

Paper No. ____

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

WESTERN DIGITAL TECHNOLOGIES, INC.,
Petitioner,

v.

GODO KAISHA IP BRIDGE 1,
Patent Owner.

Case No. IPR2024-01494
U.S. Patent No. 11,968,909

PATENT OWNER'S SUR-REPLY TO PETITIONER'S REPLY

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LISTING OF EXHIBITS

Exhibit	Description
2001	Kittel, C., <i>Introduction to Solid State Physics</i> , 6th Edition, 1986, pgs. 13-15, 18, 23 (“Kittel”)
2002	Duke, C.B., <i>Tunneling in Solids</i> , Solid State Physics: Advances in Research and Applications, 1969, pgs. 1, 6-7, 34-35, 78-79 (“Duke”)
2003	Definition of “ferromagnetism,” Oxford English Reference Dictionary, Second Edition, pg. 513 (“Oxford English Reference Dictionary”)
2004	“Ferromagnetism,” The New Encyclopaedia Britannica: Volume 4, 15th Edition, 2003, pgs. 748-749 (“Britannica”)
2005	Zhu, J.G., et al., <i>Magnetic tunnel junctions</i> , Materials today, Volume 9, Number 11, November 2006, pgs. 36-45 (“Zhu”)
2006	Wulfhekel, W., et al., <i>Single-crystal magnetotunnel junctions</i> , Applied Physics Letters, Volume 78, Number 4, January 2001, pgs. 509-511 (“Wulfhekel”)
2007	Hard disk Market – Global Industry Analysis and Forecast (2025-2032), https://www.maximizemarketresearch.com/marketreport/global-hard-disk-market/63888/
2008	Yuasa citations, https://scholar.google.com/citations?view_op=view_citation&hl=en&user=kb5EQcsAAAAJ&citation_for_view=kb5EQcsAAAAJ:3fE2CSJlr18C
2009	Yuasa citations 2, https://scholar.google.com/citations?view_op=view_citation&hl=en&user=kb5EQcsAAAAJ&citation_for_view=kb5EQcsAAAAJ:kNdYIxmWkoC
2010	Wang, S.X., et al., <i>Magnetic Information Storage Technology</i> (Academic Press 1999) (Chapter 6)
2011	RESERVED

Exhibit	Description
2012	Parkin, S.P, et al., <i>Giant tunneling magnetoresistance at room temperature with MgO (100) tunnel barriers</i> , Nature Materials, 3 (2004), 862-867
2013	Transcript of Deposition of Jeffrey Bokor, Ph.D. (June 24, 2025)
2014	Transcript of Deposition of Jeffrey Bokor, Ph.D. (June 25, 2025)
2015	Djayaprawira, D., et al., <i>230% room-temperature magnetoresistance in CoFeB/MgO/CoFeB magnetic tunnel junctions</i> , Applied Physics Letters, 86(9) (2005)
2016	Yuasa, S., et al., <i>High Tunnel Magnetoresistance at Room Temperature in Fully Epitaxial Fe/MgO/Fe Tunnel Junctions due to Coherent Spin-Polarized Tunneling</i> , Japanese Journal of Applied Physics, 43(4B), (2004) L588
2017	Yuasa, S., et al., <i>Giant room-temperature magnetoresistance in single crystal Fe/MgO/Fe magnetic tunnel junctions</i> , Nature Materials, 3(12) (2004), 868-871
2018	Statutory Disclaimer Under 37 C.F.R. § 1.321(a)
2019	Marrows, C.H., <i>Spin-polarised currents and magnetic domain walls</i> , Advances in Physics, 52(8), (2005) 585-713
2020	Tsymbal, E., et al., <i>Handbook of Spin Transport and Magnetism</i> , 2012
2021	Nagamine, Y, et. al., <i>Ultralow resistance-area product of $0.4 \Omega (\mu\text{m})^2$ and high magnetoresistance above 50% in CoFeB/MgO/CoFeB magnetic tunnel junctions</i> , Applied Physics Letters, 89 (2006), 16507
2022	Nakatani, T., et al., <i>Read sensor technology for ultrahigh density magnetic recording</i> , MRS Bulletin, Materials Research Society, 43(2), (2018) 106-111
2023	Jiang, B., et al., <i>Tunneling magnetoresistive devices as read heads in hard disk drives</i> , Journal of Magnetism and Magnetic Materials, 571 (2023) 170546

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2024	The 23rd (FY2022) Japan Society of Applied Physics Achievement Award Recipients (with English translation), The Japan Society of Applied Physics, https://www.jsap.or.jp/outstanding-achievementaward/recipients/recipients23
2025	JSAP Outstanding Achievement Award Recipients, The Japan Society of Applied Physics, https://www.jsap.or.jp/english/awards/outstanding-achievementaward/recipients
2026	2021 New Fellows, IEEE Japan Council, https://ieeelp.org/en/kaiin/fellow/fellow21.html
2027	JST owned patent wins Future Creative Invention Prize at the National Invention Award 2021, Japan Science and Technology Agency, https://www.jst.go.jp/report/2021/210525_e.html
2028	Dr. Shinji Yuasa profile, https://www.jst.go.jp/impact/sahashi/en/system/index.html
2029	AIST wins three Science and Technology Awards in the 2016 Minister of Education, Culture, Sports, Science and Technology Commendation for Science and Technology, https://www.aist.go.jp/aist_j/news/prize/pr20160412_3.html
2030	Yuasa, S., <i>Magnetoresistance and Spin-Transfer Torque in Magnetic Tunnel Junctions</i> , IEEE Transactions on Magnetics, IEEE Magnetics Society Distinguished Lecturers for 2012, Vol. 48, No. 1, 2012
2031	Shinji Yuasa – IEEE Magnetics Society, https://ieeemagnetics.org/contact/shinji-yuasa#biography
2032	AIST: 20th Tsukuba Prize winner, https://www.aist.go.jp/aist_j/news/prize/itemid025-000077.html
2033	Announcing the winners for “Tsukuba Prize,” “Esaki Leona Prize,” and “Tsukuba Encouragement Prize”: Ibaraki Prefectural Science and Technology Promotion Foundation (with English translation), https://www.tsukuba-sci.com/cms/?p=9853

Exhibit	Description
2034	AIST: 34th Inoue Harunari Prize, https://www.aist.go.jp/aist_j/news/prize/itemid025-000082.html
2035	RESERVED
2036	RESERVED
2037	Saito, Y. et al. <i>Correlation between barrier width, barrier height, and dc bias voltage dependences on the magnetoresistance ratio in Ir-Mn exchange biased single and double tunnel junctions</i> , Jpn J. Appl. Phys. 39, L1035–L1038 (2000)
2038	Maat, S., et al., <i>Physics and Design of Hard Disk Drive Magnetic Recording Read Heads</i> , Handbook of Spintronics, 2014
2039	Soukup, R.J., <i>Hot Electron Transport in Vacuum Deposited Thin Film Emission Diodes</i> , University of Minnesota, Ph.D., Physics, solid state, 1969, pgs. 1-209 (“Soukup-Dissertation”)
2040	U.S. Patent Application Publication No. 2006/0003185 A1
2041	J. C. Slonczewski, <i>Conductance and exchange coupling of two ferromagnets separated by a tunneling barrier</i> , Phys. Rev. B 39, 6995-7002 (1989)
2042	RESERVED
2043	RESERVED
2044	RESERVED
2045	RESERVED
2046	RESERVED
2047	RESERVED
2048	RESERVED
2049	RESERVED

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2050	RESERVED
2051	RESERVED
2052	RESERVED
2053	Declaration of Caroline A. Ross, Ph.D.
2054	<i>Curriculum Vitae</i> of Caroline A. Ross, Ph.D.
2055	U.S. Application No. 10/824835 File History (Partial)
2056	Citations to Butler: https://scholar.google.com/scholar?hl=en&as_sdt=0%2C22&q=Butler+et+al.%2C+Spin-dependent+tunneling+conductance+of+Fe%7CMgO%7CFe+sandwiches%2C+63+Phys.+Rev.+B+054416+%282001%29&btnG=
2057	Citations to Soukup: https://scholar.google.com/scholar?hl=en&as_sdt=0%2C22&q=Soukup+et+al.%2C+Voltage-Current+Characteristics+for+Electrical+Conduction+Through+Thin+MgO+Films%2C+41+J.+Appl.+Phys.+3229-+3236+%281970%29&btnG=
2058	Errata to EX2013 - Deposition of Jeffrey Bokor, Ph.D. (June 24, 2025)
2059	Errata to EX2014 - Deposition of Jeffrey Bokor, Ph.D. (June 25, 2025)
2060-2071	RESERVED
2072	EX2024 - The 23rd (FY2022) Japan Society of Applied Physics Achievement Award Recipients (with English translation), The Japan Society of Applied Physics, https://www.jsap.or.jp/outstanding-achievementaward/recipients/recipients23 with Amended Certification of Translation [SUPPLEMENTAL EVIDENCE - NOT FILED]
2073	Certified English Translation of EX2029 - AIST wins three Science and Technology Awards in the 2016 Minister of Education, Culture,

Exhibit	Description
	Sports, Science and Technology Commendation for Science and Technology, <i>available at</i> https://www.aist.go.jp/aist_j/news/prize/pr20160412_3.html [SUPPLEMENTAL EVIDENCE - NOT FILED]
2074	Certified English Translation of EX2032 - AIST, “Winner of the 20th Tsukuba Award,” <i>available at</i> https://www.aist.go.jp/aist_j/news/prize/itemid025-000077.html [SUPPLEMENTAL EVIDENCE - NOT FILED]
2075	Certified English Translation of EX2034 - AIST: 34th Inoue Harunari Prize, <i>available at</i> https://www.aist.go.jp/aist_j/news/prize/itemid025-000082.html [SUPPLEMENTAL EVIDENCE - NOT FILED]
2076	RESERVED
2077	RESERVED
2078	Declaration of Dara Del Rosario [SUPPLEMENTAL EVIDENCE - NOT FILED]
2079	Transcript of October 24, 2025 Board Conference Call
2080	RESERVED
2081	RESERVED
2082	RESERVED
2083	RESERVED
2084	RESERVED
2085	Transcript of Deposition of Jeffrey Bokor, Ph.D. (Oct. 30, 2025)
2086	Transcript of Deposition of Jeffrey Bokor, Ph.D. (October 31, 2025)
2087	Sur-Reply Declaration of Caroline A. Ross, Ph.D.
2088	Errata to EX2085 - Deposition of Jeffrey Bokor, Ph.D. (Oct. 30, 2025)

Exhibit	Description
2089	Errata to EX2086 - Deposition of Jeffrey Bokor, Ph.D. (Oct. 31, 2025)

I. INTRODUCTION

The only motivation the Petition alleged for lowering the barrier heights in the grounds' primary references was that POSAs believed this would increase TMR. No evidence supports that assertion. The Reply never even attempts to refute this. That should end the matter. Petitioner should be held to the Petition's failed theory of unpatentability and the claims should be confirmed.

The Reply advances a new theory for why POSAs allegedly would have lowered the barrier heights in the primary references. That new theory—the subject of a Motion to Strike (Paper 29)—should not be considered. Petitioner's new theory fails if the Board considers it. It is based entirely on the naked say-so of Petitioner's expert. His deposition revealed he is woefully unqualified to offer the testimony he gave.

The POR also demonstrated that both grounds fail because Petitioner failed to establish that Soukup would have motivated POSAs to inject oxygen defects into the MgO layers in the primary references to lower their barrier heights to 0.33 eV. The Board agreed in denying institution in a related IPR and there is no reason to reach a different conclusion here. The Reply's attempt to defend Petitioner's reliance on Soukup mischaracterizes the record.

II. PETITIONER MISCHARACTERIZES THE INVENTION, THE POR AND THE EXAMINER’S FINDINGS

Petitioner alleges “IPB contests only obviousness of the ‘barrier height’ *limitations*” which are not “patentable.” Reply, 1.¹ Not so. Petitioner must prove “the claimed invention as a whole” obvious—not individual limitations. 35 U.S.C. § 103. The claimed invention is a device with a magnetic tunnel junction (“MTJ”) structure comprising, *inter alia*, a tunnel barrier layer comprising “crystalline MgO_x(001) with oxygen vacancy defects and ($0 < x < 1$)” and a barrier height within one of two claimed ranges.

Petitioner says “IPB recently acquiesced to the Examiner’s finding the prior art” teaches the claimed barrier height ranges. Reply, 1. In that office action, the Examiner allowed other claims because they—like every claim challenged here—recited “the tunnel barrier layer comprises crystalline MgO_x (001) with oxygen vacancy defects and ($0 < x < 1$).” EX1086, 260 (claim 3 allowable). While Petitioner would have the Board believe that the Examiner reconsidered and found the claimed subject matter unpatentable (Reply, 1 and 5), the opposite is true.

Petitioner’s reliance on the Director sending IPR2025-00701 to the merits panel fares no better because that panel denied institution on the merits. *See* Paper 11.

¹ All emphasis is added.

Petitioner must prove obvious the claimed subject matter *as a whole*. The Reply fails to refute the Petition's failure to do so for any claim.

III. THE REPLY DOES NOT DEFEND THE PETITION'S FAILED REASON TO COMBINE

Petitioner never disputes that the law requires Petitioner to establish some non-hindsight *reason why* POSAs would have modified the primary references (Bowen and Nagahama) in Grounds 1-2 to meet the claimed barrier height. POR, 31.

A. The Petition Alleged POSAs Were Motivated to Lower Barrier Height to Reduce R_p and Thereby Increase TMR

Patent Owner ("IPB") does not dispute that POSAs were motivated to increase TMR. The Petition made a single argument as to *why* so-motivated POSAs would have lowered the barrier height: "*[a]ccording to the equation for TMR, lowering the resistance (barrier height) for parallel electrons (R_p) would improve [increase] TMR.*" Petition, 34; 57-58 (similar). That is the basis on which the Board instituted trial. Paper 9 ("DI"), 14 and 17-18.

B. It is Undisputed that No Prior Art Reference Taught That Lowering Barrier Height Would Increase TMR

The Petition's allegation that lowering barrier height would increase TMR cited three prior art references—EX1035 (Moodera), EX1027 and EX1055.

Petition, 34 and 58. The Reply never disputes that none² supports this assertion and that Petitioner's expert admitted this. POR, 34-37.

C. Petitioner's Expert Refuted the Petition's Assertion and Disavowed an Interpretation of His Testimony the Board Adopted in Instituting Trial

The POR explained that Dr. Bokor admitted (1) he was unaware of any prior art reference teaching that lowering barrier height would increase TMR, and (2) contrary to the Board's finding (DI, 17-18) he never testified that POSAs would have expected lowering barrier height to lower R_p *compared to* R_{ap} and thereby increase TMR. POR, 2 and 33-37. Petitioner's assertions that this is "misleading[]" because he "said the opposite" (Reply, 8-10) are false.

Bokor admitted repeatedly he was aware of *no prior art reference teaching* that lowering barrier height would increase TMR. POR, 34-37 (collecting

² Petitioner never disputes that Moodera teaches that lowering barrier height *decreased* TMR. POR, 37-43. Petitioner now alleges POSAs would not have considered Moodera—which describes (Al_2O_3) barriers—to inform *any* TMR/barrier height relationship for MgO barriers. Reply, 12-13. That reversal is stunning given that *the Petition's* allegation that lowering barrier height would increase TMR cited Moodera (Petition, 34 and 58) and the Board relied on Moodera in instituting trial (DI, 17-18).

citations); Reply, 7 (admitting Bokor said POSAs would not have known whether lowering barrier height would have increased or *decreased* TMR).

Petitioner cites *deposition* testimony in which Bokor unveiled a new obviousness theory (*infra* §IV) alleging POSAs would have expected lowering barrier height to change TMR in an “uncertain” way (it could increase *or undesirably decrease*) which is “legally sufficient motivation.” Reply, 7-10, 13-16 and 23-25. That is not what the Petition argued. Bokor’s deposition testimony never refutes that no evidence supports the *Petition’s* argument that POSAs would have lowered the barrier height because they would have expected this to “*improve [i.e., increase]* TMR.” Petition, 34-36; POR, 31-54.

D. Petitioner Should Be Held to The Petition’s Failed Argument

Petitioner must make its case “with particularity” *in the Petition*. 35 U.S.C. § 312; 37 C.F.R. § 42.22 (requiring a “detailed explanation”). No Bokor testimony supports the *Petition’s* assertion that POSAs would have lowered barrier height because of an expectation it “would *improve* TMR.” Petition, 34-35 and 57-59 (“improve” means “increase” TMR).

Even if the Board were to find that Bokor testified that POSAs would have expected lowering barrier height to increase TMR (he did not), it is undisputed that *no prior art reference taught this*. *Supra* §III.B. Petitioner cannot meet its burden based on an expert’s say-so unsupported by any prior art reference.

Petitioner failed to carry its burden on either ground because *no evidence supports the Petition's assertion*. That is fatal to Petitioner's challenges to claims 6, 12 and 15-20 (0.2-0.5 eV barrier height) because the Reply never disputes that Petitioner offered no other obviousness theory for those claims. POR, 43-46.

E. Petitioner Offered No Other Valid Obviousness Theory for Any Claim

Petitioner says adopting Soukup's 0.33 eV alleged barrier height to increase TMR was not its "only theory" for claims 5, 9-11 and 13-14 (Reply, §II.D) but fails to identify any other valid obviousness theory.

Petitioner repeats the Petition's assertion that the difference between Bowen's 0.9 eV barrier height and 0.85 eV is "slight[]" (Reply, 13), but ignores, and thereby fails to refute: (1) the POR-cited caselaw establishing that "proximity" is insufficient and that some "reason" to modify is required and (2) no *evidence* supports Petitioner's attorney argument that there is no meaningful difference between barrier heights of 0.9 eV and 0.85 eV. POR, 43-46.

The Reply's "§II.A" (*cited* Reply, 13) advances improper new arguments addressed *infra* §IV—not an alternative obviousness theory in the *Petition*.

The Petition's motivation "to explore lower barrier heights" (Reply, 13) was to "facilitate tunnelling of *parallel electrons*" (Petition, 35) which is the same failed argument about lowering resistance "for parallel electrons (R_p)" (Petition, 34) discussed *supra* §III.A-C. *See* EX2086, 71:12-16 (resistance and conductance

are inversely related). The only “reason” the Petition offered to lower barrier height was the failed assertion that this would ““improve TMR.”” Reply, 13.

The Petition offered no other valid obviousness theory for any claim. POR, 43-47. The grounds fail for *all* claims for the reasons discussed *supra* §III.A-C.

IV. THE REPLY’S IMPROPER NEW MOTIVATION TO COMBINE ARGUMENTS SHOULD NOT BE CONSIDERED AND FAIL IF THEY ARE

Unable to defend the Petition’s argument, the Reply advances three new arguments, based on new evidence, alleging: (1) *Butler* motivated POSAs to lower Bowen’s/Nagahama’s barrier height to increase TMR because (2) *Butler* allegedly teaches this would have changed TMR in some “uncertain” way and (3) this was “legally sufficient motivation.” Reply, 7-10 (*citing* EX2013-EX2014), 13-16 (*citing* EX1105-EX1106 and Butler pages 2-4 and Figs. 3-4) and 23-25 (*citing* EX2013). Based on this newly-alleged motivation from Butler, Petitioner alleges POSAs would have introduced oxygen vacancy defects into Bowen’s/Nagahama’s MgO layer to lower the barrier height to 0.33 eV (based on Soukup) in the hope it *might* increase TMR. Reply, 5. These new arguments are improperly relied on in a belated attempt to establish a new theory of *primary facie* unpatentability and should not be considered.

If considered, the Reply’s new unpatentability theory fails for reasons detailed below.

A. POSAs Motivated to Increase TMR Would Not Have Introduced Defects into Bowen's/Nagahama's MgO to Maximize TMR Because the Art Taught that Defect-Free MgO Layers Would Maximize TMR

The Reply says Soukup teaches the alleged “mechanism” to reduce barrier height (oxygen defects) whereas “the motivation to lower barrier height comes from...Butler/Mathon.” Reply, 24-25.

POSAs motivated by Butler/Mathon to increase TMR would not have injected defects into Bowen's/Nagahama's MgO layer because the art taught *the opposite*. It is undisputed that Butler/Mathon theorized high TMR using models of perfectly-crystalline MgO with electron symmetries that produced coherent tunneling *enhancement*,³ and Bowen/Nagahama tried to replicate Butler's modelled structure by making their MgO as defect-free as possible in an attempt to maximize TMR. POR, 69-70; EX1024, ¶¶90; EX2043, ¶¶47-49, 101-102; EX2087, ¶¶17-18; EX2086, 135:18-136:7-20, 138:9-19, 142:21-143:8, 145:1-147:19, 151:14-19. As Petitioner's expert admitted, POSAs would have expected MgO defects to cause scattering which would degrade TMR under Butler's theory. EX2086, 67:1-71:16 (admitting high TMR theorized “due to the absence of scattering in the barrier”), 76:3-78:9, 80:20-24 (scattering from defects “will degrade the TMR”), 90:24-91:17 (same); EX2087, ¶¶20-23.

³ Explained POR, 12-14.

Recognition that MgO defects could be present and MTJs could “function” despite them (Reply, 26-27) ignores the undisputed facts that Butler/Mathon’s theories were based on defect-free MgO and Bowen/Nagahama taught that *eliminating* oxygen defects to the extent possible would maximize TMR. POR, 69-70. The Reply’s assertion that POSAs—motivated by Butler—would have done the opposite and *introduced* defects into Bowen/Nagahama in an attempt to increase TMR is baseless. Reply, 5-8.

Petitioner’s remaining argument is nonsensical. Petitioner alleges that despite oxygen vacancies being “harmful ... the benefit of lowering barrier height would still” have motivated POSAs to introduce them. Reply, 27. Defects were believed “harmful” to high TMR. POR, 69-70; EX2086, 80:20-24 (admitting defects “will degrade the TMR”). The “benefit of lowering barrier height” Petitioner alleges is that it would change TMR in an “uncertain” way—it might increase or *decrease*. Reply, 7-8. The hindsight underlying Petitioner’s argument is laid bare by the absurd assertion that despite it being undisputed that the art taught that MgO defects would *undesirably lower TMR*, a POSA “still” would have injected MgO defects to allegedly achieve an *uncertain* change to TMR.

B. Petitioner’s Attempt to Dismiss Prior Art Teachings that Lowering Barrier Height Would Decrease TMR Fails

Petitioner never disputes lowering barrier height was known to decrease TMR for MTJs with Al₂O₃ barrier layers. POR, 37-43. The evidence includes *data*

Saito measured from real devices. Id. Petitioner’s allegation that POSAs would have dismissed these teachings because Al₂O₃ devices were “inadequate to predict MgO barrier behavior”⁴ cites only Bokor’s testimony. Reply, 10-13. Bokor’s testimony is not credible because it is refuted by objective evidence and his own testimony in other IPRs.

No prior art reference taught that *all* Al₂O₃ MTJ teachings relating to TMR were “inapplicable” to MgO MTJs. In two co-pending IPRs, Petitioner told the Board the opposite. Petitioner alleged that some Al₂O₃ MTJ references were predictive of the TMR in MgO MTJs, and that the same Bokor testimony cited here about Al₂O₃ teachings being “inapplicable to MgO MTJs” was not to the contrary. IPR2024-01493, Paper 1 at 24-28 (alleging POSAs would have applied Wang’s and Hosomi’s material selections for Al₂O₃ MTJs to MgO MTJs to purportedly increase TMR) and Paper 24 at 16 (“*Bokor never opined that all teachings about alumina MTJs would be discarded by a skilled artisan.*”); IPR2024-01447, Paper 1 at 35-37 (similar) and Paper 25, 20 (Dr. Bokor said “findings on Al₂O₃ barriers” were not “*irrelevant*’ to MgO MTJs,” citing EX2017, 148:10-18).

⁴ Al₂O₃ MTJs “lack crystallographic symmetry and ... coherent tunneling *enhancement*” so they are not *fully* predictive of MgO MTJs. POR, 13.

Petitioner and Bokor never attempted to reconcile their arguments across proceedings. That is reason enough why Petitioner fails to carry its burden here. The arguments in IPR2024-01493/IPR2024-01447 are admissions that POSAs expected at least *some* teachings about factors influencing TMR in Al₂O₃ MTJs to apply to MgO MTJs. That refutes the *only* argument Petitioner advances here for why POSAs allegedly would have dismissed as inapplicable to Bowen/Nagahama prior art teachings that lowering barrier height decreases TMR. Reply, 10-13.

Petitioner also ignores Dr. Yuasa's Nature Materials article's explanation that it was "surprising" that high TMR was achieved "despite the low barrier height" in an MgO MTJ. EX2017, 868-869; POR, 39-40. Petitioner never disputed this is a prestigious *peer-reviewed* journal. POR, 39-40. The Nature Materials editors and the peer-reviewers endorsed Yuasa's results as "surprising." Petitioner cites no evidence of anyone disputing that despite this article having been cited over 4,000 times. *Id.* Petitioner's and Bokor's unsupported assertions decades later that POSAs would not have expected the prior art teachings that TMR decreased at lower barrier heights to apply to MgO devices are not credible.

C. Butler Never Teaches That Barrier Height Impacts TMR

The Reply's assertion that Butler taught that lowering barrier height would change TMR in some "uncertain" way (Reply, 7-10, 13-16, and 23-25) is based on nothing but Bokor's naked say-so.

Dr. Bokor admitted Butler never mentions a TMR/barrier height relationship: “Butler’s paper doesn’t explore [the effect of changing barrier height on TMR]...within the confines of the paper.” EX2013, 71:22-72:7. That should end the matter. Petitioner must carry its burden based on *prior art* teachings (35 U.S.C. § 311(b))—not the naked say-so of it is expert. That is particularly true here given that Bokor’s testimony is not credible and he was not qualified to offer it.

1. Bokor’s Testimony is Facially Unreliable and Inconsistent With Objective Evidence

Petitioner’s assertion that POSAs “could not help noticing” Butler’s teaching that reducing barrier height would change TMR (Reply, 15) is refuted by objective evidence. It is undisputed that Butler’s “famous” 24-year-old paper has been cited almost *three thousand times* yet *no* publication has ever characterized Butler as teaching a TMR/barrier height relationship. POR, 49-50; EX2014, 41:16-25 (“I haven’t found a publication that explicitly discusses that”); EX2086, 21:4-22:7.

If Butler taught a TMR/barrier height relationship, Bokor should have been able to explain the alleged relationship. He could not. He said POSAs would have thought it “equally likely” that TMR would undesirably decrease as increase: “*I’m not completely sure* ... Butler is a pretty *complicated* paper. It’s a very advanced level of theory. ... I have a *hard time* being able to *hand-wave* my way one way or the other.” EX2013:72:13-25. Dr. Bokor should not have “hand-wav[ed].” But that is precisely what he did.

Bokor admitted “*I do not have the level of expertise required* to analyze and evaluate [Butler’s] gory details.” EX2086, 48:3-16. He allegedly “trust[ed]” its “higher level” “bottom line conclusions.” *Id.*, 46:18-48:16. That is no justification for his opinion that Butler teaches a TMR/barrier height relationship because Bokor admitted Butler never “explores” that relationship (EX2013, 71:22-72:7) or “explicitly” mentions barrier height (EX2086, 65:15-66:3).

Bokor’s “analysis” moves the Fermi energy level on Butler’s Figs. 3-4 to purportedly change the density of states (DOS). EX1105, ¶11. But he admitted “it is *not quite as simple* as” that. *Id.* Bokor said “*Butler’s calculations would need to be repeated to see what happens.*” *Id.* But Bokor never did “calculations” *he* said “need[ed]” to be done and admitted he lacked the expertise to do them. EX2086, 103:5-15 (“I can’t repeat” Butler’s calculations).

Bokor’s declaration alleged changing the DOS “will change TMR” based on an equation (EX1105, ¶11), but Bokor *disavowed* this at deposition because “Butler criticizes that equation.” EX2086, 107:6-110:24 (“I’m correcting” and “modif[ying] my testimony”). He offered a new theory based on substituting “tunneling DOS” into the equation and said “Butler is my support for that” despite having to acknowledge that Butler “doesn’t” describe that. *Id.*, 110:25-111:20; EX2087, ¶¶30-32. Bokor’s admission that he did not understand Butler’s “details” and only relied on Butler’s “higher level” “bottom line conclusions” (*id.*, 46:18-

48:16) is fatal to Bokor’s attempt to read into Butler a teaching to use “tunneling DOS” as a parameter in the equation “Butler criticizes” despite Bokor admitting Butler “doesn’t” describe this (*id.*, 110:25-111:20).

Additional reasons why Bokor’s Butler analysis fails are detailed *infra* §IV.C.2 with citation to Dr. Ross. But the Board need not even dive into this complex technology to see that Bokor’s testimony warrants no weight. Bokor admits he had a “hard time” understanding Butler because it is “complicated” (EX2013:72:13-25) and he lacked the “expertise required” to analyze Butler in detail (EX2086, 48:3-16). Bokor admitted his declaration testimony was wrong and needed to be “corrected.” EX2086, 107:9-110:24. Bokor moves the Fermi level in Butler’s figures despite admitting it is not that “simple” and that “calculations” are “need[ed]” (EX1105, ¶11) that Bokor did not have the expertise to do (EX2086, 103:5-15). The Board should not credit Bokor’s testimony that sees a phantom teaching in Butler—of an “uncertain” TMR/barrier height relationship that Bokor admits Butler “doesn’t explore” (EX2013, 71:22-72:7) and that Bokor cannot explain (*id.*)—that no one has ever seen despite Butler having been cited thousands of times.

2. Bokor’s “Analysis” Fails

Bokor’s allegation that “Butler taught that a change in barrier height” would affect tunneling is based on the assertion that moving the Fermi level on Butler’s

Figs. 3-4—which show the density of states (DOS) and Fermi level for the ideal Fe/MgO/Fe structure Butler modeled—would change the majority/minority DOS at the Fermi level. EX1105, ¶¶10-12. Moving the Fermi level on Butler’s figures—which Butler nowhere describes—is a meaningless exercise POSAs would not have engaged in and would not have drawn any conclusions from. EX2087, ¶¶8-12, 24-32.

Butler developed a “model” for an Fe/MgO interface then “used [this model] for calculations of the electronic and magnetic structures ... described in Sec. III.” EX1044, 1. Section III includes Figs. 3-4 which show the result of Butler’s model-based calculations. EX1044, 2-3 (DOS “was calculated” from the model); EX2087, ¶¶13-16; EX2086, 23:5-11. The reason Bokor had to admit it is not as “simple” as moving the Fermi level in Butler’s Figs. 3-4 (EX1105, ¶11) is because the Fermi level is a property of the Fe/MgO structure Butler calculated from his model, not a variable POSAs can simply “mov[e].” EX2087, ¶¶8-12.

Petitioner proposes changing Butler’s Fermi level by “introducing oxygen defects [into the MgO] to adjust barrier height.” Reply, 15-16. This would yield a *different* physical structure than what Butler modelled. EX2087, ¶16; EX2053, ¶96. Butler provides *no* information about the DOS or Fermi level of Petitioner’s modified physical structure because is undisputed that Butler *only* modelled *defect-free* crystalline MgO. POR, 15, 18, 69; EX1044, 1-3; EX2053, ¶¶47-49, 95-

96, 101-102; EX2086, 33:8-17 (admitting Butler “didn’t model vacancy defects”), 43:25-44:4, 55:6-56:3, 91:22-92:10 (Butler’s Figs. 3-4 “do not account ... for the introduction of oxygen vacancies”), 132:23-134:25.

To understand what (if any) impact a “lower” barrier height resulting from MgO defects would have had on TMR, POSAs would have needed to develop a *different model* than Butler’s. EX1044, 1-3; EX2087, ¶¶13-16; EX2086, 56:4-15 (admitting the model would have to be “different” but Bokor is “*not an expert on this*” so he could not opine on “how much” would have to change). It is undisputed that a different model accounting for MgO defects would have been far more complicated than Butler’s model. EX2087, ¶16. Bokor admitted that developing a more complicated model to address MgO defects was beyond a POSA’s capabilities. EX2086, 60:16-61:7 (“*I couldn’t do that calculation*” to model oxygen vacancies which is “even more complicated”; POSAs “would not be able to” either), 96:12-98 (same), 63:11-65:7 (Bokor looked for but failed to find anybody in the art having modified Butler’s model to account for oxygen defects); 85:25-87:8 (POSAs “would not have the capability to make a calculation at this level of sophistication” and “I can’t testify as to how much they would have to change the model”), 49:14-50:2 (Bokor is “*not an expert*” so he was “uncomfortable” opining on the sensitivities of changing Butler’s model), 52:6-53:1 (same).

Bokor's handwaving is breathtaking. He admits POSAs would have expected MgO defects to cause scattering and degrade TMR. EX2086, 93:20-96:11. Undaunted, Bokor alleges it was "reasonable to expect" that lowering barrier height *might* "overcome the degradation of TMR that comes from scattering" despite POSAs being unable to "predict" if that were true and despite Bokor not doing any experimentation to test his theory. EX2086, 93:20-96:11; *see also id.*, 99:18-101:3 (admitting neither Bokor nor POSAs could figure out how oxygen defects would affect Butler's calculations, alleging "optimist[ic]" POSAs would have tried anyway, but admitting Bokor searched and failed to find anyone in the prior art having tried this), 79:12-82:19 (POSAs could not "predict" the impact on TMR of lower barrier height or scattering from defects).

The Reply's assertion that Butler motivated POSAs to lower barrier height in Bowen/Nagahama to change TMR finds no support in Butler which says nothing about barrier height impacting TMR. EX2053, 93-96; EX2087, ¶¶24-32; EX2013, 71:22-72:7 (Bokor admitting same). Petitioner's new Reply theory hinges entirely on the naked say-so of Bokor who, as detailed above, is simply not credible. *No credible evidence* supports Petitioner's new Reply theory which fails if considered.

D. Petitioner's New Theory is Not "Legally Sufficient"

Petitioner says lowering barrier height to achieve an "uncertain" impact on TMR is "legally sufficient motivation." Reply, 7 (citing *KSR* and *Pfizer*). That is not the law.

Under *Pfizer*, "'obvious to try' is *not* the proper standard by which to evaluate obviousness." *Pfizer v Apotex*, 480 F.3d 1348, 1367-1368 (Fed. Cir. 2007) *rehearing denied* 488 F.3d 1377, *cert denied* 552 U.S. 941 (2007). There, claims were obvious because the prior art "predicted the results, which Pfizer merely had to *verify* through routine testing." *Id.*, 1367-1368. Here, the results were unpredictable. EX2086, 79:12-82:19 (admitting POSAs could not "predict" the impact on TMR of lower barrier height or MgO defects), 95:1-15 (same); EX2013, 64:9-14; EX2087, ¶¶19-24.

Unpredictability also forecloses Petitioner's reliance on *KSR*. Lowering barrier height was not a "predictable solution[]" "identified" in the prior art to increase TMR with an expectation of success. *KSR Int'l v. Teleflex* 550 U.S. 398, 421 (2007); POR, 34 (citing evidence). Petitioner never alleges POSAs could have predicted what the TMR of Bowen or Nagahama would have been if their barrier heights were lowered to 0.33eV and Bokor admitted he had no idea. EX2013, 80:10-24; 188:2-19.

V. PETITIONER'S RELIANCE ON SOUKUP FAILS

The Grounds alleged that Soukup motivated adopting a barrier height of 0.33 eV . Petition, 33-34, 57-58. The Reply fails to refute that Petitioner's reliance on Soukup fails. POR, 51-72.

A. Petitioner Fails to Establish that Soukup is Analogous Art

Petitioner fails to carry its burden to show that Soukup is from the same field of endeavor as the '909 Patent or reasonably pertinent to the problem the inventor was involved with. POR, 51.

Petitioner's allegation that the '909 Patent and Soukup are in the alleged "field" of "current-voltage characteristics of MgO barriers" (Reply, 17) ignores the considerations the Federal Circuit applies. Applying the *proper* considerations, the '909 Patent's field is MgO MTJs having magnetic electrodes and a TMR. POR, 51-54. Petitioner never disputes Soukup's devices are not MTJs, have non-magnetic electrodes and no TMR. *Id.* Petitioner's assertion that Soukup must be in the same field because "Simmons" is (Reply, 18) ignores that Simmons is cited extensively by MTJ references because its tunneling model was foundational for MTJs, whereas Soukup has never been cited by an MTJ reference (POR, 57).

Petitioner never disputes that the problem Yuasa addressed was achieving an MTJ device with improved TMR and low resistance/output voltage. POR, 54-57. Petitioner's assertion that Soukup is reasonably pertinent because it relates to the

“**solution** the ‘909 Patent adopts and claims” reveals hindsight bias and misstates the law. Reply, 19 (citing *Wyers*). *Wyers* found art reasonably pertinent because it was “directed toward the same **problem** the inventor was trying to solve.” *Wyers v. Master Lock*, 616 F.3d 1231, 1238 (Fed. Cir. 2010). Petitioner’s assertion that IPB’s explanation that no **POSAs** considered Soukup relevant to MTJs “improperly considers their subjective intent or knowledge” (Reply, 19-20) mischaracterizes *Singhai* which said the “**inventor’s** subjective intent or knowledge” was not determinative of whether art is analogous. *In re Singhai*, 602 F.App’x 826, 830 (Fed. Cir. 2015).

B. Soukup Did Not Motivate a 0.33 eV Barrier Height to Increase TMR

Even if analogous, Petitioner’s reliance on Soukup fails. POR, 58-72.

1. Nothing Teaches that a 0.33 eV Barrier Height Would Increase TMR

Petitioner says Soukup having no TMR is “irrelevant” because Butler/Mathon motivated lowering barrier height. Reply, 24-25. Butler/Mathon do not teach a 0.33 eV barrier height. Neither do Bowen/Nagahama. Petitioner points to no reference describing a device with a TMR that discloses a barrier height of 0.33 eV, let alone that a 0.33 eV barrier height would yield a high TMR. Petitioner’s grounds fail because the only prior art relied upon for a barrier height within either claimed range is Soukup (Petition, 33-37, 57-59), and Soukup

indisputably never teaches that its alleged barrier height of 0.33 eV would increase TMR (POR, 60-62).

2. Petitioner's Failure to Dispute Soukup's Teaching that Schottky Emissions Dominate at an Alleged Barrier Height of 0.33 eV is Fatal

Petitioner never disputes that Soukup says the dominant current-flow mechanism for its devices with alleged barrier heights of 0.33 eV was Schottky emission, nor that POSAs would have avoided barrier heights where Schottky emissions were significant because that would decrease TMR. POR, 63-67. ***Dr. Bokor's reply declaration did not dispute either point.***

Petitioner's only response is obfuscation. Reply, 25-26. Petitioner mischaracterizes Dr. Ross as attributing Soukup's Schottky emissions to a "thick[er] barrier" than in Bowen/Nagahama. *Id.* Dr. Ross explained it was unsurprising that tunnelling was not the dominate current flow in Soukup's devices because ***tunnelling*** requires thinner barriers. EX2053, ¶129. Dr. Ross never said ***Schottky emissions*** require thick barriers—they do not. Dr. Ross was unequivocal that low "barrier height" can lead to Schottky emissions dominating which "would be expected to dramatically decrease TMR" in Bowen/Nagahama. *Id.*, ¶¶136-139. Bokor never disputed this.

Petitioner' assertion that POSAs would have adopted Soukup's alleged barrier height of 0.33 eV to ***increase*** TMR fails because Soukup says Schottky

emissions would be significant at that alleged barrier height which POSAs would have expected to *decrease* TMR.

3. Soukup's 0.33 eV Value Was Inaccurate

As the Board found in denying institution in IPR2024-01384 (Paper 10, 18-20), Soukup said the Arrhenius plot method used to calculate the 0.33 eV barrier height yielded values that were “too low.” POR, 67-69. Petitioner's response mischaracterizes Soukup. Reply, 20-24.

Soukup's thesis says he expected the Arrhenius plot and zero-intercept methods to yield “the same [barrier height] value” but they did not. EX2039, 57-58. Because barrier height “increase[d] with increasing temperature” the Arrhenius plot produced a barrier height value “*less than the real barrier height.*” *Id.*, 89; *see also id.*, 88 (Arrhenius plot slope is “*not* ... proportional to barrier height” if barrier height “is a function of temperature”). Soukup's thesis unambiguously says the 0.33 eV barrier height value Petitioner hinges its grounds on is “less than the real barrier height.” *Id.*, 88-89. That is undisputed.

Petitioner alleges Soukup “corrected the ... data” for one device—PY-G-11(1)—before publishing his paper and “noted” that the Arrhenius plot for this *single* device was “valid.” Reply, 21-24. Not so.

Soukup repeats the thesis's conclusions that (1) if barrier height increases with temperature the Arrhenius plot produces a number “*smaller than the actual*

barrier height” (Soukup, 3234) and (2) “barrier height also appeared to become higher with higher temperature” (*id.*, 3236). Petitioner admits POSAs would not have relied on the Arrhenius plots for other devices (Reply, 21) but alleges Soukup says the Arrhenius plot’s accuracy was device-specific and correct for PY-G-11(1). Soukup never says this.

Despite asserting that Soukup “corrected the PY-G-11(1) data” (Reply, 23), Petitioner never disputes that Soukup’s Arrhenius plot value for this device is *identical* (0.33 eV) to the value the thesis said was “less than the real barrier height.” EX2039, 57-58, 88-89; POR, 67. Petitioner also never disputes that Soukup restates the thesis’s conclusions that barrier height increased with temperature (Soukup, 3236) which meant the Arrhenius plot gave “a number ... *smaller than the actual barrier height*” (Soukup, 3234). Petitioner’s assertion that POSAs would not have believed that 0.33 eV was smaller than the “actual” or “real” barrier height is incredible. *Id.*, EX2039, 88-89.

Finally, Petitioner never disputes that Soukup (like the thesis) reports a different barrier height (0.714 eV) for device PY-G-11(1) using the zero-intercept method. Soukup, 3222; EX2029, 57-58. Petitioner ignores this, never attempts to reconcile Soukup’s teachings, and offers no reason why POSAs would have credited the 0.33 eV value from the Arrhenius plot method Soukup says was

suspect over the 0.714 eV zero-intercept value. Petitioner cannot carry its burden by ignoring facts refuting Petitioner's assertion.

Both grounds rely on Soukup to motivate adopting a 0.33 eV barrier height *and* to establish a reasonable expectation of success in achieving an MTJ with this barrier height. POR, 58-67, 70-72. Petitioner's failure to prove that POSAs would have believed 0.33 eV was the actual barrier height of Soukup's device is fatal to both grounds.

4. Petitioner Relies on Incompatible Soukup Teachings

Petitioner never disputes Soukup's observed "inverse relationship between oxygen defects and MgO barrier height" Petitioner relies on (Reply, 20) was from the zero-intercept method. POR, 67-69; Soukup, 3233; EX2039, 57-58. As the Board found in IPR2024-01384 (Paper 10, 22-25), Soukup's Arrhenius plot method that produced the 0.33 eV value yielded the *opposite* barrier height/oxygen defect relationship. POR, 67-69.

Petitioner alleges POSAs "*like Soukup* would not have relied upon the Arrhenius plots for" the devices made under oxygen pressure, suggesting Soukup taught no barrier height/oxygen defect relationship from the Arrhenius plots. Reply, 21. Soukup refutes this: "*for increasing oxygen pressure ... the barrier height determined from the Arrhenius plot went down.*" Soukup, 3329.

“Petitioner cannot have it both ways.” IPR2024-01384, Paper 10, 22-25. If POSAs believed the zero-field intercept method accurately measured barrier height and its relationship to oxygen-vacancy defects, POSAs would have considered the correct barrier heights to be those reported using that method which Petitioner never relied on because they fail to meet most Challenged Claims. POR, 68.

VI. SECONDARY CONSIDERATIONS

A. Nexus

Petitioner never disputes that Yuasa recognized that “defect-free crystalline MgO”—used by Bowen/Nagahama—had a barrier height yielding a resistance area (*RA*) “too high” for MRAM applications, so he introduced MgO defects to *lower the resistance* yet “surprisingly” achieved high TMR. POR, 25-27. The claims capture this by reciting an MTJ with “MgO_x(001) with oxygen vacancy defects and ($0 < x < 1$)” and a barrier height within a claimed range. *Supra* §II.

EX2024, EX2029 and EX2022 have direct nexus to the claimed invention. POR, 25-27.

Japan’s Society of Applied Physics highlighted Yuasa’s “pioneering work” in developing “technologies to *reduce the resistivity* of elements, which is *indispensable* when increasing the density of HDDs and MRAMs.” EX2024, 3. The “Science and Technology Prize” similarly recognized Yuasa’s contribution to making MgO MTJ’s capable of “practical use” in “hard disk storage devices

(HDDs).” EX2029, 2. Petitioner’s only response—that this evidence lacks nexus to the claimed lower barrier height (Reply, 4)—fails because Petitioner never refutes the evidence establishing that reducing barrier height was *how* Yuasa achieved the reduced resistance for which he was praised because it made practical MTJ HDD and MRAM devices possible. POR, 17-20; EX2017, 869.

Petitioner never disputes that EX2022’s praise for an MgO MTJ with a “*smaller*” “*barrier height*” making “a TMR sensor with *low resistance* and high TMR possible” has a nexus to the claims. EX2022, 107; POR, 25. Instead, Petitioner falsely mischaracterizes EX2022 as “credit[ing] Butler/Mahon and not Yuasa” for low resistance. Reply, 3. The “theoretical prediction” EX2022 attributed to Butler/Mathon was that an Fe(001)/MgO(001)/Fe(001) MTJ could produce “large TMR.” EX2022, 107. Butler/Mathon did not teach low resistance—Yuasa’s Nature Materials paper did. EX2017, 869 (“low *R_A*”); EX2053, 56-61. EX2022 credited *Yuasa’s* Nature Materials paper as having “demonstrated” that a device with high TMR and *low resistance* was possible. EX2022, 107.

B. Petitioner Misstates the Law

Petitioner’s assertion that secondary considerations cannot apply because the barrier height limitation—in isolation—was known (Reply, 2) misstates the law. Showing *individual* claim elements were known does not refute objective secondary consideration evidence refuting Petitioner’s hindsight *combinations*.

Chemours Co. FC v. Daikin Indus, 4 F.4th 1370, 1378 (Fed. Cir. 2021) (citations omitted) (“Contrary to the Board’s decision, the separate disclosure of individual limitations [in the art], where the invention is a unique combination ... does not negate a nexus. Concluding otherwise would mean that nexus could never exist where the claimed invention is a ***unique combination of known elements*** from the prior art.”).

Respectfully submitted,
GODO KAISHA IP BRIDGE I

Date: November 19, 2025

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CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24, the undersigned certifies that the foregoing **PATENT OWNER'S SUR-REPLY TO PETITIONER'S REPLY** contains 5,598 words excluding; a table of contents, a table of authorities, a certificate of service or word count, or appendix of exhibits or claim listing. Patent Owner has relied on the word count feature of the word processing system used to create this paper in making this certification.

Date: November 19, 2025

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CERTIFICATE OF SERVICE UNDER 37 C.F.R. § 42.6 (E)(4)

I certify that on November 19, 2025, a copy of the foregoing document, including any exhibits filed therewith, is being served via electronic mail, as previously consented to by Petitioner, upon the following:

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