid disk drive industry: A history of commercial and technological turbulence</i> . Business history review 67.4 (1993): 531-588.
Ex-1018	P. Gourevitch, R. Bohn, and D. McKendrick. <i>Globalization of production: insights from the hard disk drive industry</i> . World development 28.2 (2000): 301-317.
Ex-1019	<i>MR Technologies GmbH v. Western Digital Technologies, Inc.</i> , 8:24-cv-01848 (C.D. Cal.), Dkt. No. 195, Claim Construction Order
Ex-1020	S. Okamoto et al., <i>The anisotropy field of FePt L10 nanoparticles controlled by very thin Pt layer</i> . Journal of Physics: Condensed Matter 16.12 (2004): 2109.
Ex-1021	WIPO Patent Publication No. WO 2001/022407 A1
Ex-1022	U.S. Patent No. 7,846,564 (“Li”)
Ex-1023	K. Z. Gao, et al., <i>Magnetic recording configuration for densities beyond 1 Tb/in² and data rates beyond 1 Gb/s</i> . IEEE transactions on magnetics 38.6 (2002): 3675-3683.
Ex-1024	JP Patent Application JP2004-197775 (Takenori Certified Priority Document)
Ex-1025	JP4540557B2 (Takenori JP counterpart)
Ex-1026	CN100570715C (Takenori CN counterpart)
Ex-1027	U.S. Patent Application Publication No. 2003/0096127 A1
Ex-1028	T. Shimatsu et al., <i>High perpendicular magnetic anisotropy of CoPtCr/Ru films for granular-type perpendicular media</i> . IEEE transactions on magnetics 40.4 (2004): 2483-2485.
Ex-1029	I. Kaitsu, R. Inamura, J. Toda, and T. Morita, <i>Ultra High Density Perpendicular Magnetic Recording Technologies</i> , Fujitsu Science and Technology Journal, vol. 42, No. 1, p.122-130 (January 2006).

Ex-1030	G. Asti et al., <i>Magnetic phase diagram and demagnetization processes in perpendicular exchange-spring multilayers</i> , 73 Phys. Rev. B 094406 (2006).
Ex-1031	S.S.P. Parkin, <i>Systematic Variation of the Strength and Oscillation Period of Indirect Magnetic Exchange Coupling through the 3d, 4d, and 5d Transition Metals</i> , 67 Phys. Rev. Lett. 398 (1991).
Ex-1032	M. Zheng et al., <i>Role of Oxygen Incorporation in Co-Cr-Pt-Si-O Perpendicular Magnetic Recording Media</i> . IEEE Transactions on Magnetics, 40.4 (2004): 2498-2500.
Ex-1033	Reserved
Ex-1034	CV of Sylvia Hall-Ellis, Ph.D.
Ex-1035	Jeong et al., <i>In Situ ordered polycrystalline FePt L10 (001) nanostructured films and the effect of CrMn and Zn top layer diffusion</i> . Journal of Applied Physics, 91 (2002): 6383-6385.
Ex-1036	Declaration of Sylvia Hall-Ellis, Ph.D.

I. INTRODUCTION

Petitioners request *Inter Partes* Review (“IPR”) of claims 1-2 and 4-12 (“Challenged Claims”) of U.S. Patent No. 12,020,734 (“’734 Patent,” Ex-1001), purportedly owned by MR Technologies GmbH (“Patent Owner” or “PO”).

This petition asks the USPTO to right its wrong in allowing a family of patent applications on what the field already knew and practiced: multilayer perpendicular magnetic recording (“PMR”) media with a thermally stable hard layer (that can only be switched by a high external magnetic field) to preserve data and one or more softer layers (exchange coupled to the hard layer) that switches under a lower external magnetic field and thereby assists in switching of the hard layer. The Examiner did not consider the most relevant prior art, including Takenoiri, which expressly teaches this structure and renders the challenged claims unpatentable.

By the time Austrian professor, Dr. Seuss, filed his first application in the challenged family in June 2006, U.S. research labs and U.S. and Japanese hard-drive manufacturers had already published, built, and shipped this architecture. His supposed “contribution” was merely to add another soft layer and recite hard-to-search numerical parameters that were either disclosed or inherent in known structures. But tri- (or more) layer PMR stacks with graded anisotropy were not new.

This is not invention; it is appropriation. The Office erred, and the PTAB, with its technical expertise, is the proper forum to correct it.

II. MANDATORY NOTICES

A. Real Party-in-Interest (37 C.F.R. §42.8(b)(1)):

The real parties-in-interest for Petitioners are Resonac Hard Disk Corporation, Resonac Corporation, and Resonac America, Inc.

B. Related Matters (37 C.F.R. §42.8(b)(2)):

The following judicial or administrative matters may affect, or be affected by, a decision in this proceeding:

- *MR Technologies GmbH v. Toshiba America Electronic Components, Inc. et al*, No. 8:25-cv-00786-JVS (C.D. Cal.)
- *MR Technologies GmbH v. Seagate Technology LLC et al*, 0:25-cv-01460 (D. Minn.)
- *MR Technologies GmbH v. Western Digital Technologies, Inc.*, 8:24-cv-01848 (C.D. Cal.) (terminated)

Petitioners are not named defendants in the above matters. To the best of Petitioners' knowledge, the '734 Patent has not been asserted in any other matters.¹

C. Lead Counsel (37 C.F.R. §§42.8(b)(3) & 42.10):

Petitioners designate Dion M. Bregman (Reg. No. 45,645) as lead counsel,

¹ Petitioners are concurrently challenging two related patents of the '734 Patent, i.e., U.S. Patent Nos. 9,928,864 ("the '864 Patent") and 11,138,997 ("the '997 Patent"), in IPR2026-00014 and IPR2026-00015, respectively.

and designate Sarah J. Guske (*pro hac vice* forthcoming) and Amanda S. Williamson (Reg. No. 73,683) as back-up counsel.

D. Service (37 C.F.R. §42.8(b)(3)-(4)):

Service Address: Morgan, Lewis & Bockius LLP, 1400 Page Mill Road, Palo Alto, CA (Telephone: 650.843.4000; Fax: 650.843.4001).

Pursuant to 37 C.F.R. §42.8(b)(4), Petitioners consent to email service at: MLB-Resonac-IPRs@morganlewis.com.

Pursuant to 37 C.F.R. §42.10(b), a Power of Attorney accompanies this Petition.

III. SUMMARY OF THE '734 PATENT

The application resulting in the '734 Patent was filed on October 4, 2021, and through a series of continuation applications claims the benefit of U.S. Patent Appl. No. 11/424,859, now U.S. Patent No. 9,978,413, filed on June 17, 2006 (hereinafter, the "Critical Date"). For purposes of this Petition, Petitioners assume that the Challenged Claims are entitled to the Critical Date as the priority date, which is consistent with the inventor's district court testimony, but Petitioners reserve the right to challenge such date in other proceedings. The '734 Patent is governed under the pre-AIA Patent Act.

A. Brief Description of the '734 Patent

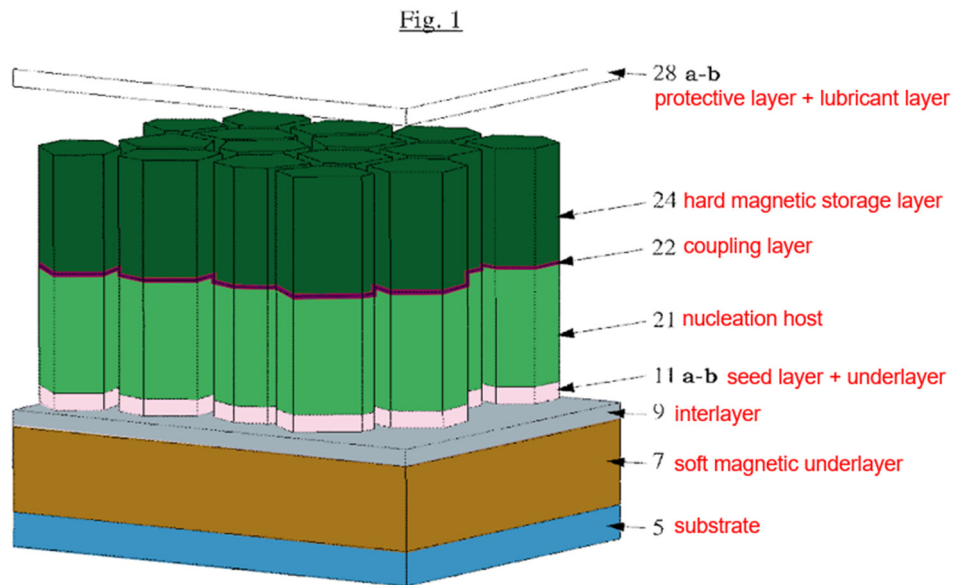
As recording density for magnetic recording media increases, a continued decrease in the magnetic grain size is no longer feasible because when the grain size

is small enough, thermal fluctuations at room temperature can switch the grain's magnetization, resulting in loss of information. Ex-1001, 1:14-24. While increasing the material's anisotropy constant K helps improve thermal stability, according to the '734 Patent, "such an increase also results in an unfavorable increase of the coercivity H_c ," making it harder to write. *Id.*, 1:22-31. Ex-1003, ¶58.

To address this, prior designs used a soft magnetic layer on top of the hard layer. Ex-1001, 1:51-58. These layers are exchange-coupled, allowing the write head to flip the soft layer, which in turn switches the hard layer, thereby reducing the required write field while preserving thermal stability. Ex-1003, ¶59.

The '734 Patent purportedly adds a second soft layer on top of the existing soft layer, forming what it calls a "nucleation host." This nucleation host consists of "ferromagnetic layers with increasing anisotropy constant K from layer to layer," exchange-coupled to the hard layer beneath. Ex-1001, 10:53–55. The patent asserts that with its structure, "the coercive field is reduced..., while the thermal stability is...not influenced." Ex-1001, 3:48–54. It claims to "overcom[e] the writeability problem of extremely hard magnetic storage layers." Ex-1001, 3:58–61. However, Figure 1 depicts the nucleation host below the hard layer, contrary to claim 1, which

requires the nucleation host to be on top.² Ex-1003, ¶60.

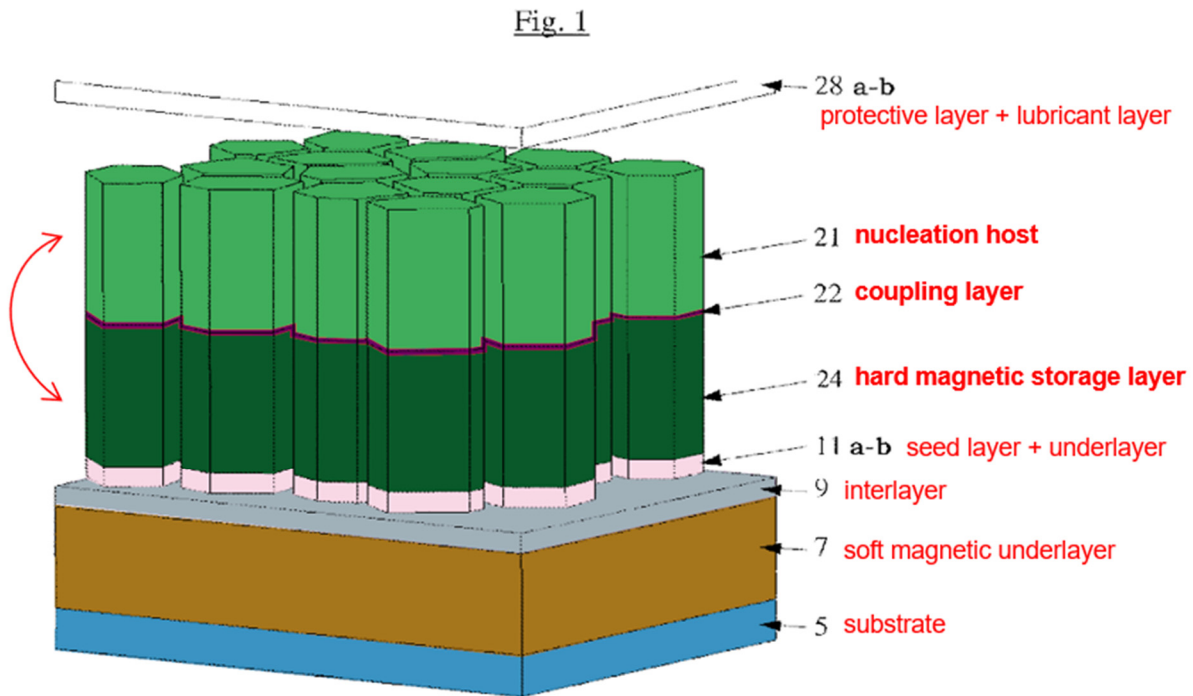


Ex-1001, Fig. 1, 4:17-23.³

For purposes of this IPR, Figure 1 of the '734 Patent has been revised to show the structure of the claimed magnetic recording medium:

² Petitioners reserve the right to challenge the '734 Patent claims under 35 U.S.C. § 112 in other proceedings. *See* 37 C.F.R. 1.83(a).

³ Unless indicated otherwise, all annotations and emphasis are added.



Ex-1001, Fig. 1 (revised, nucleation host on top). Ex-1003, ¶¶61-62.

As the '734 Patent acknowledges, combining soft and hard layers was nothing new. *Id.*, 1:54-58. What was purportedly new was the “special **multilayer** host layer (nucleation host).” *Id.*, 2:48-52. However, as shown in Ground 1 below, this structure was also well known at the time of the alleged invention. Ex-1003, ¶63.

B. Summary of the Prosecution History of the '734 Patent

U.S. Patent No. 9,928,864 (the “'864 Patent”), a parent application to the '734 Patent, issued on March 27, 2018, from U.S. Pat. Appl. No. 12/619,849, filed November 17, 2009. Ex-1012. Prosecution of the '864 Patent spanned eight years and included eight Office Actions rejecting the claims under §§ 102 and 103 based on various combinations of the same four references. *See, e.g.*, Ex-1013, 323. The

Applicant repeatedly amended the claims, and in the final two Office Actions added the following limitations (underlined) to secure allowance:

A magnetic recording medium, comprising:
an essentially non-magnetic substrate;
an underlayer formed on the non-magnetic substrate; and
an exchange coupled magnetic multilayer structure, including
a hard magnetic storage layer, having a first coercive field $H_s > 0.5$ T, formed on the underlayer; and
a nucleation host, having a second coercive field H_n without the hard magnetic storage layer, lower than the first coercive field, $H_n < H_s$, wherein
said nucleation host
is formed on the hard magnetic storage layer such that the hard magnetic storage layer is between the nucleation host and the non-magnetic substrate,
is exchange coupled to the hard magnetic storage layer, and
comprises ferromagnetic layers with increasing anisotropy constant K from layer to layer.

Ex-1013, 110, 193.

In the Notice of Allowance, the Examiner noted that “the prior art of record does not teach or suggest [(i)] the coercive field relationship between the nucleation host and hard magnetic storage layer *and* [(ii)] a nucleation host comprising multiple ferromagnetic layers with increasing anisotropy constant K from layer to layer.” Ex-1013, 16 (emphasis original).

During prosecution of the '734 Patent, in a First Office Action, the Examiner rejected all claims on multiple grounds of non-statutory double patenting. Ex-1002, 227-232. The Examiner further rejected claims 13, 16, 17, and 22-24 under pre-AIA 35 U.S.C. § 103(a) as being unpatentable over US 2007/0243418 (“Fullerton 1”),

and claims 14, 15, and 18-21 under pre-AIA 35 U.S.C. § 103(a) as being unpatentable over Fullerton 1 in view of US 2003/0108721 (“Fullerton 2”). Ex-1002, 232. In response, the Applicant filed multiple terminal disclaimers and amended claim 1 to read:

“a hard magnetic storage layer, formed from a large perpendicular anisotropy material, having a first coercive field $H_s > 0.5$ T, formed on the underlayer; and

A nucleation host ...

said nucleation host ...

comprises ferromagnetic layers with increasing anisotropy constant K from layer to layer, wherein at least two of the ferromagnetic layers are exchange coupled with a thin coupling layer.”

Ex-1002, 176, 189.

In a second Office Action, the Examiner rejected claims 1, 2, 4, 6, 7, 14-20, and 25-28 under 35 U.S.C. § 112 (pre-AIA), second paragraph. Ex. 1002, 82. The Examiner further rejected claims 25, 27, and 28 under 35 U.S.C. § 112 (pre-AIA), first paragraph. Ex-1002, 84. To secure allowance, Applicant further amended claim 1 to read:

“a hard magnetic storage layer, formed from a perpendicular anisotropy material, having a first coercive field $H_s > 0.5$ T, formed such that the underlayer is between the non-magnetic substrate and the hard magnetic storage layer; and

A nucleation host ...

said nucleation host ...

comprises at least a first ferromagnetic layer with an anisotropy constant K1 and a second ferromagnetic layer between the first ferromagnetic layer and the hard magnetic storage layer with an increased anisotropy constant K2 greater than K1, wherein

the first and second ferromagnetic layers are exchange coupled with an exchange coupling layer”

Ex-1002, 73 (showing added language only).

Thus, again, the Applicant amended claims to recite multiple ferromagnetic layers on the hard magnetic storage layer and with increasing K (anisotropy constants) toward the hard magnetic storage layer in order to obtain allowance of the '734 Patent claims.

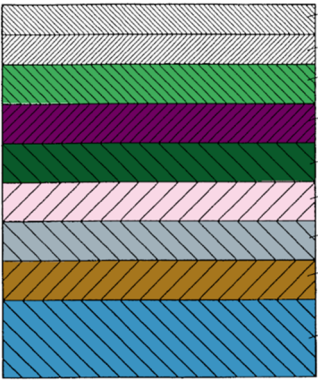
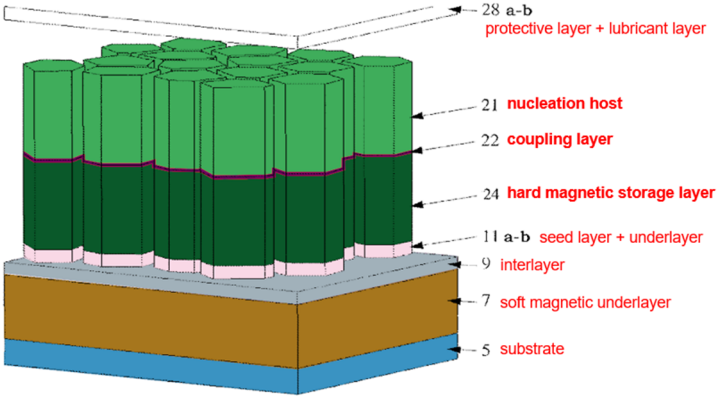
IV. THE PRIOR ART

A. Takenoiri

U.S. Patent No. 8,329,321 (“Takenoiri,” Ex-1005) was filed on **July 1, 2005** and issued **December 11, 2012**, and is prior art under at least §§102(a) and (e). The Examiner was not aware of Takenoiri during prosecution.

Like the '734 Patent, Takenoiri recognizes the same trade-off between thermal stability and writeability, explaining that increasing the anisotropy within each magnetic recording layer, and reducing bit size, improves stability but makes writing more difficult, reducing what it calls “recordability.” Ex-1005, 1:62-67. Also, like the '734 Patent, Takenoiri introduces a softer magnetic recording layer 7 (green) on top of a hard magnetic recording layer 5 (dark green), coupled by a coupling layer 6

(purple), as illustrated below. Ex-1003, ¶71.

Fig. 1 bi-layer  9 8 7 second magnetic recording layer 6 coupling layer 5 first magnetic recording layer 4 nonmagnetic intermediate layer 3 underlayer 2 soft magnetic backing layer 1 nonmagnetic substrate	Fig. 1  28 a-b protective layer + lubricant layer 21 nucleation host 22 coupling layer 24 hard magnetic storage layer 11 a-b seed layer + underlayer 9 interlayer 7 soft magnetic underlayer 5 substrate
Ex-1005, Fig. 1	Ex-1001, Fig. 1 (revised, to show nucleation host on top)

Takenoiri’s structure achieves “simultaneous improvements in thermal stability and recordability” because “each magnetic layer reverses magnetization individually.” Ex-1005, 5:8-15. Ex-1003, ¶¶72-74.

Critically, Takenoiri expressly discloses that its structure can have “three or more magnetic recording layers” (Ex-1005, 10:7-18; *see* Section VIII.A, *infra*), which, as explained in Ground 1 below, teaches the exact same “nucleation host” (with varying anisotropy) that the ’734 Patent claims. Ex-1003, ¶75.

B. Fullerton

U.S. Patent No. 6,834,026 (“Fullerton,” Ex-1006), filed on **July 23, 2003**, and issued **December 21, 2004**, is prior art under at least §§102(a), (b), and (e). Fullerton discloses various high-anisotropy materials suitable for magnetic recording layers, including the materials recited in claims 5-6 and 9-11 of the ’734 Patent. Fullerton

is a related application of Fullerton 2 relied on by the Examiner, but the Applicant did not dispute that Fullerton 2 discloses the materials recited in claims 5-6 and 9-11 of the '734 Patent. Ex-1002, 214-215.

C. Shen

Composite perpendicular magnetic recording media using $[\text{Co/PdSi}]_n$ as a hard layer and FeSiO as a soft layer ("Shen," Ex-1007), publicly available at least as early as May 17, 2005, is prior art under at least §§102(a) and (b). Ex-1036, ¶50. Shen discloses a hysteresis loop that meets the requirements in claim 12 of the '734 Patent. Shen was cited in an IDS submitted by the Applicant but was not relied on by the Examiner.

V. REQUIREMENTS FOR *INTER PARTES* REVIEW UNDER 37 C.F.R. §42.104

A. Grounds for Standing 37 C.F.R. §42.104(a) and Fees

Petitioners certify that the '734 Patent is available for IPR and that Petitioners are not barred or estopped from requesting this IPR of the Challenged Claims.

Any additional fees for this IPR may be charged to Deposit Account No. 50-0310 (Order No. 034913-0832).

B. Identification of Challenge Under 37 C.F.R. §42.104(b) and Relief Requested

Claims 1-2 and 4-12 of the '734 Patent are unpatentable and should be cancelled.

Ground	Statute	Reference(s)	'734 Patent Claims
1	§103	Takenoiri	1-2, 4, 7-8
2	§103	Takenoiri + Fullerton	5-6, 9-11
3	§103	Takenoiri + Shen	12

VI. LEVEL OF ORDINARY SKILL

A person having ordinary skill in the art (“POSITA”) at the time of the alleged invention of the ’734 patent was a person holding at least a master’s degree in Physics, Material Science, or Electrical Engineering with at least two years training or experience with magnetic recording, such as hard disk drives. Ex-1003, ¶16.

VII. CLAIM CONSTRUCTION

The court in *MR Technologies GmbH v. Western Digital Technologies, Inc.*, 8-22-cv-01599 (C.D. Cal.) (the “Western Digital case”) issued a claim construction order, which provides claim construction for certain terms in related patents, the ’864 and ’997 Patents, and some of these construed terms are also recited in the challenged claims of the ’734 Patent. Petitioners note that the claim constructions from the Western Digital case are not binding in this proceeding.

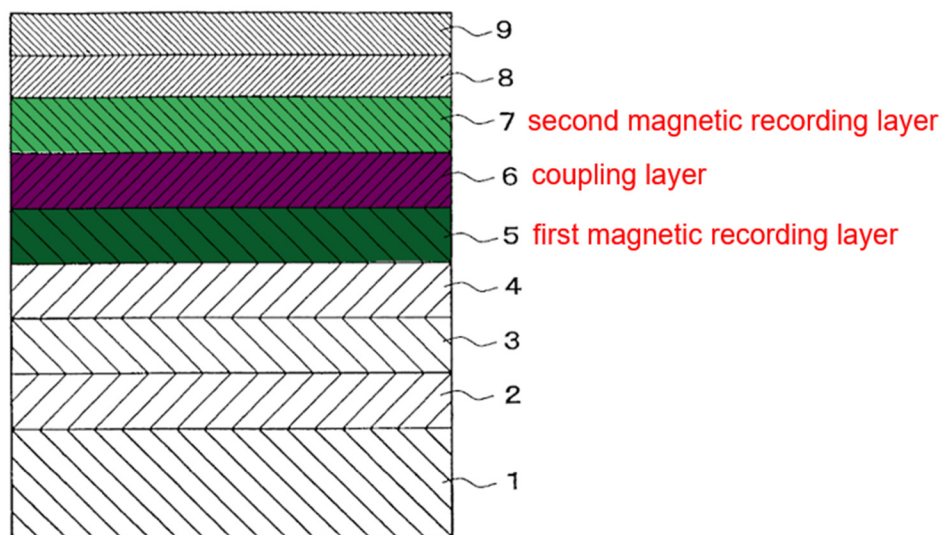
For this Petition, Petitioners believe that all claims should be given their plain and ordinary meanings, and no express constructions are required. Ex-1003, ¶79.

VIII. GROUND 1: CLAIMS 1-2, 4, AND 7-8 ARE OBVIOUS OVER TAKENOIRI ALONE

A. Takenoiri's Tri-Layer Structure

As discussed in Section IV.A, Takenoiri discloses a bi-layer embodiment with two magnetic recording layers: first magnetic recording layer 5 and second magnetic recording layer 7, coupled by coupling layer 6. Ex-1005, 5:66-6:6.

Fig. 1 **bi-layer**

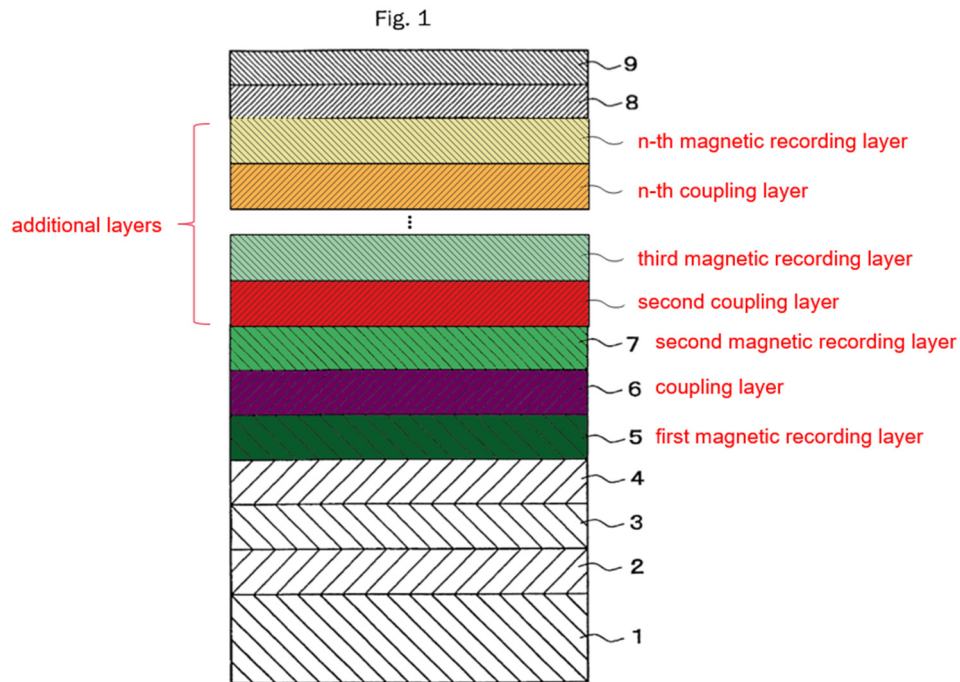


Ex-1005, Fig. 1. Ex-1003, ¶93.

Takenoiri expands on the disclosure, teaching that the structure can have “three or more layers.” *Id.*, 10:7-10.⁴ Below is a revised Figure 1 that illustrates a

⁴ While Takenoiri does not explicitly state where a third magnetic recording layer would be positioned in its bi-layer structure, a POSITA would have found it obvious to add additional layer(s) above the second magnetic recording layer 7. Ex-1003, ¶95.

three (or more) magnetic recording layered structure.



Ex-1005, Fig. 1 (tri-layer structure in modified Fig. 1).⁵ Ex-1003, ¶¶94-96.

As shown above, a second coupling layer (**red**) is disposed between the second magnetic recording layer 7 (**green**) and the third magnetic recording layer (**light green**) as taught by Takenoiri: “[t]he ferromagnetic coupling is provided between every two magnetic recording layers through a coupling layer.” *Id.*, 10:8-10. Ex-1003, ¶97.

Therefore, Takenoiri discloses, or at least renders obvious, a tri-layer

⁵ To distinguish from Takenoiri’s bi-layer structure, this Petition refers to Takenoiri’s multilayer structure with three or more magnetic recording layers as “tri-layer structure.”

structure. Ex-1003, ¶98.

B. Claim 1

1. 1[P]: “A magnetic recording system, comprising:”

To the extent that the preamble 1[P] is limiting, Takenoiri discloses it. Ex-1003, ¶100.

Takenoiri is directed to “a perpendicular magnetic recording medium mounted on various **magnetic recording devices**,” such as “**a hard disk drive** used for an external storage device of computers, AV equipment, and other apparatus.” Ex-1005, 1:14-19; *see also id.* at 1:20-33 (discussing development of “a perpendicular magnetic recording system” in place of “the longitudinal magnetic recording system” used in “hard disk drives (HDDs)”). Moreover, as discussed below, Takenoiri discloses all remaining claim elements, and as such discloses “[a] **magnetic recording system** [e.g., a magnetic recording device, such as a hard disk drive, having the claimed elements described below].” Ex-1003, ¶101.⁶

2. 1[A]: “a writing head; and”

Takenoiri discloses a “magnetic head used for magnetic recording.” Ex-1005, 6:13-16 (“Soft magnetic backing layer 2 is preferably formed to improve **read/write**

⁶ The specification fails to mention a “magnetic recording system,” so Petitioners reserve the right to challenge this limitation under 35 U.S.C. § 112 in other proceedings.

characteristics by controlling the magnetic flux from the **magnetic head used for magnetic recording**.”); *see also id.*, 6:21-22 (“magnetic head used for recording”), 6:49 (“recording head”), 16:41 (“magnetic recording head”). In the field of magnetic recording media, recording means writing. Ex-1003, ¶103. Further, a “writing head” is a necessary part of a hard disk drive to enable “recording” or “writing.” *Id.* Thus, Takenoiri’s “magnetic head” used for writing, discloses the claimed “writing head.” *Id.*

Therefore, Takenoiri discloses “**a writing head** [e.g., Takenoiri’s magnetic head used for writing].” Ex-1003, ¶104.⁷

3. 1[B]: “a disk, including a magnetic recording medium, comprising”

Takenoiri discloses “a perpendicular **magnetic recording medium** mounted on a **hard disk drive**,” which applies to the embodiment described in Figure 1 and the tri-layer structure. Ex-1005, 1:14-19. A POSITA would have understood that, as its name confirms, a hard **disk** drive includes a **disk** and that Takenoiri’s magnetic recording medium is part of the **disk**. Ex-1003, ¶106.

The ’734 Patent also confirms that a disk was a well-known component of a magnetic recording device. *See, e.g.*, Ex-1001, 6:24 (“conventional disk overcoat”),

⁷ The specification fails to mention “writing head,” so Petitioners reserve the right to challenge this limitation under 35 U.S.C. § 112 in other proceedings.

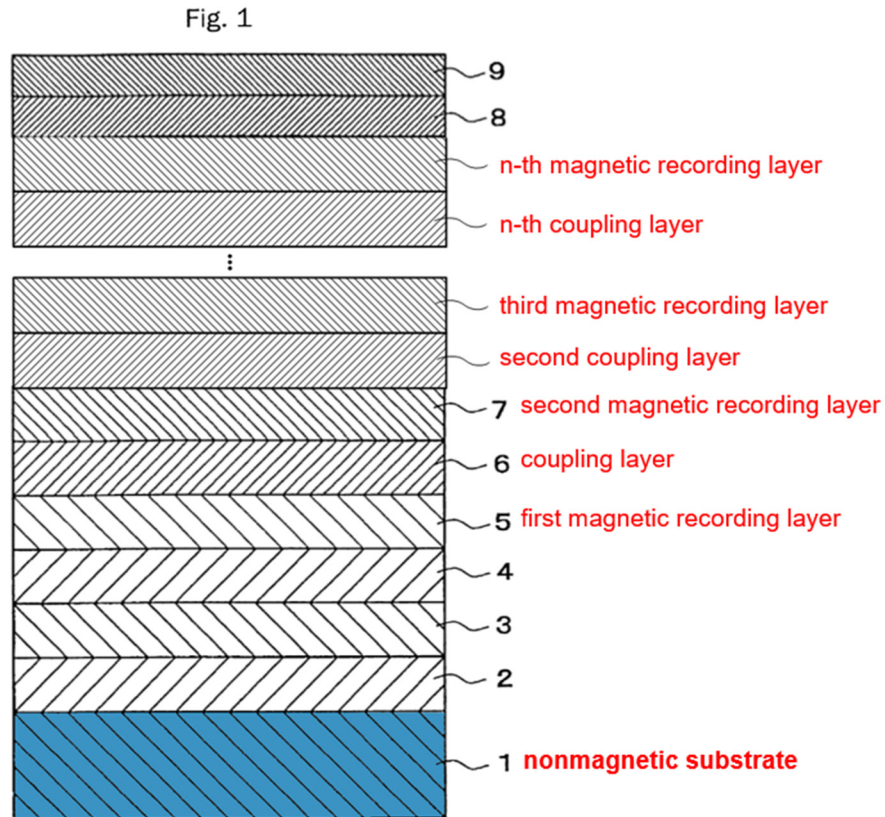
6:29 (“commercially available single disk systems”). Ex-1003, ¶107.

Therefore, Takenoiri discloses “**a disk** [e.g., a disk as a necessary part of Takenoiri’s hard disk drive], **including a magnetic recording medium** [e.g., Takenoiri’s perpendicular magnetic recording medium].” Ex-1003, ¶108.

4. 1[C]: “an essentially non-magnetic substrate;”

The ’734 Patent specification uses “essentially non-magnetic substrate” only once, without explanation. *See, e.g.*, Ex-1001, 10:21-23, 10:17, 11:64, 12:5. Claim 1 later references “the non-magnetic substrate” without antecedent basis, which a POSITA would understand as referring to the earlier recited “essentially non-magnetic substrate.” Ex-1001, claim 1. A POSITA would thus interpret “essentially non-magnetic substrate” to include a “non-magnetic substrate.” Ex-1003, ¶110.

Takenoiri discloses a “[n]onmagnetic substrate 1 [blue]...composed of an **aluminum alloy with NiP plating, strengthened glass, crystalline glass, or the like.**” Ex-1005, 6:7-10. These are the same or similar substrate materials in the ’734 Patent. *See* Ex-1001, 4:26-28 (“Substrate 5 may be made of any suitable material such as **ceramic glass, amorphous glass, or NiP plated AlMg or an AlMg alloy base with a NiP surface coating.**”).

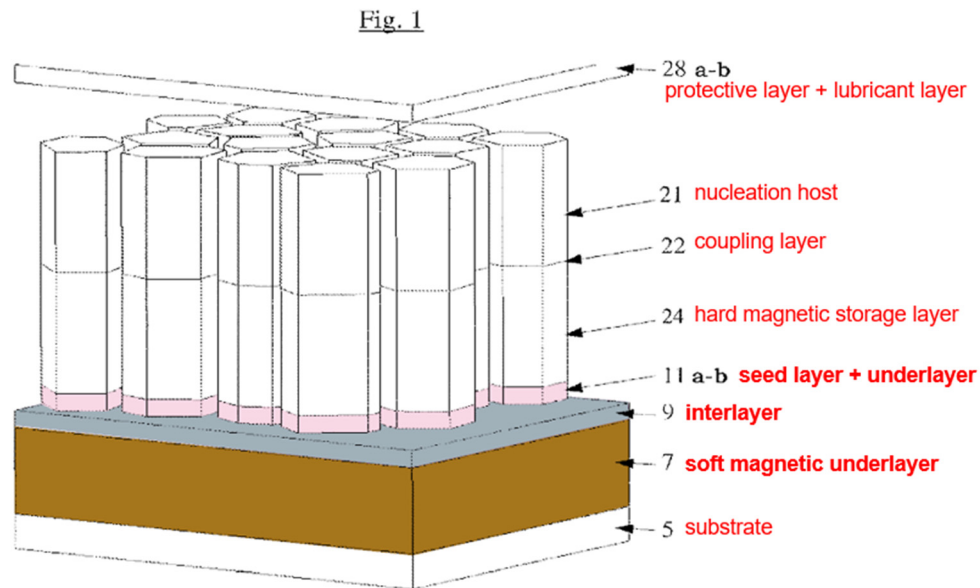


Ex-1005, Fig. 1 (tri-layer structure in modified Fig. 1). Ex-1003, ¶111.

Therefore, Takenoiri discloses “**an essentially non-magnetic substrate** [e.g., Takenoiri’s non-magnetic substrate 1].” Ex-1003, ¶112.

5. 1[D]: “an underlayer; and”

The ’734 Patent discloses “a soft magnetic underlayer 7” and an “underlayer 11b,” as well as an interlayer 9 and a seed layer 11a in between. Ex-1001, 4:17-25 (describing Figure 1).

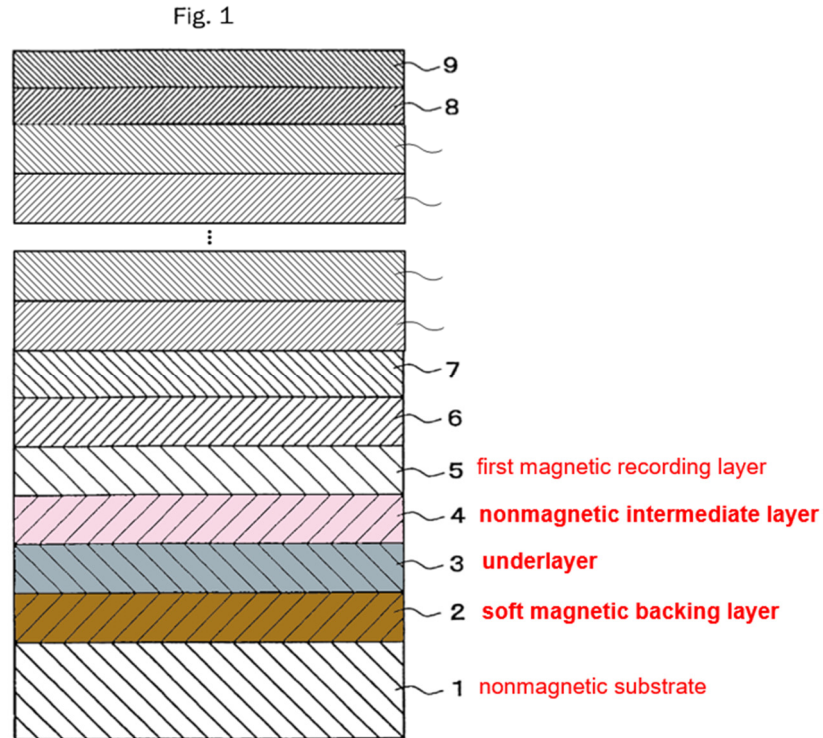


Ex-1001, Fig. 1(revised, to show nucleation host on top). Ex-1003, ¶14.

The claims of the '734 Patent only recite a positional requirement in limitation 1[G]: “[the hard magnetic storage layer] formed such that the underlayer is between the non-magnetic substrate and the hard magnetic storage layer.” *Id.*, claim 1.⁸

Takenoiri discloses that “[o]n nonmagnetic substrate 1 sequentially formed are **soft magnetic backing layer 2, underlayer 3, nonmagnetic intermediate layer 4, first magnetic recording layer 5...**” Ex-1005, 6:1-4.

⁸ The claims do not specify that the “underlayer” be a single layer formed from a single material between the non-magnetic substrate and the hard magnetic storage layer, and the Western Digital court’s construction for the term “underlayer” was: “**one or more layers** on which the hard magnetic storage layer is formed.” Ex-1019 (Western Digital CC Order), pp.21-22. Ex-1003, ¶116.



Ex-1005, Fig. 1 (tri-layer structure in modified Fig. 1). Ex-1003, ¶117.

As explained for limitation 1[F] below, Takenoiri’s first magnetic recording layer 5 discloses the claimed “hard magnetic storage layer.” *See* Section VIII.B.7, *infra*. Thus, one or more of Takenoiri’s soft magnetic backing layer 2, underlayer 3, and/or nonmagnetic intermediate layer 4 correspond to the claimed “underlayer” and are located between the Takenoiri’s nonmagnetic substrate 1 (the claimed non-magnetic substrate) and first magnetic recording layer 5 (the claimed hard magnetic storage layer). Ex-1003, ¶¶118-119.

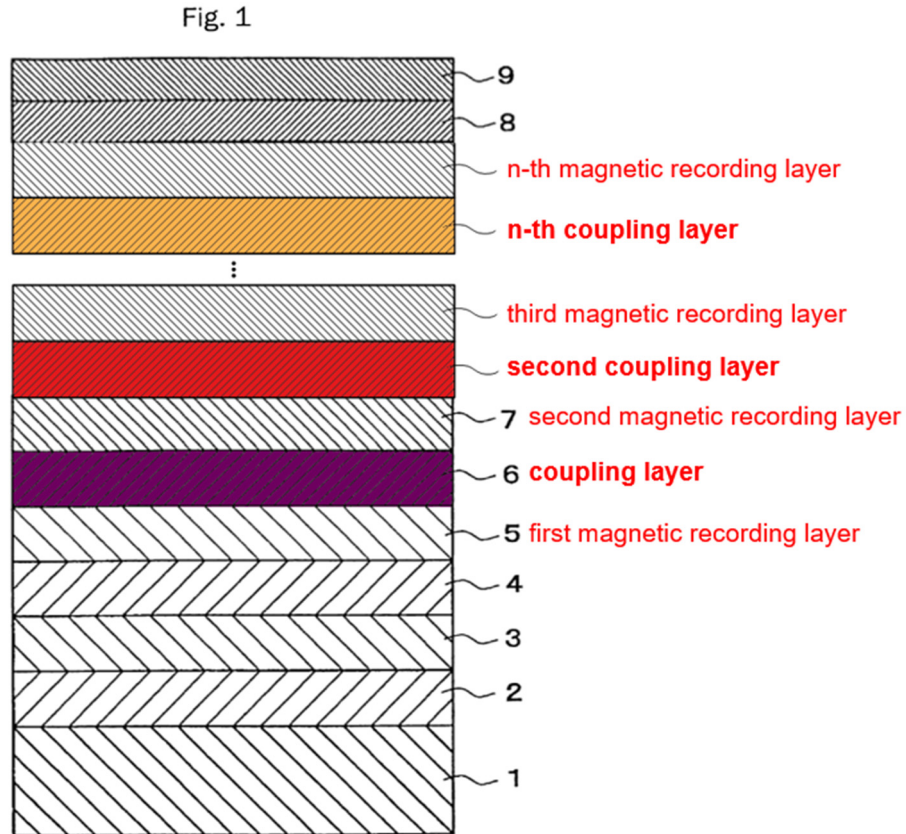
To the extent that the claimed “underlayer” requires a single layer, each of Takenoiri’s soft magnetic backing layer 2, underlayer 3, and nonmagnetic intermediate layer 4 constitutes a single underlayer and Takenoiri notes that each of

these layers “may be omitted.” Ex-1005, 6:16, 6:33-34, 6:55. Ex-1003, ¶120.

Therefore, Takenoiri discloses “**an underlayer** [e.g., one or more of Takenoiri’s soft magnetic backing layer 2, underlayer 3, and/or nonmagnetic intermediate layer 4].” Ex-1003, ¶121.

6. 1[E]: “an exchange coupled magnetic multilayer structure,”

As explained in Section VIII.A, *supra*, Takenoiri discloses a three-or-more layered structure, where every two magnetic recording layers are ferromagnetically coupled via a coupling layer “for controlling the **exchange coupling** energy between the magnetic recording layers.” Ex-1005, 5:63-65, 10:8-10. Ferromagnetic coupling is a type of exchange coupling. Ex-1003, ¶123. Accordingly, Takenoiri’s coupling layer 6 and additional coupling layers added between adjacent additional magnetic layers (including the second coupling layer and n-th coupling layer) are coupling layers that exchange couple the first, second, third,...and n-th magnetic recording layers within the multilayer structure. *Id.*



Ex-1005, Fig. 1 (tri-layer structure in modified Fig. 1).

Moreover, as discussed below, Takenoiri discloses all of the elements required in the recited “exchange coupled magnetic multilayer structure,” including the recited “hard magnetic storage layer” and “nucleation host.” Ex-1003, ¶125.

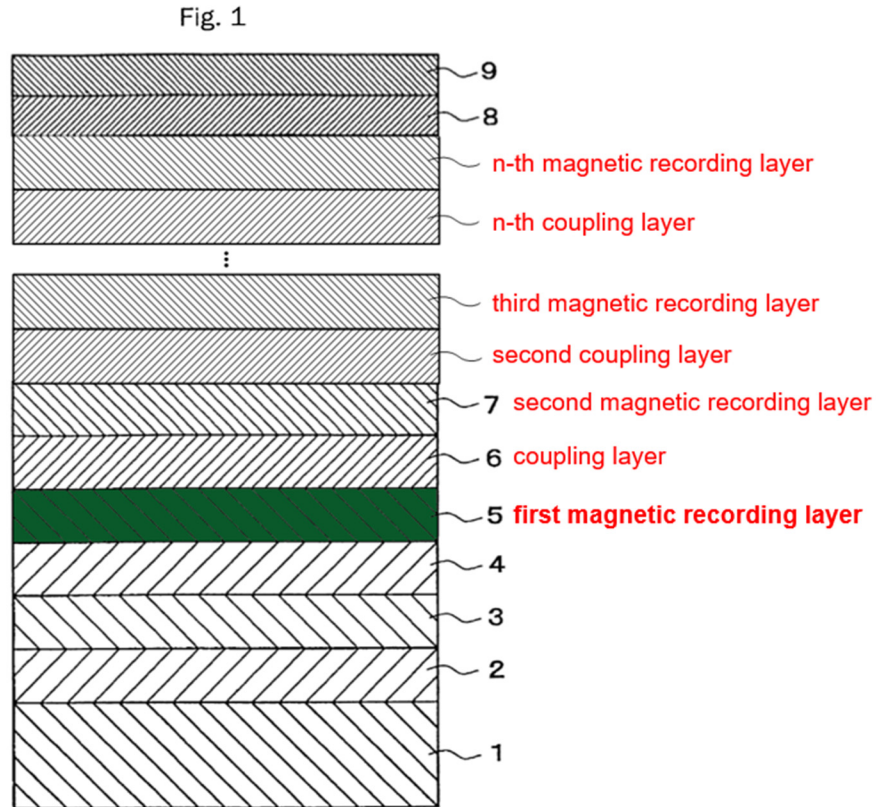
Therefore, Takenoiri discloses “**an exchange coupled magnetic multilayer structure** [e.g., Takenoiri’s multilayered structure with three or more magnetic recording layers exchange coupled to one another, having the recited structures described below].” Ex-1003, ¶126.

7. **1[F]: “a hard magnetic storage layer, formed from a perpendicular anisotropy material, having a first coercive field $H_s > 0.5$ T,”**

First, Takenoiri’s multilayer structure (including a tri-layer structure shown above) includes a “magnetic storage layer, formed from a perpendicular anisotropy material.” Ex-1003, ¶128.

In the ’734 Patent, “[h]ard magnetic storage layer 24 may be formed from any material that has large perpendicular anisotropy,” such as “CoPt...based alloys, CoPtCr alloys, including CoPtCrB, CoPtCrTa, and CoCr based granular media.” Ex-1001, 4:59-63.

Takenoiri discloses the same. Specifically, Takenoiri’s multilayer structure (including the tri-layer structure shown below) includes a first magnetic recording layer 5 (**dark green**), whose “axis of easy magnetization...align[s] in the direction perpendicular to the film surface for the use in a **perpendicular magnetic recording medium**.” Ex-1005, 6:66-7:5.



Id., Fig. 1 (tri-layer structure in modified Fig. 1). Example materials for Takenoiri’s first magnetic recording layer 5 include “an alloy material such as CoPt, CoCrPt, CoCrPtB, or CoCrPtTa...or a granular material of...CoCrPtO, CoCrPt—SiO₂, CoCrPt—Al₂O₃...or CoCrPt—Si₃N₄,” i.e., some of the exact same materials as disclosed in the ’734 Patent. *Id.*, 7:5-9. Ex-1003, ¶130.

Second, Takenoiri’s first magnetic recording layer 5 is “a hard magnetic storage layer...having a first coercive field $H_s > 0.5$ T.” Ex-1003, ¶131.

The ’734 Patent does not clearly define what constitutes a “hard” magnetic storage layer. Nonetheless, Takenoiri discloses “a hard magnetic storage layer” having a “first coercive field $H_s > 0.5$ T” (addressed below) that is higher than the

nucleation host (*see* Section VIII.B.9, (limitation 1[H])).⁹ Ex-1003, ¶¶132-133.

Takenoiri's first magnetic storage layer 5 having a coercive field greater than 0.5 T is **separately shown** in three embodiments. Ex-1003, ¶¶134-135.

Takenoiri's Example 1 and Comparative Example 1. The coercivity (H_c), i.e., coercive field, of the first magnetic recording layer 5 in Takenoiri's Example 1 is determined by looking at both Example 1 and Comparative Example 1. Because the structure in Takenoiri's Example 1 includes, among other things, a first magnetic recording layer 5, a coupling layer 6, and a second magnetic recording layer 7 (Ex-1005, 10:56-66), while Comparative Example 1 is the same as Example 1 except that it includes only the first magnetic recording layer 5, with no coupling layer 6 or second magnetic recording layer 7, the coercivity (H_c) of the first magnetic recording layer in this example is 6770 Oe (red).¹⁰ *Id.*, 11:17-21.

⁹ Because Takenoiri's first magnetic recording layer 5, as its name suggests, is used for magnetic recording, a POSITA would have understood that it also meets the Western Digital court's claim construction for the term "hard magnetic storage layer": "a magnetic layer that stores information in magnetically oriented bits." Ex-1019 (Western Digital CC Order), p.20. Ex-1003, ¶133.

¹⁰ Coercivity and coercive field are synonymous. While the '734 Patent claim 1 uses H_s and H_n to refer to coercive field, it is most often denoted by H_c . Ex-1003, ¶135.

TABLE 1		
Item	Example 1	Comp Ex 1
H _c (Oe)	4,710	6,770
TAA [336 kfcf] (mVp-p)	1.82	1.29
normalized noises [336 kfcf] (μVrms/mVp-p)	19.5	22.4
S/N [336 kfcf] (dB)	25.5	23.5
D ₅₀ (kfcf)	371	344
decay rate of output signals [28 kfcf] (%/decade)	0.67	0.25

Id., Table 1. Ex-1003, ¶136.

The unit conversion for coercive field is 1 Tesla (T) = 10k Oersted (Oe). Ex. 1021, p.9 (“1 Tesla (10,000 Oe)”). Therefore, the coercive field of the first magnetic recording layer 5 in this example is 0.677 T, which is greater than 0.5 T. Ex-1003, ¶137.

Similarly for Example 2 and Comparative Example 3, the H_c of the first magnetic recording layer 5 is 6990 Oe (red), which is 0.699 T and greater than 0.5 T.

TABLE 3		
Item	Example 2	Comp Ex 3
H _c (Oe)	5,214	6,990
O/W (dB)	46.5	16.0
normalized noises [336 kfcf] (μVrms/mVp-p)	22.8	23.1
S/N [336 kfcf] (dB)	24.3	22.9
D ₅₀ (kfcf)	396	349
decay rate of output signals [28 kfcf] (%/decade)	0.01	4.66

Id., Table 3. Ex-1003, ¶138.

Similarly for Examples 3-6 and Comparative Example 4, the H_c of the first magnetic recording layer 5 in Examples 3-6 is 6449 Oe (red), which is 0.6449 T and greater than 0.5 T.

TABLE 4						
		Example 3	Example 4	Example 5	Example 6	Comp Ex 4
first magnetic recording layer	composition		(Co ₇₂ Cr ₁₀ Pt ₁₈) ₉₀ (SiO ₂) ₁₀			
	thickness (nm)	9.5	9.5	9.5	9.5	9.5
coupling layer	composition	Ru	Ru	Ru	Ru	none
	thickness (nm)	1.6	0.25	0.25	0.25	none
second magnetic recording layer	composition	Co ₆₁ Cr ₂₂ Pt ₁₃ B ₄	Co ₆₁ Cr ₂₂ Pt ₁₃ B ₄	Co ₆₉ Cr ₂₂ Pt ₃ B ₄	Co ₇₆ Cr ₂₀ B ₄	none
	thickness (nm)	6.5	6.5	6.5	6.5	none
	H _c (Oe)	5,016	5,119	4,490	4,176	6,449
	O/W (dB)	38.1	37.4	45.6	46.2	24.7

Id., Table 4. Ex-1003, ¶139.

Therefore, Takenoiri discloses “a **hard magnetic storage layer** [e.g., Takenoiri’s first magnetic recording layer 5], **formed from a perpendicular anisotropy material** [e.g., material used for Takenoiri’s first magnetic recording layer 5 in a perpendicular magnetic recording medium, whose axis of easy magnetization is perpendicular to the film surface], **having a first coercive field $H_s > 0.5$ T** [e.g., in each of Takenoiri’s Examples 1-6, the coercive field of the first magnetic recording layer 5 is 0.677 T, 0.699 T, or 0.6449 T, respectively, which are all greater than 0.5 T].” Ex-1003, ¶¶140-141.

To the extent that the recited “first coercive field” refers to the coercive field

of the hard magnetic storage layer with the nucleation host attached, Takenoiri also discloses or at least renders obvious this limitation. For example, as shown below, Takenoiri discloses in Examples 2-4 that the coercive field of the entire structure is 0.5214 T, 0.5016 T, and 0.5119 T, respectively. Because the completion of magnetic reversal of an entire composite magnetic recording medium structure depends on the completion of magnetic reversal of the hardest layer within the stack (e.g., Takenoiri's first magnetic recording layer 5, *see* Section VIII.B.12, *infra*, for limitation 1[K]), a POSITA would have understood that for Takenoiri's multilayer structure, the coercive field of the first magnetic recording layer 5 in the stack of layers in Examples 2-4 is at least 0.5214 T, 0.5016 T, and 0.5119 T, respectively, which are all greater than 0.5 T. Ex-1003, ¶¶142-143.

TABLE 3

Item	Example 2	Comp Ex 3
Hc (Oe)	5,214	6,990
O/W (dB)	46.5	16.0
normalized noises [336 kfc] ($\mu V_{rms}/mV_{p-p}$)	22.8	23.1
S/N [336 kfc] (dB)	24.3	22.9
D ₅₀ (kfc)	396	349
decay rate of output signals [28 kfc] (%/decade)	0.01	4.66

Ex-1005, Table 3.

TABLE 4

		Example 3	Example 4	Example 5	Example 6	Comp Ex 4
first magnetic recording layer	composition		(Co ₇₂ Cr ₁₀ Pt ₁₈) ₉₀ (SiO ₂) ₁₀			
	thickness (nm)	9.5	9.5	9.5	9.5	9.5
coupling layer	composition	Ru	Ru	Ru	Ru	none
	thickness (nm)	1.6	0.25	0.25	0.25	none
second magnetic recording layer	composition	Co ₆₁ Cr ₂₂ Pt ₁₃ B ₄	Co ₆₁ Cr ₂₂ Pt ₁₃ B ₄	Co ₆₉ Cr ₂₂ Pt ₅ B ₄	Co ₇₆ Cr ₂₀ B ₄	none
	thickness (nm)	6.5	6.5	6.5	6.5	none
	Hc (Oe)	5,016	5,119	4,490	4,176	6,449
	O/W (dB)	38.1	37.4	45.6	46.2	24.7

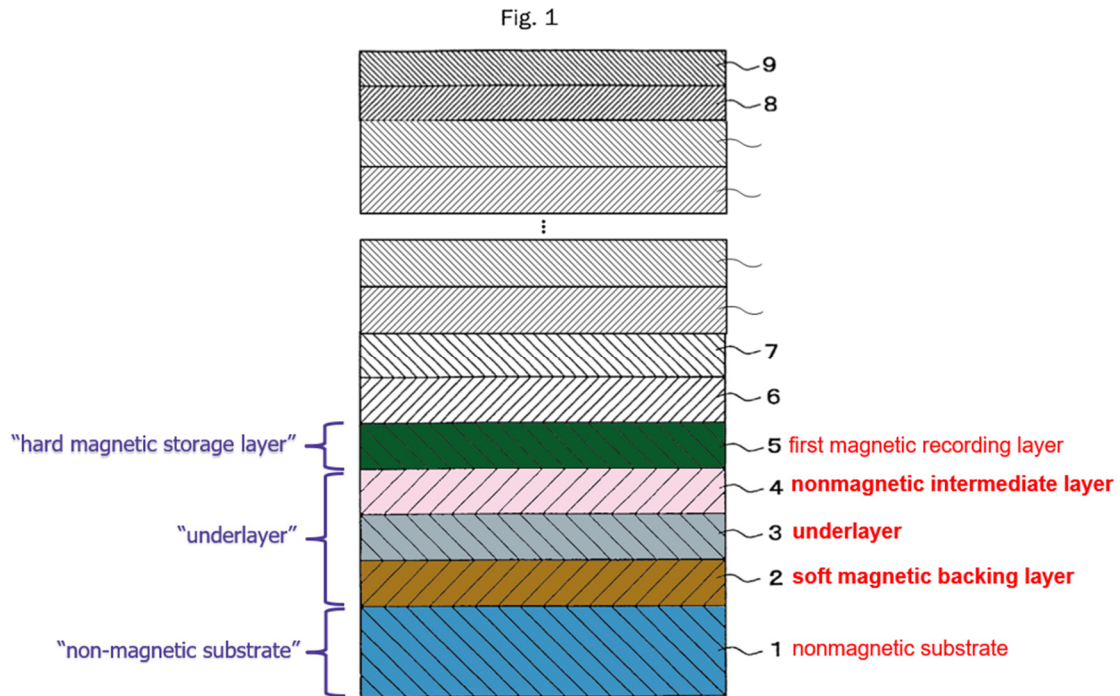
Id., Table 4.

As detailed in Section VIII.B.9 (limitation 1[H]), *infra*, Takenoiri teaches introducing softer layer(s) to make switching easier, e.g., by initiating reversal through the layer stack. *See, e.g.*, Ex-1005, 10:7-18. This allows Takenoiri to maintain thermal stability by keeping the first magnetic recording layer with high coercivity/anisotropy. *Id.*; Ex-1003, ¶144. Takenoiri's tri-layer structure introduces a third magnetic recording layer softer than the second magnetic recording layer 7, which makes switching even easier than the bi-layer structure. Therefore, in view of the additional third magnetic recording layer (e.g., introduced into Takenoiri's bi-layer structure in Examples 2-4), a POSITA looking to further improve the thermal stability of Takenoiri's tri-layer structure while maintaining its writeability would have been motivated to further increase the coercivity/anisotropy of the first magnetic recording layer 5, such that the overall coercivity of the tri-layer structure

(which is also the coercivity of the first magnetic recording layer with Takenoiri's "nucleation host" (Section VIII.B.9 (limitation 1[H])) attached) maintains at the same level as the bi-layer structure, i.e., 0.5214 T, 0.5016 T, and 0.5119 T, respectively, which are all greater than 0.5 T as required by this limitation, and would have had reasonable expectation of success as Takenoiri expressly teaches tuning H_c via layer thickness and composition. Ex-1005, 9:23-29; *see also id.*, 9:63-67. Ex-1003, ¶¶144-145.

8. 1[G]: "[the hard magnetic storage layer] formed such that the underlayer is between the non-magnetic substrate and the hard magnetic storage layer;"

As explained for limitation 1[D] above, one or more of Takenoiri's soft magnetic backing layer 2, underlayer 3, and nonmagnetic intermediate layer 4 correspond to the claimed "underlayer." *See* Section VIII.B.5, *supra*. As shown in Takenoiri's tri-layer structure below, the soft magnetic backing layer 2, underlayer 3, and nonmagnetic intermediate layer 4 are all located between the nonmagnetic substrate 1 (blue, the claimed "non-magnetic substrate") and the first magnetic recording layer 5 (dark green, the claimed "hard magnetic storage layer").

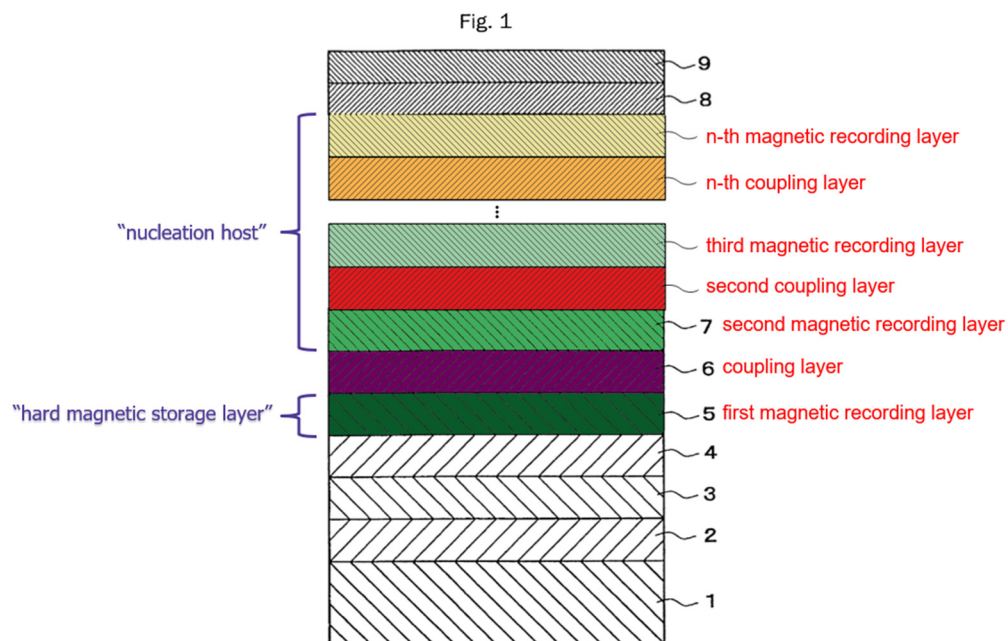


Ex-1005, Fig. 1 (tri-layer structure in modified Fig. 1); *see also id.*, 6:1-5 (“**On nonmagnetic substrate 1 sequentially formed** are soft magnetic backing layer 2, underlayer 3, nonmagnetic intermediate layer 4, **first magnetic recording layer 5...**”). Ex-1003, ¶147.

Therefore, Takenoiri discloses “[the hard magnetic storage layer] **formed such that the underlayer** [e.g., one or more of Takenoiri’s soft magnetic backing layer 2, underlayer 3, and/or nonmagnetic intermediate layer 4] **is between the non-magnetic substrate** [e.g., Takenoiri’s nonmagnetic substrate 1] **and the hard magnetic storage layer** [e.g., Takenoiri’s first magnetic recording layer 5].” Ex-1003, ¶148.

9. 1[H]: “a nucleation host, having a second coercive field H_n without the hard magnetic storage layer, lower than the first coercive field, $H_n < H_s$, wherein”

As shown below, in addition to the first magnetic recording layer, Takenoiri’s tri-layer structure includes multiple additional magnetic recording layers (second, third, fourth,...n-th magnetic recording layers). And as shown below, these additional magnetic recording layers have a coercivity lower than that of the first magnetic recording layer (i.e., the claimed hard magnetic storage layer), allowing them to facilitate switching of the first magnetic recording layer & they to which they are coupled. These layers therefore constitute the recited “nucleation host,” consistent with Western Digital court’s construction of this term. See Section VIII.B.12 (limitation 1[K]), *infra*.



Ex-1005, Fig. 1 (tri-layer structure in modified Fig. 1). Ex-1003, ¶150.

Takenoiri's "nucleation host" (at least second and third magnetic recording layers) has a coercive field lower than that of the first magnetic recording layer 5 for at least the following reasons. Ex-1003, ¶151.

Takenoiri's Examples 1–6 demonstrate that adding a second magnetic recording layer with lower coercivity (H_{c2}) to the first layer (H_{c1}) reduces the overall coercivity (H_{c1+2}). Ex-1003, ¶152. For example, in Example 1, adding the second magnetic recording layer and a coupling layer drops H_c from 6770 Oe (Comparative Example 1) to 4710 Oe—a 30% reduction. Ex-1005, 11:16-20, Table 1; Ex-1003, ¶¶153-154. The same effect appears in Examples 2–6, with H_c consistently reduced compared to their respective controls. Ex-1005, 12:46-16:49, Tables 3-4; Ex-1003, ¶¶155-159. This demonstrates that H_{c2} is lower than both H_{c1} and H_{c1+2} . Ex-1003, ¶160.

Given that $H_{c2} < H_{c1}$, a POSITA would have been motivated to continue this trend in a tri-layer (or more) structure by setting $H_{c3} < H_{c2}$ to accomplish Takenoiri's stated goal of reducing switching fields while maintaining thermal stability. Ex-1003, ¶¶161-162. While Takenoiri's Figures 1 and 4, as well as Examples 1-6, concern bi-layer structures, Takenoiri explicitly states that the same individual magnetization reversal principle applies to a structure having three or more magnetic recording layers. *See* Ex-1005, 10:14-18 ("**By individually reversing the magnetization of each magnetic recording layer as in this measure**, the structure

having three or more magnetic recording layers still produces the effect of **improving thermal stability** and the effect of **reducing switching field** at the same time.”). Thus, a POSITA would have been motivated to set H_{c3} lower than H_{c2} , to continue to **reduce the switching field** for the tri-layer structure as taught by Takenoiri.¹¹ Ex-1003, ¶¶163-164. Doing so would further reduce the overall coercivity (H_{c1+2+3}), enhancing writability as Takenoiri intended. Alternatively, the overall coercivity (H_{c1+2+3}) can be maintained while increasing the coercivity of the first layer (H_{c1}) to improve the thermal stability of the recording layer. Therefore, it is axiomatic that when $H_{c3} < H_{c2} < H_{c1}$, the coercivity of the combined second and third magnetic recording layers (hereinafter “ **H_{c2+3}** ”) is lower than H_{c1} . Ex-1003, ¶165.

At a minimum, a POSITA would have been motivated to set H_{c3} lower than H_{c1+2} to maintain or reduce the overall coercivity (H_{c1+2+3}) as compared to a bi-layer structure, because as Takenoiri teaches with its bi-layer structures, introducing a “softer” layer with coercivity lower (H_{c2}) than the existing structure reduces the overall coercivity (H_{c1+2}). Ex-1003, ¶¶166-167. Moreover, as there are only three

¹¹ Takenoiri appears to use coercive field H_c and switching field synonymously. *See* Ex-1005, Abstract (“achieves improved recordability... by **reducing the switching field**”), 12:1-3 (“This condition contributes to the **reduction of H_c** , which in turn is believed to improve the recordability.”). Ex-1003, ¶168.

configurations for H_{c3} relative to H_{c1+2} (greater than, equal to, or less than), a POSITA would have been motivated to try (i.e., it would have been **obvious to try**) the third option, as it aligns with Takenoiri's goal of reducing switching fields. Ex-1003, ¶¶169-170. When $H_{c3} < H_{c1+2} < H_{c1}$, since $H_{c2} < H_{c1}$ (as explained above), it follows that $H_{c2+3} < H_{c1}$. *Id.*

A POSITA would have had reasonable expectation of success in setting H_{c3} lower than H_{c1+2} and/or H_{c2} , both of which results in H_{c2+3} and H_{c1+2+3} lower than H_{c1} , as Takenoiri teaches how to tune H_c via layer thickness, composition, and grain isolation. Ex-1003, ¶¶171-172.¹²

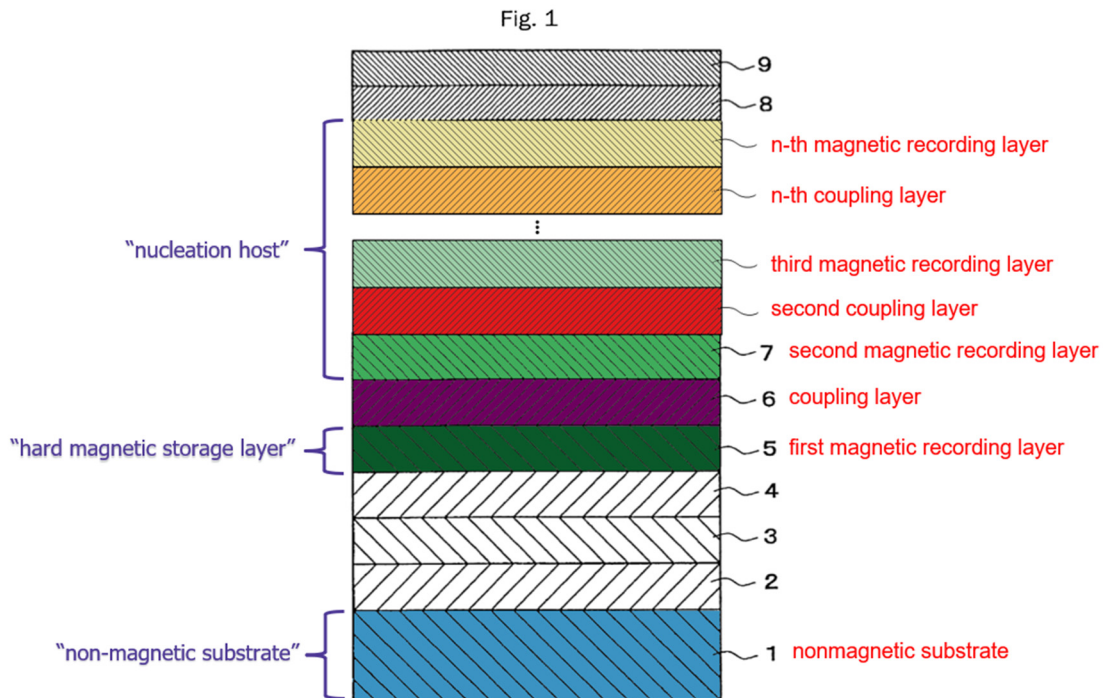
Therefore, Takenoiri renders obvious “a nucleation host [e.g., at least Takenoiri's second magnetic recording layer 7, the third magnetic recording layer,

¹² Moreover, this configuration of $H_{c3} < H_{c2} < H_{c1}$ is not novel. A POSITA would have been motivated by Osato and Li to implement a coercivity gradient ($H_{c3} < H_{c2} < H_{c1}$) in Takenoiri's tri-layer structure, with a reasonable expectation of success. Osato shows such a gradient at room temperature; Li shows a reverse gradient in PMR. These references confirm that coercivity grading was known and technically feasible, making its application to Takenoiri's structure both logical and predictable. See Ex-1016, 2:24-39, Figs 1A-1B; see also Ex-1022, 5:20-25, 5:9-16. Ex-1003, ¶¶173-174.

and the coupling layer in between, as part of Takenoiri's tri-layer structure], **having a second coercive field H_n without the hard magnetic storage layer** [e.g., the coercive field H_c of Takenoiri's "nucleation host," i.e., H_{c2+3}], **lower than the first coercive field, $H_n < H_s$** [e.g., both H_{c2+3} and H_{c1+2+3} being lower than H_c of Takenoiri's first magnetic recording layer 5, i.e., H_{c1}]." Ex-1003, ¶175.

10. 1[I]: "said nucleation host is formed on the hard magnetic storage layer such that the hard magnetic storage layer is between the nucleation host and the non-magnetic substrate,"

Takenoiri's tri-layer structure discloses the claimed "nucleation host." Section VIII.B.9 (limitation 1[H]), *supra*. As shown below, Takenoiri's "hard magnetic storage layer" is between its "nucleation host" and the non-magnetic substrate.

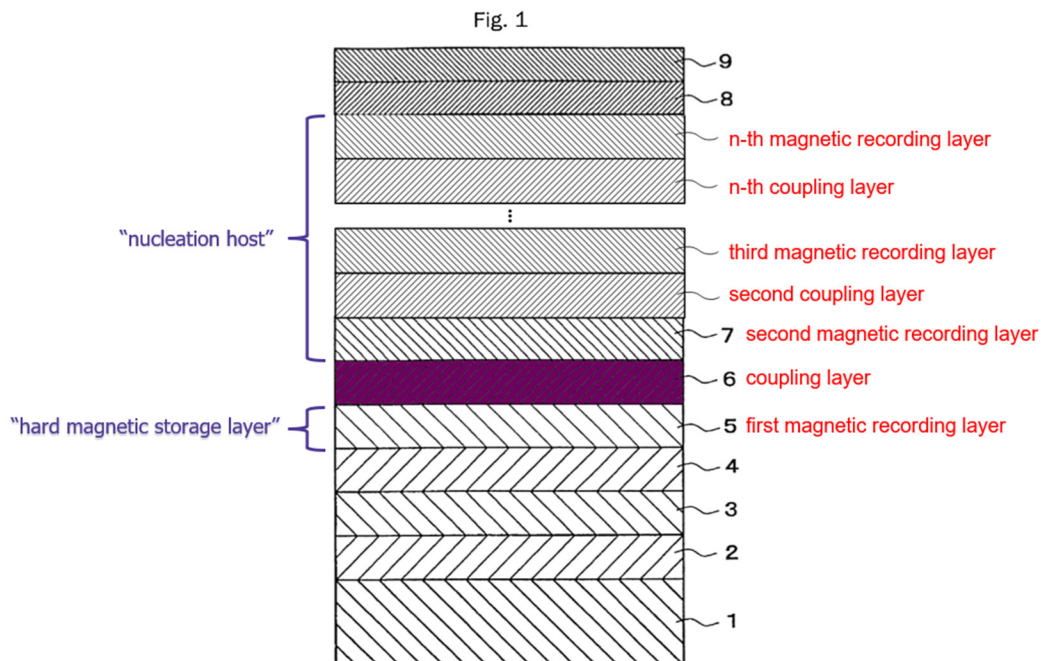


Ex-1005, Fig. 1 (tri-layer structure in modified Fig. 1). Ex-1003, ¶177.

Therefore, Takenoiri discloses that “**said nucleation host** [e.g., at least Takenoiri’s second magnetic recording layer 7, the third magnetic recording layer, and the coupling layer in between, as part of Takenoiri’s tri-layer structure] **is formed on the hard magnetic storage layer** [e.g., Takenoiri’s first magnetic recording layer 5] **such that the hard magnetic storage layer is between the nucleation host and the non-magnetic substrate** [e.g., Takenoiri’s nonmagnetic substrate 1].” Ex-1003, ¶178.

11. 1[J]: “[said nucleation host] is exchange coupled to the hard magnetic storage layer, and”

Takenoiri discloses a tri-layer structure. Section VIII.A, *supra*.



Ex-1005, Fig. 1 (tri-layer structure in modified Fig. 1). Ex-1003, ¶180.

As shown, “[t]he first magnetic recording layer [5] and the second magnetic recording layer [7] are ferromagnetically coupled through the coupling layer [6 (purple)].” *Id.*, 3:5-7; *see also id.*, 3:21-23 (“Advantageously, an **exchange coupling energy** per unit area between the first magnetic recording layer and the second magnetic recording layer is at least 5×10^{-3} erg/cm².”). Ex-1003, ¶181.

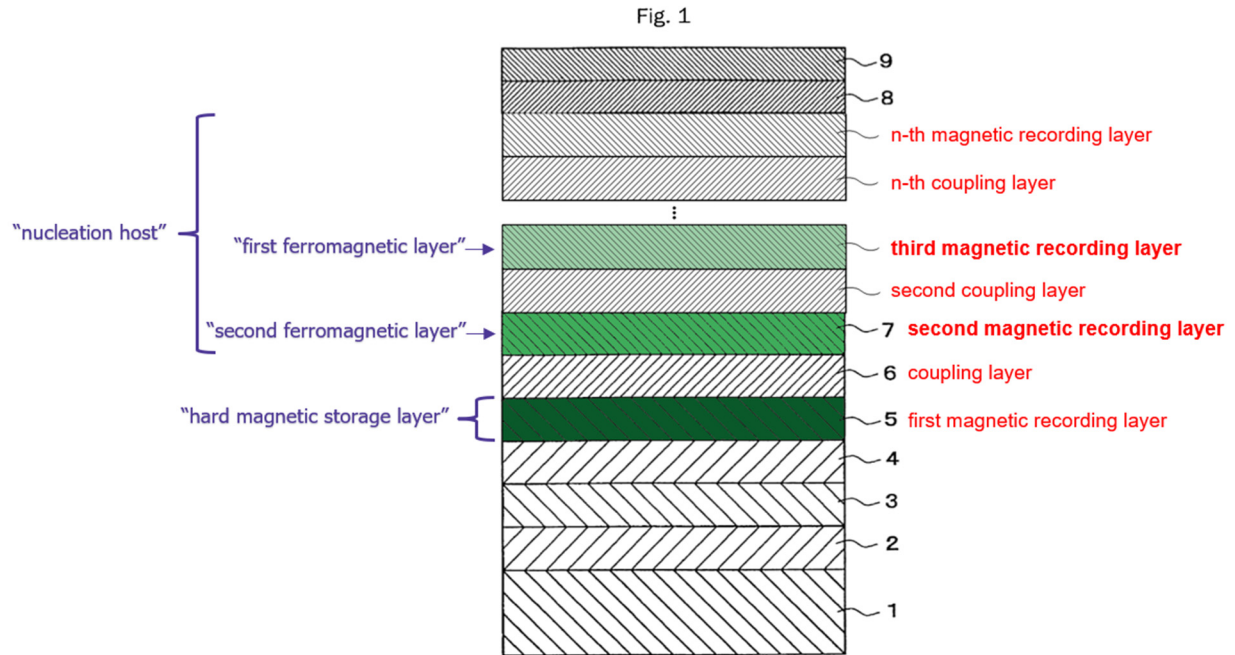
Therefore, Takenoiri discloses “[said nucleation host] **is exchange coupled to the hard magnetic storage layer** [e.g., Takenoiri’s “nucleation host” is exchange coupled to the first magnetic recording layer 5 because the second magnetic recording layer 7 as part of Takenoiri’s “nucleation host” is exchange coupled to the first magnetic recording layer 5].” Ex-1003, ¶182.

12. 1[K]: “**comprises at least a first ferromagnetic layer with an anisotropy constant K1 and a second ferromagnetic layer between the first ferromagnetic layer and the hard magnetic storage layer with an increased anisotropy constant K2 greater than K1; wherein**”

Takenoiri’s tri-layer magnetic recording architecture satisfies the structural and material requirements of the claimed “nucleation host,” including the presence of two ferromagnetic layers with the claimed anisotropy gradient. Takenoiri expressly extends the described bi-layer switching and anisotropy principles to three or more magnetic recording layers. Ex-1005, 10:7-18. As shown below, Takenoiri’s second and third magnetic recording layers form the “nucleation host” and meet the claimed configuration: a first ferromagnetic layer (Takenoiri’s third magnetic

recording layer) and a second ferromagnetic layer (Takenoiri's second magnetic recording layer 7) positioned between the first ferromagnetic layer (Takenoiri's third magnetic recording layer) and the hard magnetic storage layer (Takenoiri's first magnetic recording layer 5). Takenoiri further teaches and suggests that these layers are made of ferromagnetic alloys and that their anisotropy constants (K_u values) are tuned to enable top-down sequential switching. Ex-1005, 10:7-18. A POSITA would have recognized from Takenoiri's teachings, and known design principles in the art, that configuring the second magnetic recording layer with anisotropy higher than that of the third magnetic recording layer, i.e., $K_{u2} > K_{u3}$, not only preserves this switching behavior but also improves writability and thermal stability, as discussed in detail below. Ex-1003, ¶184.

Ferromagnetic layers. Takenoiri's "nucleation host" includes "a first ferromagnetic layer...and a second ferromagnetic layer between the first ferromagnetic layer and the hard magnetic storage layer," as required by this limitation. As shown below, Takenoiri's "nucleation host," as part of its tri-layer (or more) structure includes at least two magnetic recording layers: the second magnetic recording layer 7 and the third magnetic recording layer, with the second magnetic recording layer 7 (green) located between the third magnetic recording layer (light green) and the first magnetic recording layer 5 (dark green).



Ex-1005, Fig. 1 (tri-layer structure in modified Fig. 1); Ex-1003, ¶185.

Takenoiri discloses that the second magnetic recording layer 7 can employ “the same material and structure as in first magnetic recording layer 5” (Ex-1005, 9:13-15), which “is preferably composed of a **ferromagnetic alloy** containing at least cobalt and platinum.” *Id.*, 6:66-67. Therefore, Takenoiri’s second magnetic recording layer 7 is a ferromagnetic layer. Ex-1003, ¶186.

A POSITA would have found it obvious to use the same or a similar material as in the first and second magnetic recording layers for the third magnetic recording layer for the following reasons. First, the third layer participates in the same sequential magnetization reversal process as the first and second layers, as described in Ex-1005 at 10:14–18. Second, the third layer is exchange-coupled to the second layer beneath it, just as the second layer is exchange-coupled to the first. Third, all

three layers must satisfy the same functional requirement involving the $K_u \cdot T$ relationship. *Id.*, 10:10-14 (“The order of magnitude of the product $K_u T$ of a uniaxial anisotropy constant and a thickness of each magnetic recording layer are determined in accordance with the order of magnitude of the anisotropy magnetic field H_k of the magnetic recording layer.”); *see also* Takenoiri’s Examples 1-6 (showing that similar materials are used for the first and second magnetic recording layers though different compositions for achieving different anisotropy field H_k). Takenoiri uses similar material with different compositions to meet this requirement in the first and second magnetic recording layers, and a POSITA would have applied the same approach to the third magnetic recording layer. Moreover, because Takenoiri’s magnetic layers are exchange coupled (*id.*, 10:7-10), a POSITA would have understood that the main ferromagnetic element(s) in the magnetic alloy materials used for these magnetic layers need to be of similar though different compositions to ensure appropriate coupling. Thus, the third magnetic recording layer is also composed of “ferromagnetic alloy” and therefore is also a ferromagnetic layer. Ex-1003, ¶¶187-188.

Therefore, Takenoiri discloses, or at least suggests, “**a first ferromagnetic layer** [e.g., Takenoiri’s third magnetic recording layer as part of its tri-layer structure]... **and a second ferromagnetic layer** [e.g., Takenoiri’s second magnetic recording layer 7 as part of its tri-layer structure] **between the first ferromagnetic**

layer and the hard magnetic storage layer [e.g., Takenoiri's first magnetic recording layer 5].” Ex-1003, ¶189.

Anisotropy Constants. A POSITA would have found it obvious to configure Takenoiri's “nucleation host” such that the anisotropy constant of Takenoiri's second magnetic recording layer 7 (hereinafter Ku_2 , the claimed K2) is greater than that of the third magnetic recording layer (hereinafter Ku_3 , the claimed K1), for at least the following reasons. Ex-1003, ¶190.

First, Takenoiri discloses that for a bi-layer structure, if $Hk_1 > Hk_2$, then $Ku_1 T_1 > Ku_2 T_2$, where “ Hk_1/Hk_2 , Ku_1/Ku_2 , and T_1/T_2 are anisotropy magnetic field, uniaxial anisotropy constant, and thickness of the first/second magnetic recording layer, respectively.” Ex-1005, claim 1. As shown in the table below summarizing Takenoiri's Examples 1-6, in each of Examples 1-6, $Ku_1 > Ku_2$. Ex-1003, ¶191.

		Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6
second magnetic recording layer 7	Composition	(Co ₇₂ Cr ₁₆ Pt ₁₂) ₉₀ -(SiO ₂) ₁₀	Co ₇₀ Cr ₂₀ Pt ₁₀	Co ₆₁ Cr ₂₂ Pt ₁₃ B ₄		Co ₆₉ Cr ₂₂ Pt ₅ B ₄	Co ₇₆ Cr ₂₀ B ₄
	thickness T ₂	6	6	6.5	6.5	6.5	6.5
	Ku_2	2.5	2	1.85	1.85	1.51	1.31
	Hk ₂	13.2	11.1	13.2	13.2	10.1	8.17
coupling layer 6	Composition	Ru	Cobalt	Ru			
	Thickness	0.2	0.3	1.6	0.25	0.25	0.25
first magnetic recording layer 5	Composition	(Co ₇₄ Cr ₁₂ Pt ₁₄) ₉₀ -(SiO ₂) ₁₀	(Co ₇₂ Cr ₁₀ Pt ₁₈) ₉₀ -(SiO ₂) ₁₀				
	thickness T ₁	10	10	9.5	9.5	9.5	9.5
	Ku_1	4.2	5	5.05	5.05	5.05	5.05
	Hk ₁	18.7	20	20	20	20	20

As disclosed in Takenoiri, the unit for thickness T₁ and T₂ is nm and the unit for Hk₁ and Hk₂ is kOe. *See, e.g.*, Ex-1005, 10:56-66, 11:31-36. While the unit for Ku_1 and Ku_2 in Takenoiri is 10⁻⁶ erg/cm³ (*id.*, 11:31-33), a POSITA would have

understood that this is a typographical error, because it was well known that the K_u values of CoCrPt-based materials, as used for Takenoiri's Examples 1-6, are in the 10^6 erg/cm³ range. *See* Ex-1028, Figures 3, 4, 7; Ex-1036, ¶90; Ex-1003, ¶ 192. Regardless, this typographical error does not change the analysis in this Petition because Takenoiri discloses the correct relative values of K_u and K_{uT} . Ex-1003, ¶ 192.

Thus, if a third magnetic layer is added (per Takenoiri's tri-layer (or more) structure described above), it would have been obvious to a POSITA that $K_{u2} > K_{u3}$, following the same K_u trend described in each of Examples 1-6 to preserve the switching behavior, e.g., sequential magnetization switching from top to bottom. *See, e.g.*, Ex-1005, 9:25-29 ("This is because the switching field can be effectively decreased without impairing thermal stability by reversing the magnetization first in the second magnetic recording layer in the case $H_{k1} > H_{k2}$, for example."). In other words, a POSITA would have understood that extending the K_u scheme between two magnetic layers to a third magnetic layer naturally suggests the same directional K_u gradient, so that sequential magnetization switching from top to bottom (as illustrated in Examples 1-6) can be more easily achieved in Takenoiri's tri-layer structure (as explained below), thereby "still produc[ing] the effect of improving thermal stability and the effect of reducing switching field at the same time." *Id.*, 10:14-18; Ex-1003, ¶193.

Second, of the only three configurations that could exist: (i) $Ku_3 > Ku_2$; (ii) $Ku_3 = Ku_2$; or (iii) $Ku_3 < Ku_2$, a POSITA would have been motivated to try (i.e., **obvious to try**) all three configurations, but in particular a POSITA would have been motivated to try configuration (iii) because, as explained above, it aligns with Takenoiri's established gradient of decreasing anisotropy and supports sequential switching from top to bottom, which is also a known strategy for reducing coercivity while maintaining thermal stability. Ex-1003, ¶¶194-195.

Third, a POSITA would have been motivated to configure Ku_3 such that $Ku_2 > Ku_3$ because a lower Ku_3 makes Takenoiri's top-to-bottom sequential switching easier to achieve. In Takenoiri, for the second magnetic layer 7 to reverse before the first magnetic recording layer 5, $Hk_1 > Hk_2$ and $Ku_1 T_1 > Ku_2 T_2$ must be satisfied. Extending this to a tri-layer structure, a POSITA would have recognized that $Hk_2 > Hk_3$ and $Ku_2 T_2 > Ku_3 T_3$ must also hold. See Ex-1005, 10:10-14 ("The order of magnitude of the product KuT of a uniaxial anisotropy constant and a thickness of each magnetic recording layer are determined in accordance with the order of magnitude of the anisotropy magnetic field Hk of the magnetic recording layer."). Lowering Ku_3 helps meet both conditions. Lower Ku_3 contributes to lower $Ku_3 T_3$. Moreover, under Takenoiri's equation " $Hk = 2 Ku/Ms$," lower Ku_3 also reduces Hk_3 , which in turn contributes to lower H_c , making sequential switching more attainable. Ex-1003, ¶196.

Fourth, a POSITA would have been motivated to configure Ku_3 such that $Ku_2 > Ku_3$ because a lower Ku_3 also helps reduce the overall coercivity (H_c) of the structure. Although Takenoiri discloses specific relationships between Hk_1 , Hk_2 , Ku_1 , Ku_2 , T_1 , and T_2 , these relationships aim to “contribute to the reduction of the H_c .” Ex-1005, 14:30-34; *see also id.*, 10:14-18 (“By individually reversing the magnetization of each magnetic recording layer as in this measure, the structure having three or more magnetic recording layers still produces the effect of improving thermal stability and the **effect of reducing switching field** at the same time.”).¹³ As explained in Section VIII.B.9 (limitation 1[H]), a POSITA would have been motivated to configure $Hc_3 < Hc_2$ to further reduce the overall coercivity. It was also well known that lower Ku leads to lower H_c or switching field. The ’734 Patent itself acknowledges this: “[I]ncreasing the anisotropy K ...results in an unfavorable increase of the coercivity H_c .” Ex-1001, 1:22-26. Therefore, to achieve $Hc_3 < Hc_2$, a POSITA would have been motivated to configure $Ku_3 < Ku_2$. Ex-1003, ¶197.

Finally, a POSITA would have had **reasonable expectation of success** in configuring Ku_3 lower than Ku_2 , as Takenoiri has provided detailed examples of magnetic recording layers with varying Ku values, material compositions, and

¹³ As explained above, Takenoiri appears to use coercive field H_c and switching field synonymously. *See* fn. 11, *supra*.

deposition conditions in Examples 1-6. *See* Ex-1005, 10:56-66, 13:49-58, 15:21-30.

Using these teachings, a POSITA would have easily selected a lower-Ku layer—such as the second magnetic layer 7 in Example 5 (**red**)—to serve as the third magnetic recording layer in the Example 1. Ex-1003, ¶198.

		Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6
second magnetic recording layer 7	Composition	(Co ₇₂ Cr ₁₆ Pt ₁₂) ₉₀ -(SiO ₂) ₁₀	Co ₇₀ Cr ₂₀ Pt ₁₀	Co ₆₁ Cr ₂₂ Pt ₁₃ B ₄		Co ₆₉ Cr ₂₂ Pt ₅ B ₄	Co ₇₆ Cr ₂₀ B ₄
	thickness T ₂	6	6	6.5	6.5	6.5	6.5
	Ku ₂	2.5	2	1.85	1.85	1.51	1.31
	Hk ₂	13.2	11.1	13.2	13.2	10.1	8.17
coupling layer 6	Composition	Ru	Cobalt	Ru			
	Thickness	0.2	0.3	1.6	0.25	0.25	0.25
first magnetic recording layer 5	Composition	(Co ₇₄ Cr ₁₂ Pt ₁₄) ₉₀ -(SiO ₂) ₁₀	(Co ₇₂ Cr ₁₀ Pt ₁₈) ₉₀ -(SiO ₂) ₁₀				
	thickness T ₁	10	10	9.5	9.5	9.5	9.5
	Ku ₁	4.2	5	5.05	5.05	5.05	5.05
	Hk ₁	18.7	20	20	20	20	20

Moreover, Takenoiri teaches that lower Hk, and therefore lower Ku, can be achieved by reducing platinum content in the magnetic recording layer. Ex-1005, 10:1-6, 9:49-54. Ku adjustment was well known and widely implemented. A POSITA would also have readily lowered Ku by increasing Cr content and incorporating elements such as Ta, B, Nb, and N, as Takenoiri suggests. *See, e.g.*, Ex-1005, 9:57-67. Therefore, a POSITA would have had **reasonable expectation of success** in configuring Ku₃ lower than Ku₂ in Takenoiri's tri-layer structure. Ex-1003, ¶199.

Therefore, Takenoiri renders obvious that “[said nucleation host] **comprises at least a first ferromagnetic layer with an anisotropy constant K1** [e.g., Takenoiri's third magnetic recording layer as part of its tri-layer structure with

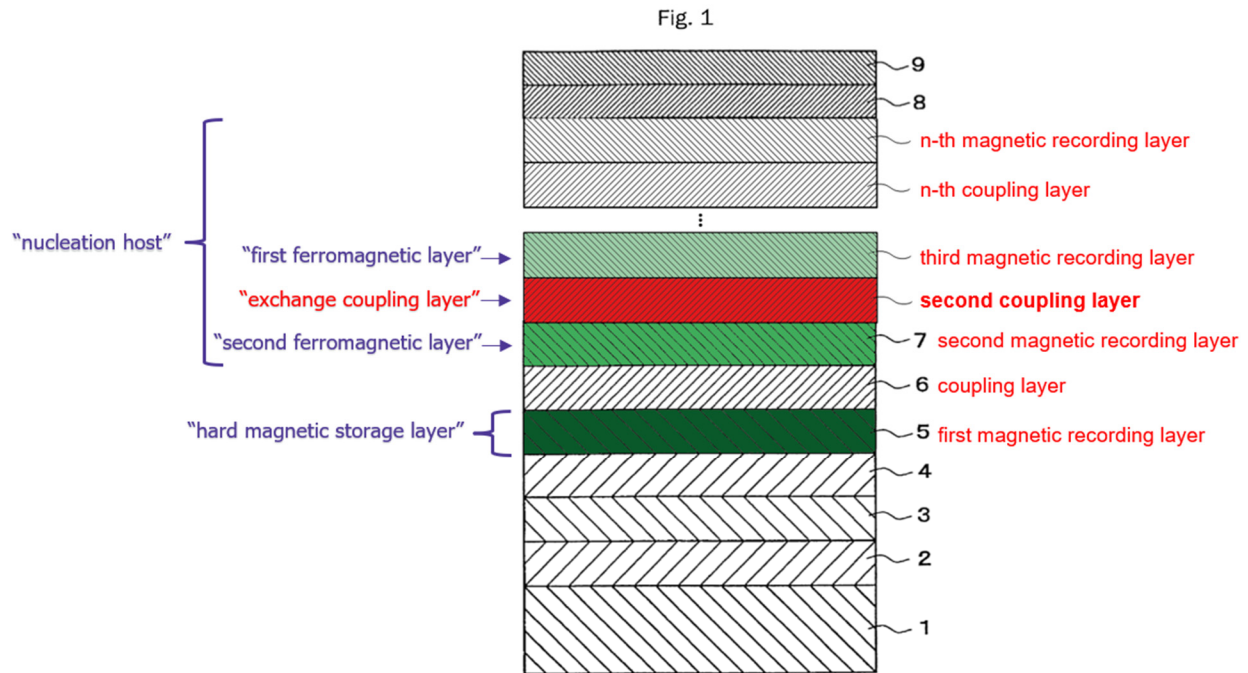
anisotropy constant K_{u3}] **and a second ferromagnetic layer between the first ferromagnetic layer and the hard magnetic storage layer** [e.g., Takenoiri's nonmagnetic substrate 1] **with an increased anisotropy constant K_2** [e.g., Takenoiri's second magnetic recording layer 7 as part of its tri-layer structure with anisotropy constant K_{u2}] **greater than K_1** [e.g., Takenoiri's K_{u2} being greater than K_{u3}]."¹⁴ Ex-1003, ¶200.

13. 1[L]: “the first and second ferromagnetic layers are exchange coupled with an exchange coupling layer.”

As explained in Section VIII.B.6 (limitation 1[E]), Takenoiri's tri-layer structure is “an exchange coupled magnetic multilayer structure.” In particular, as shown below, the second magnetic recording layer 7 and the third magnetic

¹⁴ Because the second and third magnetic recording layers in Takenoiri's tri-layer structure are ferromagnetic layers and are expected to switch magnetization earlier than the first magnetic recording layer, thereby facilitating the switching of the first magnetic storage layer 5, Takenoiri's second and third magnetic recording layers, as well as the coupling layer in between, corresponds to the claimed “nucleation host,” consistent with the court's construction in the Western Digital case: “a structure that includes ferromagnetic layers that assist in switching the hard magnetic storage layer, and optional coupling layers.” Ex-1019 (Western Digital CC Order), p.17-18. Ex-1003, ¶201.

recording layer are exchange coupled via an exchange coupling layer (red).



Ex-1005, Fig. 1 (tri-layer structure in modified Fig. 1). Ex-1003, ¶203.

Therefore, Takenoiri discloses “**wherein the first and second ferromagnetic layers** [e.g., Takenoiri’s second and third magnetic recording layers] **are exchange coupled with an exchange coupling layer** [e.g., the exchange coupling layer between the second and third magnetic recording layers].” Ex-1003, ¶204.

C. Claim 2

Claim 2 depends from claim 1 (obvious over Takenoiri; Section VIII.B). Claim 2 further recites “**wherein: the nucleation host and the hard magnetic storage layer are in direct contact,**” which is disclosed, or at least rendered

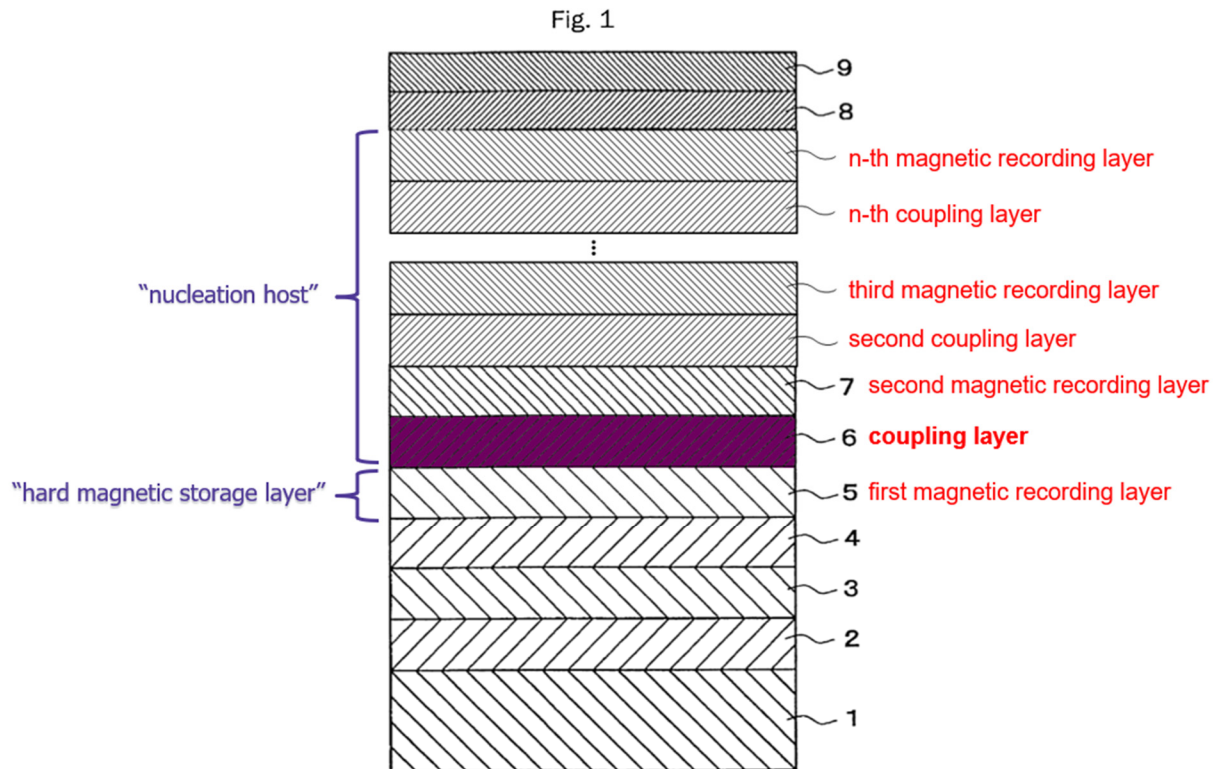
obvious, by Takenoiri. Ex-1003, ¶206.¹⁵

Claim 1 of the '734 Patent states that the nucleation host “comprises at least...,” which does not limit the nucleation host to only the first and second ferromagnetic layers but allows inclusion of additional layers. Moreover, claim 1 of the '734 Patent states that the nucleation host “is formed on the hard magnetic storage layer,” and “comprises at least a first ferromagnetic layer...and a second ferromagnetic layer...wherein the first and second ferromagnetic layers are exchange coupled with **an exchange coupling layer.**” Therefore, for the embodiment claimed in claim 2, Takenoiri’s coupling layer 6 can be considered part of the nucleation host formed on the hard magnetic storage layer. This is further confirmed by PO’s own proposed claim construction of “nucleation host” in the Western Digital case (which was also adopted by the court): “a structure that includes ferromagnetic layers that assist in switching the hard magnetic storage layer, and **optional coupling layers.**” Ex-1019 (Western Digital CC Order), p.17-18. Ex-1003, ¶207.

Therefore, for the embodiment claimed in claim 2, as shown below, Takenoiri’s “nucleation host” includes the coupling layer 6 (**purple**), so Takenoiri’s

¹⁵ Petitioners reserve right to challenge this claim under 35 U.S.C. § 112 in other proceedings.

“nucleation host” (including the coupling layer 6) and its first magnetic recording layer 5 (i.e., the claimed “hard magnetic storage layer”) are in direct contact.



Ex-1005, Fig. 1 (tri-layer structure in modified Fig. 1). As such, claim 2 is obvious over Takenoiri. Ex-1003, ¶208.

To the extent that the coupling layer 6 cannot be considered part of Takenoiri’s “nucleation host,” a POSITA would have found it obvious to omit that layer from Takenoiri’s tri-layer structure, placing the first and second magnetic recording layers in direct contact, resulting in direct contact between Takenoiri’s “nucleation host” and “hard magnetic storage layer.” Ex-1003, ¶209.

Although Takenoiri states that a coupling layer is necessary, it does so only “from the viewpoint of leading to an appropriate coupling energy between the

magnetic recording layers while retaining the ferromagnetic coupling” to achieve simultaneous improvement of thermal stability and reduction in the switching field. Ex-1005, 7:27-43. This language reflects a desire to improve the device’s performance, not a structural requirement, and confirms that Takenoiri describes a magnetic recording medium that could exist without the coupling layer 6. Ex-1003, ¶210.

Moreover, a POSITA seeking to implement or evaluate Takenoiri’s teachings would have been motivated to fabricate and compare versions of Takenoiri’s multilayer structure with and without the coupling layer 6 to assess its impact. Since direct contact leads to stronger exchange coupling between the two adjacent magnetic layers, a POSITA seeking stronger exchange coupling (and thereby a further reduction in the structure’s coercivity) would have been motivated to omit the coupling layer 6. Whether to test the efficacy of Takenoiri’s invention or in applications where thermal stability or switching field is less critical, omitting the coupling layer 6 would have simplified fabrication, and a POSITA would have had a reasonable expectation of success. Ex-1003, ¶211. In fact, Takenoiri teaches that there existed magnetic recording media having three magnetic recording layers in direct contact. Ex-1005, 2:3-14 (citing JP 2003-157516); Ex-1027 (“Hikosaka,” US equivalent of JP 2003-157516), ¶¶ 44, 102, Figs. 3 and 8; *see also* Ex-1022, 7:1-13 (“tailoring of the local exchange coupling strength between adjacent sub-layers to

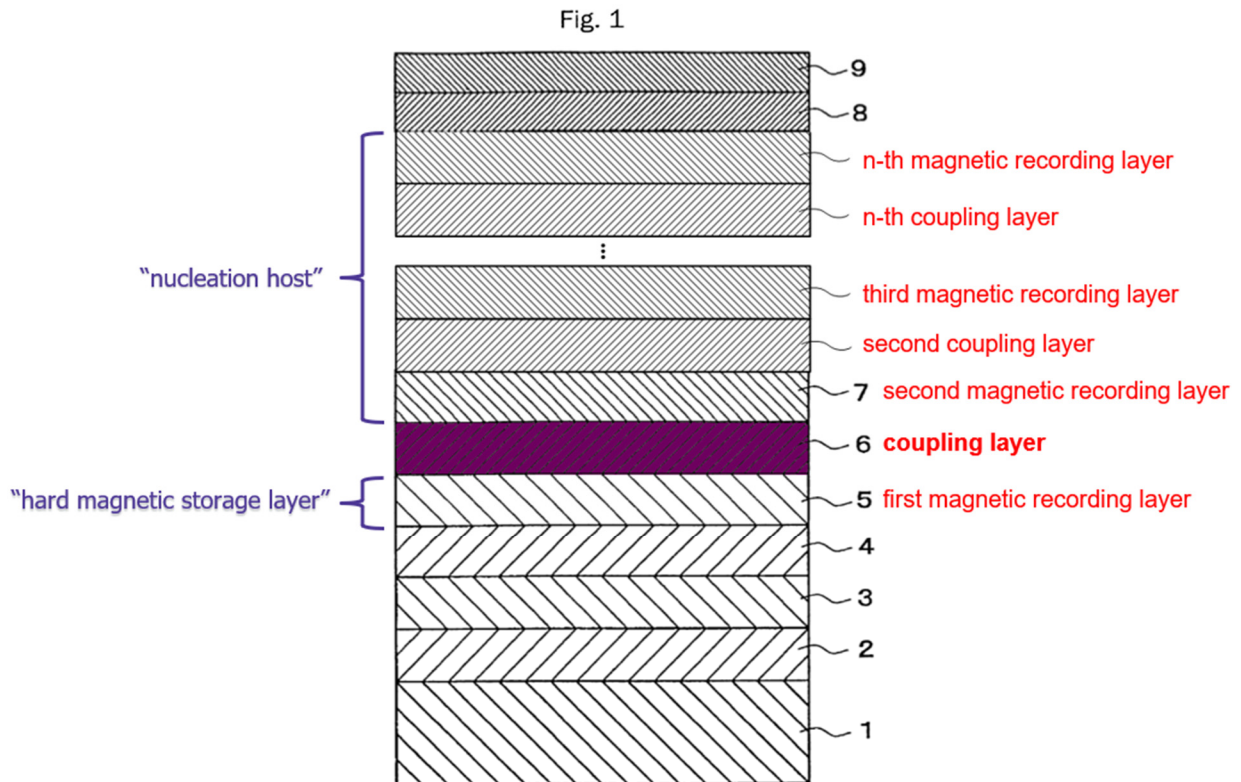
achieve a desired coupling strength is accomplished by...forming the adjacent sub-layers positioned in direct contact...”). Ex-1003, ¶211.

D. Claim 4

Claim 4 depends from claim 1 (obvious over Takenoiri; Section VIII.B). As stated above, claim 1’s nucleation host must include the two magnetic storage layers, and may (or may not) include other layers, such as coupling layers.

Here, the embodiment claimed in Claim 4 requires “**a coupling layer [] disposed between the nucleation host and the hard magnetic storage layer.**” This claimed embodiment is also disclosed by Takenoiri. Ex-1003, ¶214.

As shown in revised Figure 1 below, Takenoiri discloses a coupling layer 6 (purple) between second magnetic recording layer 7 and the first magnetic recording layer 5.



Ex-1005, Fig. 1 (tri-layer structure in modified Fig. 1). For the embodiment claimed in claim 2, as shown above, Takenoiri's "nucleation host" includes the second and third magnetic recording layers but does not include the coupling layer 6. Section VIII.C. For this claimed embodiment, Takenoiri's coupling layer 6 is the coupling layer added in claim 4. Ex-1003, ¶215.

Therefore, Takenoiri discloses that **"a coupling layer [e.g., Takenoiri's coupling layer 6] is disposed between the nucleation host [e.g., Takenoiri's "nucleation host" including the second magnetic recording layer 7 at the bottom] and the hard magnetic storage layer [e.g., the first magnetic recording layer 5]."** Ex-1003, ¶216.

E. Claim 7

Claim 7 depends from claim 1 (obvious over Takenoiri; Section VIII.B). Claim 7 further recites “wherein: **the perpendicular anisotropy material** [of the hard magnetic storage layer] is **one of** a **CoPt based alloy**, and a **CoPtCr alloy**.” This is disclosed by Takenoiri. Ex-1003, ¶217.¹⁶

As explained above, Takenoiri’s first magnetic recording layer 5 is formed from a perpendicular anisotropy material. Section VIII.B.7 (limitation 1[F]). Takenoiri further discloses that “[f]irst magnetic recording layer 5 can be composed of an alloy material such as **CoPt**, **CoCrPt**, **CoCrPtB**, or **CoCrPtTa**... or a granular material of **CoPt—SiO₂**, **CoCrPtO**, **CoCrPt—SiO₂**, **CoCrPt—Al₂O₃** [*sic*], **CoPt—AlN** [*sic*], or **CoCrPt—Si₃N₄**.” Ex-1005, 7:5-9. A POSITA would have understood that CoPt, CoPt—SiO₂, and CoPt—AlN, as well as CoCrPt, CoCrPtB, CoCrPtTa, CoCrPtO, CoCrPt—SiO₂, CoCrPt—Al₂O₃, and CoCrPt—Si₃N₄, are CoPt based

¹⁶ To the extent this limitation is not indefinite, the plain meaning of this limitation is disjunctive because it specifies the material for the hard magnetic storage layer, which a POSITA would have understood to include only one type of alloy. Ex-1003, ¶ 218. Even if this limitation is interpreted as conjunctive, Takenoiri still discloses it because as explained below, Takenoiri discloses a CoPtCr alloy, which meets both the “CoPt based alloy” requirement and the “CoPtCr alloy” requirement. *Id.*

alloys, and CoCrPt, CoCrPtB, and CoCrPtTa, as well as CoCrPtO, CoCrPt—SiO₂, CoCrPt—Al₂O₃, and CoCrPt—Si₃N₄ are CoPtCr alloys, as claimed in claim 7. Ex-1003, ¶¶219-220.¹⁷

Therefore, Takenoiri discloses that “the **perpendicular anisotropy material is one of a CoPt based alloy** [e.g., Takenoiri’s alloy materials such as CoPt, CoPt—SiO₂, CoPt—AlN, CoCrPt, CoCrPtB, CoCrPtTa, CoCrPtO, CoCrPt—SiO₂, CoCrPt—Al₂O₃, and CoCrPt—Si₃N₄], **and a CoPtCr alloy** [e.g., Takenoiri’s alloy materials such as CoCrPt, CoCrPtB, CoCrPtTa, CoCrPtO, CoCrPt—SiO₂, CoCrPt—Al₂O₃, and CoCrPt—Si₃N₄].” Ex-1003, ¶221.

F. Claim 8

Claim 8 depends from claim 1 (obvious over Takenoiri; Section VIII.B). Claim 8 further recites “wherein: the **perpendicular anisotropy material is one of** a CoPtCrB, CoPtCrTa, and **CoCr based granular media**,” which is disclosed by Takenoiri. Ex-1003, ¶222.¹⁸

As explained above, Takenoiri’s first magnetic recording layer 5 is formed

¹⁷ Takenoiri uses “Al₂O₃” and “AlN.” A POSITA would have understood to be a typographical error and should refer to “Al₂O₃” and “AlN.” Ex-1003, ¶219.

¹⁸ To the extent this limitation is not indefinite, the plain meaning of this limitation is disjunctive. *See* fn. 16. Ex-1003, ¶ 223.

from a perpendicular anisotropy material. Section VIII.B.7 (limitation 1[F]). Takenoiri further discloses that “[f]irst magnetic recording layer 5 can be composed of...a **granular** material of CoPt—SiO₂, **CoCrPtO**, **CoCrPt—SiO₂**, **CoCrPt—Al₂O₃**, CoPt—AlN, or **CoCrPt—Si₃N₄**.” Ex-1005, 7:5-9. A POSITA would have understood that CoCrPt—SiO₂, CoCrPt—Al₂O₃, and CoCrPt—Si₃N₄ are CoCr based materials. Ex-1003, ¶224.

Therefore, Takenoiri discloses that “**the perpendicular anisotropy material is one of a CoPtCrB, CoPtCrTa, and CoCr based granular media** [e.g., Takenoiri’s granular material of CoCrPt—SiO₂, CoCrPt—Al₂O₃, and CoCrPt—Si₃N₄ as CoCr based granular media].” Ex-1003, ¶225.

IX. GROUND 2: CLAIMS 5-6 AND 9-11 ARE OBVIOUS OVER TAKENOIRI IN VIEW OF FULLERTON

Petitioners note that during prosecution, the Applicant did not dispute that Fullerton 2 (a related application of Fullerton) disclosed each of the limitations recited in claims 5-6 and 9-11. Section IV.B, *supra*.

A. Claim 5

Claim 5 depends from claim 1 (obvious over Takenoiri; Section VIII.B). Claim 5 further recites “**wherein: the perpendicular anisotropy material is an FePt based alloy**,” which is disclosed by Fullerton. Ex-1003, ¶227.

In particular, Fullerton discloses that “[o]ne type of material for recording layer 16 is chemically-ordered FePt or CoPt with its c-axis substantially out-of-plane

for perpendicular recording,” and “[c]hemically-ordered alloys of FePt and CoPt, in their bulk form, are known as tetragonal L1₀-ordered phase materials.” Ex-1006, 5:52-57. As explained below, a POSITA would have been motivated to use FePt (including in its L1₀-ordered phase) as the material for Takenoiri’s first magnetic recording layer 5. Section IX.F, *infra*. Therefore, claim 5 is rendered obvious by Takenoiri in view of Fullerton. Ex-1003, ¶228.

B. Claim 6

Claim 6 depends from claim 1 (obvious over Takenoiri; Section VIII.B). Claim 6 further recites “**wherein: the perpendicular anisotropy material is an L1₀-ordered phase material,**” which is disclosed by Fullerton for at least the same reasons explained above for claim 5. *See* Section IX.A (claim 5). Ex-1003, ¶229.

As also explained above, a POSITA would have been motivated to use FePt (including in its L1₀-ordered phase) as the material for Takenoiri’s first magnetic recording layer 5. Section IX.F, *infra*. Therefore, claim 6 is rendered obvious by Takenoiri in view of Fullerton. Ex-1003, ¶230.

C. Claim 9

Claim 9 depends from claim 1 (obvious over Takenoiri; Section VIII.B). Claim 9 further recites “**wherein: the perpendicular anisotropy material is an alloy based on FePt—X, wherein X is one of Ni, Au, Cu, Pd and Ag,**” which is disclosed by Fullerton. Ex-1003, ¶231.

In particular, Fullerton discloses that “high anisotropy materials suitable for the recording layer 16 include pseudo-binary alloys based on the FePt and CoPt L₁₀ phase, i.e., **FePt—X** and **CoPt—X**, **where the element X may be Ni, Au, Cu, Pd or Ag.**” Ex-1006, 6:18-21. As explained below, a POSITA would have been motivated to use FePt—X (with X being Ni, Au, Cu, Pd or Ag) as the material for Takenoiri’s first magnetic recording layer 5. Section IX.F, *infra*. Therefore, claim 9 is rendered obvious by Takenoiri in view of Fullerton. Ex-1003, ¶232.

D. Claim 10

Claim 10 depends from claim 1 (obvious over Takenoiri; Section VIII.B). Claim 10 further recites “**wherein: the perpendicular anisotropy material is an alloy based on CoPt—X, wherein X is one of Ni, Au, Cu, Pd and Ag,**” which is disclosed by Fullerton. Ex-1003, ¶233.

In particular, Fullerton discloses that “high anisotropy materials suitable for the recording layer 16 include pseudo-binary alloys based on the FePt and CoPt L₁₀ phase, i.e., FePt—X and **CoPt—X**, **where the element X may be Ni, Au, Cu, Pd or Ag.**” Ex-1006, 6:18-21. As explained below, a POSITA would have been motivated to use CoPt—X (with X being Ni, Au, Cu, Pd or Ag) as the material for Takenoiri’s first magnetic recording layer 5. Section IX.F, *infra*. Therefore, claim 10 is rendered obvious by Takenoiri in view of Fullerton. Ex-1003, ¶234.

E. Claim 11

Claim 11 depends from claim 1 (obvious over Takenoiri; Section VIII.B). Claim 11 further recites “**the perpendicular anisotropy material is a granular composite material based on FePt—C,**” which is disclosed by Fullerton. Ex-1003, ¶235.

In particular, Fullerton discloses that “high anisotropy materials suitable for the recording layer 16 include granular composite materials such as **FePt—C...**” Ex-1006, 6:18-21. As explained below, a POSITA would have been motivated to use FePt—C as the material for Takenoiri’s first magnetic recording layer 5. Section IX.F, *infra*. Therefore, claim 11 is rendered obvious by Takenoiri in view of Fullerton. Ex-1003, ¶236.

F. Motivation to Combine Takenoiri with Fullerton

Takenoiri and Fullerton are analogous art to the ’734 Patent and to each other because they are in the same field of endeavor as the ’734 patent, *e.g.*, perpendicular magnetic recording media. Ex-1001, Abstract (“The invention proposes a recording media that overcomes the writeability problem of perpendicular recording media.”); Ex-1005, Title (“Perpendicular Magnetic Recording Medium”); Ex-1006, claim 3 (“a recording layer with substantially perpendicular magnetic anisotropy”). In particular, each of Takenoiri, Fullerton, and the ’734 Patent is directed to magnetic recording media with multiple magnetic layers. Ex-1001, Title (“Multilayer

Exchange Spring Recording Media”); Ex-1005, 10:7-8 (“The magnetic recording layers can be constructed with three or more layers.”); Ex-1006, 4:15-16 (“The invention is a TAMR disk that uses a bilayer medium...”). The ’734 patent, Takenoiri, and Fullerton are all in Cooperative Patent Classification (CPC) class G11B 5/66. Both references and the ’734 Patent achieve improved recordability without sacrificing thermal stability by introducing a “softer” magnetic layer. *See, e.g.*, Ex-1005, 5:56-59 (“By reversing the magnetization of each magnetic recording layer individually and sequentially, the switching field can be more effectively lowered without impairing thermal stability.”); 5:41-46 (“At the moment of the magnetization reversal in the first magnetic recording layer, the second magnetic recording layer has already reversed the magnetization thereof. So, the magnetization reversal in the first magnetic recording layer is easy owing to the effect of the magnetic field of the second magnetic recording layer.”); Ex-1006, 2:53-61 (“The first ferromagnetic layer is formed of a high-coercivity (or magnetically “hard”) material that has a room temperature coercivity too high for writing with a conventional write head and a low Curie temperature. The second ferromagnetic layer directly above or below the first layer is formed of a low-coercivity (or magnetically “soft”) material with a coercivity suitable for writing with a conventional write head and a high Curie temperature.”); Ex-1001, 2:48-60 (“embodiments according to the invention include a magnetic recording media

wherein the magnetic recording layer consists of a multilayer structure, with a special multilayer host layer (nucleation host) and a hard magnetic storage layer... The nucleation host significantly decreases the coercive field of each grain of the proposed media but has only little influence on the thermal stability.”). At a minimum, both Takenoiri and Fullerton are reasonably pertinent to at least the problem identified in the ’734 Patent of how to “overcome the writability problem of extremely hard magnetic storage layers” without impairing “thermal stability.” Ex-1001, 3:58-61; Ex-1005, 2:54-57; Ex-1006, Abstract. Ex-1003, ¶237.

Ample motivations existed to combine Takenoiri with Fullerton. Ex-1003, ¶238.

First, as already explained above, Takenoiri improves recordability of the magnetic recording medium by introducing magnetic recording layer(s) with lower coercive fields (e.g., the second and third magnetic recording layers in Takenoiri’s tri-layer structure), which allows the first magnetic recording layer to maintain high coercive field, thereby not impairing thermal stability of the structure. Ex-1003, ¶239.

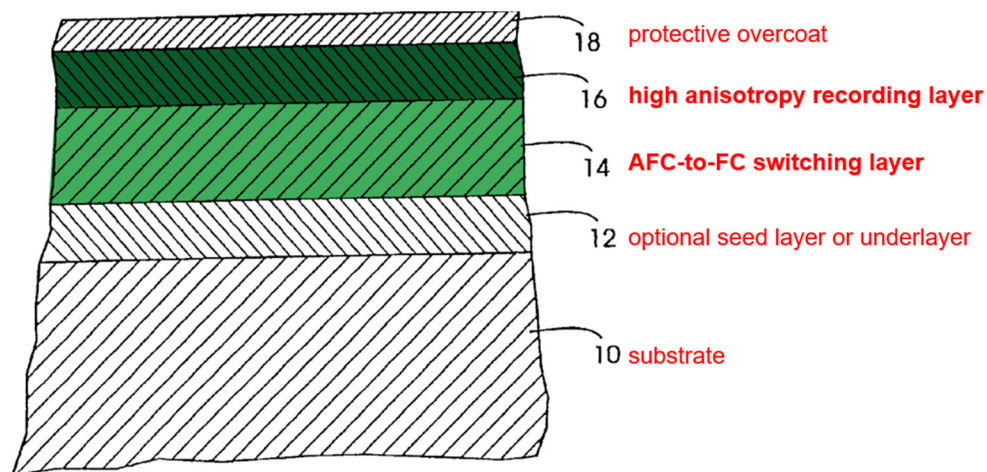
To further improve thermal stability of Takenoiri’s structure, **as explicitly motivated by Takenoiri**, a POSITA would have been motivated to look to analogous references, such as Fullerton, for magnetic materials with higher anisotropy, such as FePt and CoPt alloys as taught by Fullerton, for use as its bottom

magnetic recording layer (e.g., the first magnetic recording layer 5) because it was widely recognized in literature, including by both Takenoiri and Fullerton, that higher anisotropy contributes to better thermal stability. Ex-1005, 1:48-50 (“the Ku must be increased to keep thermal stability”); Ex-1006, 8:11-12 (“high anisotropy (and thus high thermal high stability)”); Ex-1020, p.1 (“Various high magnetic anisotropy materials have been investigated to suppress such thermal instability”); Ex-1036, ¶82; Ex-1003, ¶240.

In particular, Fullerton discloses that “[c]hemically-ordered alloys of FePt and CoPt... are known as tetragonal L₁₀-ordered phase materials [and] are known for their high magneto-crystalline anisotropy and magnetic moment, properties that are desirable for high-density magnetic recording materials.” Ex-1006, 5:55-60. As acknowledged by inventor of the '734 Patent, FePt and CoPt are “[p]romising candidates for high-anisotropy media...For example, the anisotropy of FePt is about 10 times larger than that of currently used materials like CoCrPt. Ex-1008, p. 1; Ex-1036, ¶66. In addition to FePt and CoPt L₁₀ phase, Fullerton discloses that “[o]ther high anisotropy materials...include pseudo-binary alloys based on the FePt and CoPt L₁₀ phase, i.e., FePt—X and CoPt—X, where the element X may be Ni, Au, Cu, Pd or Ag, as well as granular composite materials such as FePt—C, FePt—ZrO, FePt—MgO, FePt—B₂O₃ and other similar composites” (hereinafter “Fullerton’s high-anisotropy materials”). Ex-1006, 6:18-23. According to Fullerton, “these materials

in general have similarly high anisotropy as the binary alloy FePt and CoPt” and also “allow additional control over the magnetic and structural properties of the media.” *Id.*, 6:24-27. Therefore, such FePt—X and CoPt—X materials not only further improve Takenoiri’s thermal stability but also bring more control over the magnetic and structural properties of the media as taught by Fullerton. Ex-1003, ¶241.

Second, similar to the first magnetic recording layer 5 in Takenoiri’s tri-layer structure, Fullerton also uses its high-anisotropy materials for the bottom perpendicular high-anisotropy magnetic recording layer. Specifically, Fullerton discloses in its Figure 1 a multilayer structure where “a high anisotropy ferromagnetic recording or storage layer 16 on the switching layer 14” but “[t]he recording layer 16...[and] the switching layer 14...can be reversed.” Ex-1006, 4:58-65.



Id., Fig. 1; see also *id.*, 5:45-49 (“The ferromagnetic recording or storage layer 16 is

a high anisotropy material with a room-temperature coercivity so high that it is incapable of being written to by a conventional write head, and may be either perpendicular or horizontal type recording material.”). “[M]aterials suitable for the recording layer 16” include Fullerton’s high-anisotropy materials (*id.*, 6:18-27), as well as materials used for Takenoiri’s magnetic recording layer 5, e.g., “granular CoPtCr alloy, such as CoPtCrB or CoPtCrTa” (*id.*, 6:33-37) and “a CoPt multilayer for perpendicular recording.” *Id.*, 7:48-54; Ex-1005, 7:5-9. Thus, a POSITA would have been motivated to substitute the material used for Takenoiri’s bottom most magnetic recording layer, i.e., Co-based materials, with the material used for Fullerton’s bottom most magnetic recording layer, i.e., Fullerton’s high-anisotropy materials. Ex-1003, ¶¶242-243.

Third, Takenoiri discloses that “the methods and devices described herein are illustrative only and are not limiting upon the scope of the invention.” Ex-1005, 18:21-23. Thus, a POSITA would have understood that the material composition for Takenoiri’s magnetic recording layers is not limited to those explicitly discussed, and a POSITA would have been motivated to look to analogous art, such as Fullerton, for other candidate composition and would have understood the potential for substitute any of Fullerton’s high-anisotropy materials as a routine optimization choice. Ex-1003, ¶244.

Finally, a POSITA would have had **reasonable expectation of success** in

using any of Fullerton's perpendicular high-anisotropy materials as Takenoiri's perpendicular first magnetic recording layer 5. Fullerton's high-anisotropy materials were not new—they were “known for their high magneto-crystalline anisotropy and magnetic moment.” Ex-1006, 5:58-59. Thus, a POSITA would have had reasonable expectation of success in implementing Takenoiri's first magnetic recording layer 5 using Fullerton's high-anisotropy materials. Ex-1003, ¶245. In fact, Fullerton discloses that FePt and CoPt L₁₀ phase materials “can be made by several known processes.” Ex-1006, 5:60-62. Moreover, it was well known that by adjusting the deposition conditions, such as temperature, the anisotropy of Fullerton's high-anisotropy materials can also be lowered. Ex-1035, Fig. 3. Therefore, when Takenoiri's second and third magnetic recording layers are also fabricated using Fullerton's high-anisotropy materials (under appropriate fabrication conditions), the resulting structure still exhibits the same anisotropy/coercivity gradient across Takenoiri's magnetic recording layers as discussed above for claim 1. Therefore, a POSITA would have had reasonable expectation of success in using any of Fullerton's high-anisotropy materials for Takenoiri's magnetic recording layers. Ex-1003, ¶ 245.

X. GROUND 3: CLAIM 12 IS OBVIOUS OVER TAKENOIRI IN VIEW OF SHEN

A. Claim 12

Claim 12 depends from claim 1 (obvious over Takenoiri; Section VIII.B).

Claim 12 further recites “**a derivative k of a normalized magnetization with respect to an external magnetic field, normalized to a coercive field of the recording medium, does not change by more than a factor of 3 in a magnetization interval $-0.7 < M_z/M_s < 0.7$, wherein $[k = \frac{dM}{dH} \frac{H_c}{M_s}]$, M being a magnetization of the recording medium, M_z being a component of M perpendicular to a plane of the recording medium, H being an external magnetic field parallel to a normal of the recording medium, dM/dH being a derivative of the magnetization of the recording medium with respect to the external magnetic field, H_c being the coercive field of the recording medium, M_s being a saturation magnetization of the recording medium.**”¹⁹ This is rendered obvious by Takenoiri in view of Shen. Ex-1003, ¶¶246, 248.

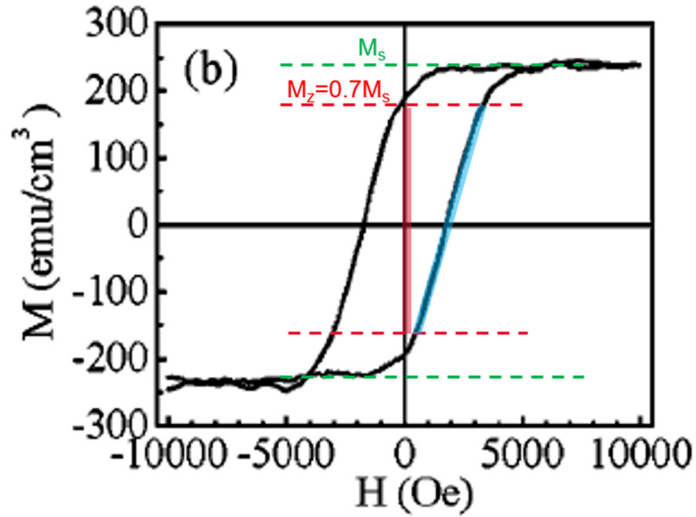
Claim 12 adds a mathematical condition to the magnetic multilayer structure described in claim 1, requiring that within the central portion of the hysteresis loop ($-0.7 < M_z/M_s < 0.7$), the slope of the magnetization curve ($\frac{dM}{dH}$) remains substantially constant, changing by no more than a factor of three. This describes a medium

¹⁹ The claim language is incomplete. Petitioners reserve right to challenge this claim under 35 U.S. C. § 112 in other proceedings. For purposes of this IPR, Petitioners assume that this claim includes “ **$k = \frac{dM}{dH} \frac{H_c}{M_s}$** ” as shown. Ex-1003, ¶247.

whose magnetization reverses smoothly and uniformly when an external magnetic field is applied. Ex-1003, ¶249.

Takenoiri discloses multilayer perpendicular magnetic recording media, including bi-layer and tri-layer structures, in which softer magnetic layers are exchange-coupled to a harder magnetic layer to reduce coercivity while maintaining thermal stability. Ex-1005, 10:7-18. Takenoiri provides “a **conceptual** illustration of the hysteresis loop” in Figure 5, recognizing that “[i]n an **actual** perpendicular magnetic recording medium, the hysteresis curve has some slope due to an effect of demagnetization, and accurate calculation of the demagnetizing factor is difficult.” *Id.*, 4:8-10, 8:20-23. Ex-1003, ¶250.

Shen provides experimental data for similar composite magnetic media combining soft and hard magnetic layers. In Shen’s Figure 5(b), the **measured** hysteresis loop shows a long, nearly linear region where magnetization changes evenly over the middle portion of the curve.

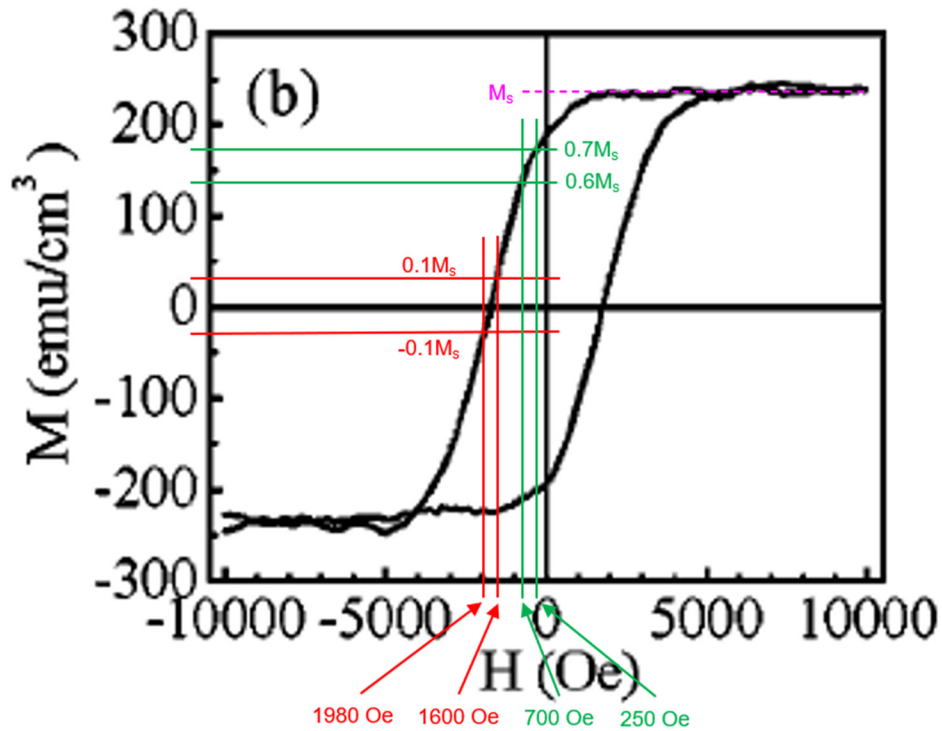


Ex-1007, Fig. 5(b); *see also id.*, p.3 (“For the proper coupling layer, uniform switching behavior is observed, while for the decoupling case (c), the switching is divided into 2 phases very clearly.”). Ex-1003, ¶251.

Because the slope $\frac{dM}{dH}$ (blue) remains substantially constant within the magnetization range $-0.7 < M_z/M_s < 0.7$ (in red) and the parameters H_c and M_s are fixed, the normalized derivative $k = \frac{dM}{dH} \frac{H_c}{M_s}$ also remains substantially constant. Thus, Shen’s hysteresis loop in Figure 5(b) meets claim 12’s requirement that k does not change by more than a factor of three in the specified magnetization range. Ex-1003, ¶ 252.

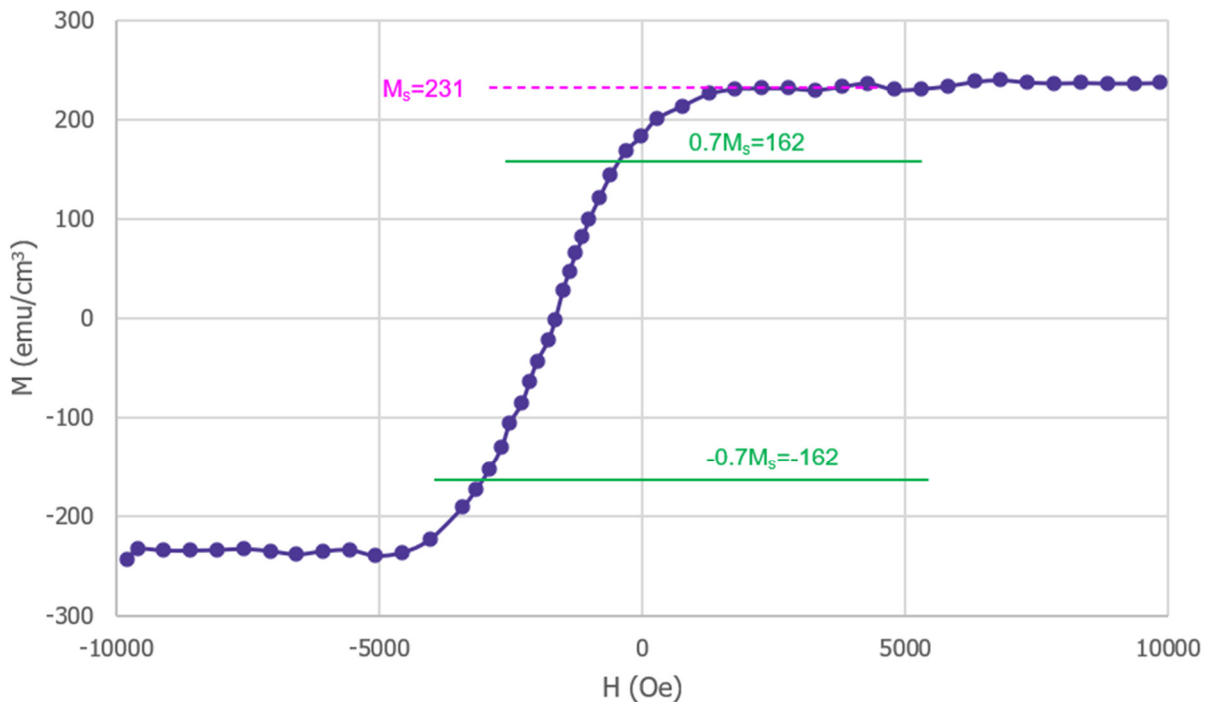
This is confirmed by the mathematical calculation based on the plot in Shen’s Figure 5(b). As illustrated below, within the $-0.7 < M_z/M_s < 0.7$ range, the smallest k value is at $0.7M_s$ to $0.6M_s$ and is therefore $\frac{H_c}{4500}$, and the biggest k value is at $0.1M_s$

to $-0.1M_s$ and is therefore $\frac{Hc}{1900}$. The ratio of the two k values is 2.37, which is smaller than 3. Ex-1003, ¶253.



Ex-1007, Fig. 5(b). Digitizing the above hysteresis loop also confirms that the ratio of the largest k value and the smallest k value with the $-0.7 < M_z/M_s < 0.7$ range is 2.549, which is smaller than 3. Ex-1003, ¶¶254-255.

Shen's Fig. 5(b) - digitized hysteresis loop (left portion)



As detailed in Section X.B, *infra*, a POSITA would have been motivated to implement Takenoiri's tri-layer structure using Shen's guidance to achieve a similar uniform loop having a smooth slope the same or at least substantially the same as that in Shen's measured curve in Figure 5(b). Therefore, Takenoiri in view of Shen renders this claim obvious. Ex-1003, ¶256.

B. Motivation to combine Takenoiri with Shen

Both Takenoiri and Shen are analogous art to the '734 Patent because they are in the same field of endeavor as the '734 patent, e.g., perpendicular magnetic recording media. *See* Section IX.F (motivation to combine with Fullerton); Ex-1007, Abstract. Similar to Takenoiri and the '734 Patent, Shen also aims to achieve improved recordability without sacrificing thermal stability by introducing a "softer"

magnetic layer. Ex-1007, Abstract. At a minimum, like Takenoiri, Shen is also reasonably pertinent to at least one problem identified in the '734 Patent—how to “overcome the writability problem of extremely hard magnetic storage layers” without impairing “thermal stability.” Ex-1001, 3:58-61; Ex-1005, 2:54-57; Ex-1007, Abstract. Ex-1003, ¶257.

Takenoiri provides the multilayer structure and teaches control of coupling strength through layer thickness. Ex-1005, 8:32-35. Shen shows that proper coupling produces the desired uniform switching behavior and smooth hysteresis loop. Ex-1007, Fig. 5. A POSITA would therefore have been motivated to implement Takenoiri’s multilayer structure using Shen’s guidance to achieve a similar uniform loop, e.g., having a smooth slope the same or at least substantially the same as that in Shen’s measured curve in Figure 5(b). Ex-1003, ¶¶258-262.

Even if the hysteresis loop of Takenoiri’s multilayer structure, including the tri-layer structure, is not as smooth as Shen’s Figure 5(b), a POSITA would have been motivated to further improve Takenoiri’s multilayer structure such that the hysteresis loop for the resulting structure has a smooth slope the same or at least substantially the same as that in Shen’s measured curve in Figure 5(b). Ex-1003, ¶¶263-265. By adjusting the coupling layer thickness in Takenoiri’s tri-layer structure to strengthen coupling, the resulting hysteresis loop would exhibit the same smooth slope as Shen’s measured curve. Ex-1003, ¶266.

XI. CONCLUSION

Trial should be instituted and the Challenged Claims cancelled as unpatentable.

Dated: October 8, 2025

Respectfully Submitted,

/Dion M. Bregman/

Dion M. Bregman, Reg. No. 45,645

CERTIFICATION OF COMPLIANCE WITH TYPE-VOLUME LIMITS

This Petition includes 11,821 words as counted by Microsoft Word and is therefore in compliance with the 14,000-word limit established by 37 C.F.R. 42.24(a)(1)(i). Accordingly, pursuant to 37 C.F.R. 42.24(d), lead counsel for the Petitioners hereby certify that this Petition complies with the type-volume limits established for a petition requesting IPR.

Dated: October 8, 2025

Respectfully Submitted,

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. 42.6(e)(4) and 42.105, lead counsel for Petitioners hereby certifies that on October 8, 2025, copies of this Petition and all supporting exhibits were sent via Priority Mail Express to the correspondence address of record for the '734 Patent:

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Appendix A

U.S. PATENT NO. 12,020,734 – Claim Listing

No.	Claim Elements
1[P]	A magnetic recording system, comprising:
1[A]	a writing head; and
1[B]	a disk, including a magnetic recording medium, comprising
1[C]	an essentially non-magnetic substrate;
1[D]	an underlayer; and
1[E]	an exchange coupled magnetic multilayer structure, including
1[F]	a hard magnetic storage layer, formed from a perpendicular anisotropy material, having a first coercive field $H_s > 0.5$ T,
1[G]	formed such that the underlayer is between the non-magnetic substrate and the hard magnetic storage layer; and
1[H]	a nucleation host, having a second coercive field H_n without the hard magnetic storage layer, lower than the first coercive field, $H_n < H_s$, wherein
1[I]	said nucleation host is formed on the hard magnetic storage layer such that the hard magnetic storage layer is between the nucleation host and the non-magnetic substrate,
1[J]	is exchange coupled to the hard magnetic storage layer, and
1[K]	comprises at least a first ferromagnetic layer with an anisotropy constant K_1 and a second ferromagnetic layer between the first ferromagnetic layer and the hard magnetic storage layer with an increased anisotropy constant K_2 greater than K_1 ; wherein
1[L]	the first and second ferromagnetic layers are exchange coupled with an exchange coupling layer.
Claim 2	2. The magnetic recording system of claim 1, wherein: the nucleation host and the hard magnetic storage layer are in direct contact.
Claim 4	4. The magnetic recording system of claim 1, wherein: a coupling layer is disposed between the nucleation host and the hard magnetic storage layer.
Claim 5	5. The magnetic recording system of claim 1, wherein: the perpendicular anisotropy material is an FePt based alloy.
Claim 6	6. The magnetic recording system of claim 1, wherein: the perpendicular anisotropy material is an Ll_0 -ordered phase material.
Claim 7	7. The magnetic recording system of claim 1, wherein: the perpendicular anisotropy material is one of a CoPt based alloy, and a

	CoPtCr alloy.
Claim 8	8. The magnetic recording system of claim 1, wherein: the perpendicular anisotropy material is one of a CoPtCrB, CoPtCrTa, and CoCr based granular media.
Claim 9	9. The magnetic recording system of claim 1, wherein: the perpendicular anisotropy material is an alloy based on FePt—X, wherein X is one of Ni, Au, Cu, Pd and Ag.
Claim 10	10. The magnetic recording system of claim 1, wherein: the perpendicular anisotropy material is an alloy based on CoPt—X, wherein X is one of Ni, Au, Cu, Pd and Ag.
Claim 11	11. The magnetic recording system of claim 1, wherein: the perpendicular anisotropy material is a granular composite material based on FePt—C.
Claim 12	12. The magnetic recording system of claim 1, wherein: a derivative k of a normalized magnetization with respect to an external magnetic field, normalized to a coercive field of the recording medium, does not change by more than a factor of 3 in a magnetization interval $-0.7 < M_z/M_s < 0.7$, wherein, M being a magnetization of the recording medium, M_z being a component of M perpendicular to a plane of the recording medium, H being an external magnetic field parallel to a normal of the recording medium, dM/dH being a derivative of the magnetization of the recording medium with respect to the external magnetic field, H_c being the coercive field of the recording medium, M_s being a saturation magnetization of the recording medium.