

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AMPEREX TECHNOLOGY LIMITED

Petitioner

v.

MAXELL HOLDINGS, LTD,

Patent Owner

Case: IPR2021-01442

U.S. Patent No. 9,166,251

PETITION FOR *INTER PARTES* REVIEW

UNDER 35 U.S.C. § 312 AND 37 C.F.R. § 42.104

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LIST OF EXHIBITS

Exhibit	Short Name	Description
Ex. 1001	'251 Patent	U.S. Patent No. 9,166,251
Ex. 1002	'251 File History	File History of U.S. Patent No. 9,166,251
Ex. 1003	van Schalkwijk Declaration	Declaration of Dr. Walter van Schalkwijk under 37 C.F.R. § 1.68
Ex. 1004	van Schalkwijk CV	<i>Curriculum Vitae</i> of Dr. Walter van Schalkwijk
Ex. 1005	Kasamatsu	WO2006/061936, published on June 15, 2006
Ex. 1006	Katayama	WO2007/066768, published on June 14, 2007
Ex. 1007	Miyatake	JP2007/335294, published on December 27, 2007
Ex. 1008	Yoshida	EP1115166, published on July 11, 2001
Ex. 1009	Nagayama	WO2006/134833, published on December 21, 2006
Ex. 1010	Takezawa	U.S. Patent Application Publication No. 2007/0015058, filed in the United States on July 14, 2006, and published on January 18, 2007
Ex. 1011	van Schalkwijk	<i>"Advances in Lithium-Ion Batteries,"</i> Walter A. van Schalkwijk and Bruno Scrosati, Eds., Kluwer Academic Publishers (2002)
Ex. 1012	Biensan	P. Biensan, B. Simon, J. P. Pérès, A. De Guibert, M. Broussely, J. M. Bodet, and F. Perton, J. Power Sources, 81–82, 906 (1999)
Ex. 1013	Richard	M. N. Richard and J. R. Dahn, J. Power Sources, 79, 135 (1999)
Ex. 1014	Spotnitz	R. Spotnitz and J. Franklin, J. Power Sources, 113, 81 (2003)

Exhibit	Short Name	Description
Ex. 1015	Baba	Y. Baba, S. Okada, and J. I. Yamaki, Solid State Ionics, 148, 311 (2002)
Ex. 1016	Abraham	D. P. Abraham, E. P. Roth, R. Kostecki, K. McCarthy, S. MacLaren, and D. H. Doughty, J. Power Sources, 161, 648 (2006)
Ex. 1017	MacNeil	D. D. MacNeil, J. Electrochem. Soc., 146, 3596 (1999)
Ex. 1018	Molicel [®] Product Data Sheet	<i>Product Data Sheet Model ICR18650H</i> , MOLICEL [®] (2005) https://www.custompower.com/documents/ICR18650H.pdf .
Ex. 1019	Katayama '577	Katayama et al. US 2007/0264577
Ex. 1020	JP '575	JP 2007/259575, filed October 3, 2007
Ex. 1021	JP '527	JP 2008/039527, filed February 21, 2008
Ex. 1022	Amagi	JP 2003/306594, published October 31, 2003
Ex. 1023	Harris	F.W. Harris, J. Chem. Ed., 58, (11), 837 (1981)
Ex. 1024	DuPasquier	A.DuPasquier et al, J. Power Sources, 136 (2004)
Ex. 1025	Shinohara	U.S. 6,447,958, filed in the United States on April 26, 1999 and granted on September 10, 2002
Ex. 1026	<i>Reserved</i>	<i>Reserved</i>

Exhibit	Short Name	Description
Ex. 1027	Maleki	H. Maleki, et al, J. Electrochem Soc, 146, 3224-3229 (1999)
Ex. 1028	Infringement Contentions	Maxell Infringement Contentions, <i>Maxell, Ltd. v. AmpereX Tech. Ltd.</i> , 6:21-cv-00347-ADA (W.D. Tex., Apr. 6, 2021)
Ex. 1029	Shirakata	US 2007/0248886, published October 25, 2007
Ex. 1030	Order of Governing Proceedings	June 24, 2021 Order of Governing Proceedings
Ex. 1031	Aqua-Calc Website	https://www.aqua-calc.com/page/density-table/substance/alumina#:~:text=Alumina%20weighs%203.965%20gram%20per%20cubic%20centimeter%20or,25%C2%B0C%20%2877%C2%B0F%20or%20298.15K%29%20at%20standard%20atmospheric%20pressure.
Ex. 1032	Magistris	A. Magistris, et al., <i>Structure, porosity and conductivity of PVdF films for polymer electrolytes</i> , 97 J. Power Sources 657 (2001)
Ex. 1033	Zhang 1998	Zhang et al Journal of Power Sources 70 (1998) 16-20
Ex. 1034	Zhang '415	US 2004/0166,415A1, published August 26, 2004
Ex. 1035	Standing Order	August 18, 2021 Standing Order

Amperex Technology Limited (“Petitioner”) petitions for *Inter Partes* Review (“IPR”) under 35 U.S.C. §§311–319 and 37 C.F.R. §42 of Claims 1–37 (“the challenged claims”) of U.S. Patent No. 9,166,251 (“the ’251 Patent”).

I. GROUNDS FOR STANDING

Petitioner certifies that the ’251 Patent is available for IPR and that Petitioner is not barred or estopped.

II. PAYMENT OF FEES

Petitioner authorizes Account No. 16-0605 to be charged.

III. OVERVIEW OF CHALLENGES

Pursuant to Rules 42.22(a)(1) and 42.104(b)(1)–(2), Petitioner requests cancellation of the challenged claims in view of the grounds set forth. This petition provides details on claim construction and where each element is found in the cited prior art. Additional support is provided in Ex. 1003–Declaration of Walter van Schalkwijk (“van Schalkwijk”). ¶ 10 *et seq.*

Ground 1A: Claims 1, 3–10, 13–30, and 32–37 are unpatentable under pre-AIA 35 U.S.C. §103(a) over Kasamatsu and Katayama.

Ground 1B: Claims 2, 11, and 12 are unpatentable under pre-AIA 35 U.S.C. §103(a) over Kasamatsu, Katayama, and Miyatake.

Ground 2A: Claims 1, 4–10, 13, 15–23, 26–27, and 30–35 are unpatentable under pre-AIA 35 U.S.C. §103(a) over Yoshida, Nagayama, Takezawa, and Amagi.

Ground 2B: Claims 2, 11, and 12 are unpatentable under pre-AIA 35 U.S.C. §103(a) over Yoshida, Nagayama, Takezawa, Amagi, and Miyatake.

Ground 2C: Claims 3, 14, 24–25, 28–29, and 36–37 are unpatentable under pre-AIA 35 U.S.C. §103(a) over Yoshida, Nagayama, Takezawa, Amagi, and Katayama.

IV. BACKGROUND

A. The '251 Patent

The '251 Patent describes a nonaqueous electrolyte battery and separator. Ex. 1001, 2:14-37; Ex. 1003, ¶¶ 80–105.

B. Prosecution History

The '251 Patent was filed on February 17, 2010. In a first Action, the Examiner rejected the claims as obvious over US 2008/0038631 (Nakura) and US 2007/0264577 (Katayama '577). Ex. 1002, 685; Ex. 1003, ¶ 110. The Applicant responded by amending certain claims to require at least 50 vol % of heat-resistant particles (claim 1) and at least 80 vol % of heat-resistant particles based on the total volume (claims 3 and 14). Ex. 1002, 752-53, 755, 759-60; Ex. 1003, ¶ 111.

After additional office actions (Ex. 1002, 797–820, 828-837; Ex. 1003, ¶¶ 113-15) and after amending independent claim 1 to require that “the shutdown layer has a thickness A (μm) of 5 to 30, the heat-resistant layer has a thickness B (μm) of 1 to 10, a sum of A and B is 6 to 23, and a ratio A/B is 1/2 to 4” to overcome

Nakura, (Ex. 1002, 839, 849), and, in a later argument, arguing that the cited combination would lead to a short-circuit, the Examiner allowed the case. Ex. 1002, 879, 885; Ex. 1003, ¶ 116.

C. **Priority Date**

The challenged claims are not entitled to the foreign priority applications' priority dates because their disclosures do not demonstrate Patent Owner was in possession of the claimed invention. *See Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1380 (Fed. Cir. 2015); Ex. 1003, ¶ 107. Neither of the priority documents (JP 2008/039527 or JP 2007/259575) disclose "a proportion of particles with a particle size of 0.2 μm or less in the heat-resistant fine particles is 10 vol % or less and a proportion of particles with a particle size of 2 μm or more in the heat-resistant fine particles is 10 vol % or less." Ex. 1003, ¶ 107. Rather, unlike the '251 Patent, the priority documents only provide average particle sizes and do not specify the claimed size distribution. *Contrast* Ex. 1001, 15:53–57 *with* Ex. 1020, [0083] and Ex. 1021, [0107]; Ex. 1003, ¶ 107. The applications each provide only a single overly broad, generic reference to 0.001–15 μm (Ex. 1020, [0033]) or 0.01–10 μm (Ex. 1021, [0025]), respectively, and such statements are insufficient to establish possession of the much narrower claimed range (less than 10 vol. % below 0.2 and less than 10 vol. % above 2 μm). Ex. 1003, ¶ 107; *In re Wako Pure Chem. Indus., Ltd.*, 4 F. App'x 853, 857 (Fed. Cir. 2001) (non-precedential) (holding

applicant was not entitled to foreign priority application where the foreign priority document disclosed a broad range of compounds and the claims covered a narrower subset within that range); *Gen. Hosp. Corp. v. Sienna Biopharmaceuticals, Inc.*, 888 F.3d 1368, 1372 (Fed. Cir. 2018) (“The disclosure of a broad range of values does not by itself provide written description support for a particular value within that range.”). Thus, the earliest possible priority date of the challenged claims of the ’251 Patent is September 30, 2008, the date the PCT application was filed.

Moreover, the earliest date for the critical date for §102(b) statutory bar purposes is September 30, 2007, one year prior to the PCT application filing date. *See* 35 U.S.C. §102(b) (“A person shall be entitled to a patent unless — . . . (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the *date of the application for patent in the United States.*”) (emphasis added); 35 U.S.C. §119(a); MPEP §§706.02(VI), 2133.02(II), 2139.01; *Japan Cash Mach. Co. v. Mei, Inc.*, No. 2:05-cv-01433-RCJ-RJJ, 2008 U.S. Dist. LEXIS 138439, at *52 (D. Nev. Oct. 21, 2008); *LG Elecs., Inc. v. Core Wireless Licensing S.A.R.L.*, No. IPR2015-01988, Paper 31 at 26-28 (PTAB Mar. 16, 2017).

D. Claim Construction (37 C.F.R. §42.104(b)(3))

Claim terms are interpreted according to the same claim construction standard used in a civil action under 35 U.S.C. §282(b), in accordance with the ordinary

meaning understood by a person of ordinary skill in the art (“POSITA”) under *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). Petitioner reserves all rights to take different positions with respect to claim construction in any other proceeding.

For purposes of this IPR, each of the challenged claims includes terms that POSITA would understand according to their plain and ordinary meaning. Ex. 1003, ¶ 118.

V. PRIOR ART REFERENCES

A. WO Publication No. WO2006/061936 (“Kasamatsu”)

Kasamatsu (Ex. 1005) is a PCT patent application published in Japanese on June 15, 2006. Kasamatsu is prior art under pre-AIA 35 U.S.C. §102(a) and §102(b) because it was published (June 15, 2006) more than one year prior to the effective US filing date of the application (September 30, 2008).¹

B. WO Publication No. WO2007/066768 (“Katayama”)

Katayama (Ex. 1006) is a PCT patent application published in Japanese on June 14, 2007. Katayama is prior art under pre-AIA 35 U.S.C. §102(a) and §102(b)

¹ Exs. 1005, 1006, 1007, 1009, and 1022 are accompanied by certified translations and the original document in the same exhibit. 37 C.F.R. §42.63(b); 35 U.S.C. §312(a)(5); *Ninebot (Tianjin) Tech. Co. v. Inventist, Inc.*, No. IPR2018-00134, Paper 11 at 10-11 (PTAB Apr. 23, 2018).

because it was published (June 14, 2007) more than one year prior to the effective US filing date of the application.

C. Japanese Patent Publication No. JP2007/335294 (“Miyatake”)

Miyatake (Ex. 1007) is a Japanese patent application published on December 27, 2007. Miyatake is prior art under pre-AIA 35 U.S.C. §102(a). *See* Section IV.C.

D. European Patent No. EP 1,115,166 (“Yoshida”)

Yoshida (Ex. 1008) is a European patent published on July 11, 2001. Yoshida is prior art under pre-AIA 35 U.S.C. §102(a) and §102(b) because it was published (July 11, 2001) more than one year prior to the effective US filing date of the application.

E. WO Publication No. WO 2006/134833 (“Nagayama”)

Nagayama (Ex. 1009) is a PCT patent application published in Japanese on December 21, 2006. Nagayama is prior art under pre-AIA 35 U.S.C. §102(a) and §102(b) because it was published (December 21, 2006) more than one year prior to the effective US filing date of the application.

F. U.S. Patent Publication No. US 2007/0015058 (“Takezawa”)

Takezawa (Ex. 1010) is a U.S. patent application published on January 18, 2007. Takezawa is prior art under pre-AIA 35 U.S.C. §102(a) and §102(b) because it was published (January 18, 2007) more than one year prior to the effective US filing date of the application.

G. Japanese Patent Publication No. JP 2003/306594 (“Amagi”)

Amagi (Ex. 1022) is a Japanese patent application published on October 31, 2003. Amagi is prior art under pre-AIA 35 U.S.C. §102(a) and §102(b) because it was published (October 31, 2003) more than one year prior to the date of the effective US filing date of the application.

VI. ORDINARY SKILL IN THE ART

A POSITA would have had at least a bachelor’s degree in chemistry, chemical engineering, or materials science and five or more years of experience in the field of batteries and battery materials. Ex. 1003, ¶ 11.

VII. HOW THE CHALLENGED CLAIMS ARE UNPATENTABLE

At the time of the earliest possible priority date, a known problem with lithium-ion batteries was (and remains) the potential for spontaneous thermal decomposition (i.e., thermal runaway). Ex. 1003, ¶¶ 43-45; 64. To minimize the possibility of thermal runaway and improve safety, lithium-ion batteries used a battery separator that would shutdown at abnormal temperatures. Ex. 1003, ¶¶ 68-69. These batteries also used positive electrode active materials having higher heat generation starting temperatures. Ex. 1003, ¶¶ 64-67. In addition, as separator technology developed, a heat-resistant layer was added to the separator to reduce thermal shrinkage and further prevent a short-circuit. Ex. 1003, ¶¶ 71-72.

The claims recite a separator and a battery that comprises these well-known components and applications. Indeed, to overcome the cited prior art during prosecution, the Applicant argued that the primary reference failed to use *both* the claimed size distribution and claimed concentration of particles *at the same time* to achieve the desired heat-resistant effect in an exemplary separator. As will be demonstrated below, the prior art demonstrates that the distribution and concentration, the only elements allegedly missing during prosecution, were well-known.

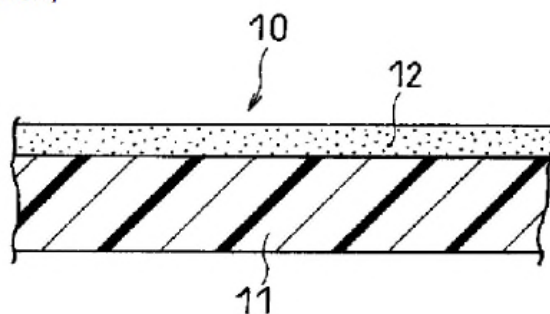
A. Ground 1A: Claims 1, 3–10, 13–30, 32–37 are unpatentable under pre-AIA 35 U.S.C. §103(a) over Kasamatsu and Katayama

1. Overview

i. Kasamatsu and Katayama

Kasamatsu discloses a nonaqueous electrolyte battery and a separator (Figure 1); the separator (10) comprising a heat-resistant layer and a shutdown layer containing a thermoplastic resin (11). Ex. 1005, [0001]-[0006], [0014]-[0017], [0023], [0028]-[0029], [0036], [0056], [0074]-[0075], [0081], Fig. 1; Ex. 1003, ¶¶ 120-128.

[FIG. 1]



Katayama similarly discloses a nonaqueous electrolyte battery and a separator for use therein; the separator comprising a heat-resistant layer and a shutdown layer. Ex. 1006, [0002], [0014]-[0015], [0021]-[0027], [0053]-[0054], [0059], [0068], [0076], [0082], [0104], [0106], [0124], [0185], Table 3; Ex. 1003, ¶¶ 130-40.

ii. Motivation to Combine

A POSITA would have understood Kasamatsu discloses a separator with a shutdown temperature range of 80–180 °C; the separator comprising a 5 or 6 µm thick heat-resistant layer made of heat-resistant fine particles and a binder, integrated with a 8–30 µm thick shutdown layer made of a thermoplastic resin. Ex. 1005, [0001], [0023], [0014]-[0017], [0020], [0036], [0056], [0075], [0081], Fig. 1; Ex. 1003, ¶¶ 125-26, 147. Kasamatsu teaches a need to control particle size so to avoid short circuit. Ex. 1005, [0028]–[0029] (“When the primary particles for forming the bonded particles used in the present invention **have an excessively large particle size**, a short circuit tends to occur during the production of a

battery.”) (emphasis added); Ex. 1003, ¶ 148. Kasamatsu further teaches that a higher concentration of heat-resistant fine particles increases the heat-resistant effect of the heat-resistant layer. *See* Ex. 1005, [0017]; Ex. 1003, ¶ 148. Kasamatsu, however, does not teach the particle size distribution of heat-resistant fine particles in the heat-resistant layer or disclose a concentration of heat-resistant particles in terms of volume-percent. Ex. 1003, ¶ 148.

Understanding the known problem of short circuit as a result of thermal shrinkage and in view of Kasamatsu’s specific teachings, a POSITA would have looked to Katayama to optimize the concentration and size distribution of the heat-resistant particles. Ex. 1003, ¶¶ 149-50. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 420 (2007). Katayama discloses a preference for fine particles, including plate-like particles, a preferred concentration of heat-resistant particles of at least 80 vol. %, and an average particle size of heat-resistant particles of 0.4 μm with a size distribution of 0.3–0.7 μm . Ex. 1006, [0056], [0059], [0124]; Ex. 1003, ¶ 150-51. Indeed, Katayama discloses what a POSITA would know—that pairing the disclosed particle size distribution with a concentration higher than at least 50, 70, and 80 vol. % would further help prevent a short-circuit. *Id.*, [0059] (“preventing a short-circuit between the positive electrode and the negative electrode as described above.”). That is, Katayama solves the precise problem identified by Kasamatsu.

Katayama also appreciates the importance of higher shutdown temperatures, and a POSITA would have understood that adjusting the composition of the heat-resistant layer according to the disclosures of Katayama would not impact the higher shutdown temperatures disclosed in Kasamatsu. Ex. 1006, Table 3; Ex. 1003, ¶¶ 152-53.

As such, A POSITA would have been motivated to apply the particle size distribution and concentration teachings of Katayama to the separator of Kasamatsu to maximize the heat-resistant properties of the heat-resistant layer without negatively impacting ion movement between the electrodes, thereby avoiding short-circuit at high temperatures. Ex. 1003, ¶ 154.

Moreover, combining the concentration and particle size distribution of heat-resistant particles disclosed in Kasamatsu and Katayama is an example of combining prior art methods of making a separator according to known methods to yield predictable results. *KSR*, 550 U.S. at 416. Kasamatsu discloses a thin separator with a heat-resistant layer having a high concentration of heat-resistant particles (less than 10 weight-percent of binder) and a distribution with an average particle size less than 3 μm . Ex. 1005, [0017], [0028]. Katayama discloses the precise concentration (over 80 vol. %) and the precise distribution (0.3–0.7 μm , with an average particle size of 0.4 μm). Ex. 1006, [0059], [0124]. The predictable results are the use of the Katayama distribution and concentration in the Kasamatsu

heat-resistant layer to create an improved heat resistant layer so as to avoid short-circuit. Ex. 1003, ¶ 151. For this additional reason, the combination of Katayama and Kasamatsu is correct.

Moreover, a POSITA would have had a reasonable expectation of success in applying the concentration and particle size distribution disclosures of Katayama to the separator of Kasamatsu because Kasamatsu teaches that a high concentration and lower average particle size will work in a similar battery, and because lithium-ion chemistry was predictable at the time of Kasamatsu and Katayama. Ex. 1005, [0017], [0028]-[0029]; Ex. 1003, ¶¶ 40, 155-56. Kasamatsu discloses that the maximum particle size is “preferably 3 μm or less.” Ex. 1005, [0028]; Ex. 1003, ¶ 155. Katayama supports such a teaching and includes a particular composition that works with Kasamatsu—a particle size distribution of 0.3–0.7 μm . Ex. 1006, [0124]; Ex. 1003, ¶ 155. Moreover, Kasamatsu discloses that the concentration of heat-resistant fine particles should be high. Ex. 1006, [0017]; Ex. 1003, ¶ 156. Katayama supports this teaching and includes a particular composition that works with Kasamatsu—a concentration of heat-resistant fine particles that exceeds 50 vol. % (even more preferably at least 80 vol. %). Ex. 1006, [0059]; Ex. 1003, ¶ 156.

2. Claim 1: [1.Pre] A battery separator comprising:

To the extent the preamble is limiting, Kasamatsu and Katayama disclose a battery separator. Ex. 1005, [0001] (“The present invention relates to a non-aqueous electrolyte secondary **battery**, and more particularly to a separator **thereof**.”) (emphasis added); Ex. 1006, [0014]; Ex. 1003, ¶¶ 157-59.

3. Claim 1: [1.A] heat-resistant fine particles;

Kasamatsu discloses that the separator comprises a layer containing a “fine particulate filler.” Ex. 1005, [0014], [0023]; Ex. 1003, ¶ 160. Kasamatsu discloses that the fine particulate filler “is highly heat resistant,” and it lists the same examples as the '251 Patent, including titanium dioxide, alumina, and silicon dioxide. Ex. 1001, 5:13-19; Ex. 1005, [0015], [0026], [0065]; Ex. 1003, ¶ 163. Kasamatsu discloses small average primary particle sizes (0.1 μm) and bonded particle sizes (0.5 μm). Ex. 1005, [0045]; Ex. 1003, ¶ 163.

Katayama similarly discloses a heat-resistant filler, including inorganic fine particles such as alumina and silica. Ex. 1006, [0053]-[0054]; Ex. 1003, ¶ 164. Katayama discloses that the inorganic fine particles are very small, for example having an average particle diameter of 0.4 μm and a particle size distribution of 0.3–0.7 μm . Ex. 1006, [0124]; Ex. 1003, ¶ 164.

4. Claim 1: [1.B] and a thermoplastic resin,

Kasamatsu and Katayama disclose a shutdown layer comprising a thermoplastic resin, such as a polyolefin (e.g. polyethylene). Ex. 1005, [0020], [0036]; Ex. 1006, [0014], [0027]; Ex. 1003, ¶¶ 166-69. *See also* limitation 1.D.

5. Claim 1: [1.C] wherein the heat-resistant fine particles along with a binder constitute a heat-resistant layer,

Kasamatsu discloses a heat-resistant porous film containing fine particulate filler and a binder. Ex. 1005, [0015]; Ex. 1003, ¶ 170. Kasamatsu discloses that shrinkage may be “inhibited” at “180°C or lower.” Ex. 1005, [0016]; Ex. 1003, ¶ 170.

Katayama similarly discloses a separator layer containing the heat-resistant filler described with respect to limitation 1.A and a binder. Ex. 1006, [0014], [0068]; Ex. 1003, ¶ 171. Katayama discloses that this separator layer “suppresses thermal shrinkage of the separator,” to prevent direct contact between the positive and negative electrodes (i.e. short-circuit). Ex. 1006, [0023]; Ex. 1003, ¶ 171.

6. Claim 1: [1.D] the thermoplastic resin constitutes a shutdown layer formed of a heat-shrinkable microporous film,

Kasamatsu discloses as a “shutdown layer” a microporous film made of thermoplastic resin having pores that close (i.e. shrink) at high temperatures. Ex. 1005, [0020] (“[t]he **shutdown layer is a porous film made of a thermoplastic resin** and having pores that allow ions to pass through”) (emphasis added), [0036] (“a

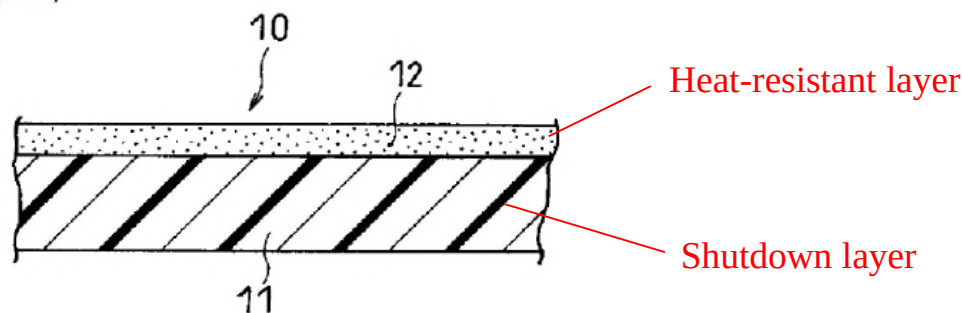
microporous film comprising a polyolefin resin is preferred in terms of chemical resistance and processability.”) (emphasis added); Ex. 1003, ¶¶ 174-75.

Katayama similarly discloses a separator layer made of thermoplastic resin that “is provided to secure the shutdown function.” Ex. 1006, [0022], [0014], [0027]; Ex. 1003, ¶ 176. Katayama discloses a “polyolefin-based porous film” as a shutdown layer. Ex. 1006, [0003]; Ex. 1003, ¶ 177.

7. Claim 1: [1.E] the heat-resistant layer and the shutdown layer are integrated into a multilayer structure,

Figure 1 of Kasamatsu illustrates a multilayer structure wherein the separator (10) has one layer containing the fine particulate filler (12) and a separate shutdown layer (11). Ex. 1005, Figure 1 (annotated below); Ex. 1003, ¶ 181.

[FIG. 1]



Kasamatsu discloses that these two layers are integrated. Ex. 1005, [0056], [0078], [0084], [0086] (disclosing that the fine particulate filler layer can be applied to the shutdown layer with a bar coater and subsequent drying); Ex. 1003, ¶ 180.

Kasamatsu discloses that these two layers are integrated such that they do not separate from one another. Ex. 1005, [0017]; Ex. 1003, ¶¶ 180, 182.

Katayama discloses another example of integration. Ex. 1006, [0076] (“In this case, the first separator layer and the second separator layer can be *integrated* with each other while sharing one porous base, . . .”) (emphasis added); Ex. 1003, ¶ 183.

8. Claim 1: [1.F] the shutdown layer has a thickness A (μm) of 5 to 30, the heat-resistant layer has a thickness B (μm) of 1 to 10, a sum of A and B is 6 to 23, and a ratio A/B is $1/2$ to 4,

Kasamatsu discloses that the shutdown layer thickness is not specifically limited, but that it preferably has a thickness A of 8–30 μm . Ex. 1005, [0036]; Ex. 1003, ¶ 186. Kasamatsu discloses various examples with a thickness A of 15 μm (shutdown layer) and thickness B of 5 μm (particulate filler-containing layer). Ex. 1005, [0056], [0078], [0084]; Ex. 1003, ¶ 186. A POSITA would have understood the sum of A and B in these examples is 20, and the ratio of A/B is 3. Ex. 1003, ¶ 186.

In Example 22, Kasamatsu discloses a thickness A of 15 μm (shutdown layer) and a thickness B of 6 μm (particulate filler-containing layer). Ex. 1005, [0081]–[0082]; Ex. 1003, ¶ 187. The sum of A and B is 21 and the ratio of A/B is 2.5. *Id.*

Katayama similarly discloses these ranges, describing the thickness of the first separator layer (A) of 1–15 μm , and the thickness of the second separator layer (B) of 2–30 μm . Ex. 1006, [0082]; Ex. 1003, ¶ 189. The sum of A and B is 3–45 μm ,

and the ratio is 1/30–7.5. Ex. 1003, ¶ 190; *In re Theresa*, 720 F. App'x 634, 637 (Fed. Cir. 2018).

9. Claim 1: [1.G] a content of the heat-resistant fine particles in the heat-resistant layer is 50 vol % or more of a total volume of components in the heat-resistant layer,

A POSITA would have understood, and Kasamatsu confirms, that maintaining a high concentration of heat-resistant particles in the heat-resistant layer is important for optimizing the heat-resistant properties of the separator. Ex. 1005, [0010], [0017]; Ex. 1003, ¶¶ 192-93. While Kasamatsu does not specifically disclose concentration of heat-resistant particles as a volume-percent, the POSITA would have been motivated to combine Katayama. *See Motivation to Combine, supra*.

Katayama discloses that the claimed concentration of heat-resistant fine particles in the heat-resistant layer is “preferably at least 50 vol. %, more preferably at least 70 vol. %, and further preferably at least 80 vol. % of the entire volume of the whole solid contents” of the heat-resistant layer. Ex. 1006, [0059]; Ex. 1003, ¶ 194. Moreover, Example 1 of Katayama discloses that the volume content of silica fine particles in the second separator layer was calculated to be 58 vol %. *Id.*, [0125]; Ex. 1003, ¶ 195. Example 10 discloses 87 vol. % of alumina fine particles in the heat-resistant layer. Ex. 1006, [0156]; Ex. 1003, ¶ 196.

10. Claim 1: [1.H] a proportion of particles with a particle size of 0.2 μm or less in the heat-resistant fine particles is 10 vol % or less and a proportion of particles with a particle size of 2 μm or more in the heat-resistant fine particles is 10 vol % or less, and

While Kasamatsu does not specifically disclose 10 vol % or less of heat-resistant particles with a particle size of 0.2 μm or less and 10 vol % or less with a particle size of 2 μm or more, a POSITA would have been motivated to combine Katayama. See Motivation to Combine, *supra*.

Katayama discloses a size distribution of the heat-resistant fine particles within the claimed range. Example 1 discloses a heat resistant layer comprising silica (SiO_2) fine particles with an average size of 0.4 μm and a particle size distribution of 0.3–0.7 μm . Ex. 1006, [0124]; Ex. 1003, ¶ 199.

A POSITA would have understood Katayama's disclosure of an average particle diameter and a particle size distribution as characterizing the bell-shaped distribution curve of particle sizes. Ex. 1003, ¶ 199. Indeed, a POSITA would have understood 0.4 μm to represent that 50 vol. % of heat-resistant particles are below 0.4 μm , and 0.3–0.7 μm to indicate that, necessarily, less than 10 vol. % of heat-resistant particles are below 0.3 μm or above 0.7 μm . *Id.*, ¶¶ 199, 201.

Examples 9 and 10 of Katayama disclose alumina having an average particle size of 0.3 and 0.4 μm , respectively, which a POSITA would have known correspond

to AA-03 and AA-04². Ex. 1006, [0150]-[0159], Ex. 1003, ¶ 200. A POSITA would have known that these materials (AA-03 and AA-04) necessarily have bell-shaped distribution curves with less than 10 vol. % of heat-resistant particles below 0.2 µm or above 2.0 µm. See, e.g., Ex. 1022, Fig. 1;³ *id.*

11. Claim 1: [1.I] a shutdown is effected in a range of 135° C. to 150° C.

A POSITA would have understood that shutdown is effected when the thermoplastic resin comprising the shutdown layer melts. Ex. 1003, ¶ 203. A POSITA would have understood that this temperature should be high enough to exceed the battery operating temperature, but low enough such that the battery “shuts down” before the temperature gets too high. *Id.* Moreover, a POSITA would have

² During prosecution, the Examiner relied on Katayama '577 as disclosing a particle size distribution of 0.3-0.7 µm of an SUMICORUNDUM AA04 particle in rejecting limitation 1.H. Ex. 1002, 778. The Applicant did not contest that a particle size distribution of 0.3-0.7 µm meets this limitation during prosecution, but instead confirmed the Examiner's rationale by admitting Katayama '577 discloses alumina fine particles having a particle size distribution of 0.3-0.7 µm. Ex. 1002, 818.

³ This ground is obviousness in view of Kasamatsu and Katayama. Amagi does not form part of the combination/modification. Rather, Amagi is provided to establish the POSITA's base knowledge.

understood that the shutdown temperature can be adjusted as a matter of routine optimization by choosing a thermoplastic resin with a lower or higher melting temperature. Ex. 1003, ¶ 204; *In re Geisler*, 116 F.3d 1465, 1470 (Fed. Cir. 1997) (holding the narrower claimed range was obvious because “it is not inventive to discovery the optimum or workable ranges by routine experimentation.”) (internal citations omitted).

Kasamatsu discloses that the pores of the shutdown layer close in the range of 80–180°C. Ex. 1005, [0036], [0020]; Ex. 1003, ¶ 205.

Katayama likewise discloses a shutdown temperature range of 105–135°C. Ex. 1006, Table 3, [0185]; Ex. 1003, ¶ 206.

12. Claims 3, 14: The [battery separator according to claim 1 or nonaqueous electrolyte battery according to claim 10], wherein [the]⁴ content of the heat-resistant fine particles in the heat-resistant layer is 80 vol % or more of the total volume of components in the heat-resistant layer.

Katayama discloses that the concentration of heat-resistant particles is most preferably “at least 80 vol.%. . .” Ex. 1006, [0059], [0156]; Ex. 1003, ¶¶ 208-09.

⁴ Claim 14 states “a content,” rather than “the content.” There is no difference for the purposes of this analysis.

13. Claims 4, 15: The [battery separator according to claim 1 or nonaqueous electrolyte battery according to claim 10], wherein the heat-resistant fine particles [of the separator] are inorganic fine particles.

Kasamatsu discloses that the shutdown layer preferably contains at least one metal oxide, such as alumina, titanium oxide, and silica (i.e. silicon dioxide). Ex. 1005, [0014]; Ex. 1003, ¶ 210.

Katayama discloses a preference for using inorganic fine particles as the filler in the heat-resistant layer. Ex. 1006, [0053]-[0054]; Ex. 1003, ¶ 211. It lists examples of inorganic fine particles (e.g. Al₂O₃ (alumina) and SiO₂ (silicon dioxide)). *Id.*

14. Claims 5, 16: The [battery separator according to claim 4 or nonaqueous electrolyte battery according to claim 15], wherein the inorganic fine particles include [fine]⁵ particles of at least one selected from the group consisting of alumina, silica, BaTiO₃, boehmite, zeolite, and kaoline.

Kasamatsu discloses that the fine particulate filler preferably comprises metal oxides, such as alumina, titanium oxide, and silica. Ex. 1005, [0014]; Ex. 1003, ¶ 213.

Katayama discloses a preference for using inorganic fine particles, such as alumina, silica, boehmite, zeolite, and kaoline. Ex. 1006, [0054]; Ex. 1003, ¶ 214.

⁵ Claim 16 has a typographical error (“line” should read “fine.”).

15. Claims 6, 17: The [battery separator according to claim 1 or nonaqueous electrolyte battery according to claim 10], wherein the heat-resistant fine particles [of the separator] include plate-like particles.

Katayama discloses that the shape of the heat-resistant filler may vary from spherical to platy, for example. Ex. 1006, [0056]; Ex. 1003, ¶ 216. Katayama discloses a preference for plate-like particles, so as to avoid short-circuit. *Id.* It lists examples, such as plate-like Al₂O₃ and plate-like boehmite. *Id.*

16. Claims 7, 18: The [battery separator according to claim 1 or nonaqueous electrolyte battery according to claim 10], wherein the heat-resistant layer [of the separator] has a thickness of 2 µm to 6 µm.

Kasamatsu discloses examples of a heat-resistant layer having a thickness of 5 or 6 µm. Ex. 1005, [0056], [0078], [0081], [0085]; Ex. 1003, ¶ 218.

Katayama similarly discloses this range, stating that the second separator layer (i.e. heat-resistant layer) preferably has a thickness of 2–30 µm. Ex. 1006, [0082]; Ex. 1003, ¶ 219.

17. Claims 8, 19: The [battery separator according to claim 1 or nonaqueous electrolyte battery according to claim 10], wherein the thermoplastic resin [of the separator] includes polyolefin.

Kasamatsu discloses that the shutdown layer is preferably a “microporous film comprising a polyolefin resin,” and lists polyethylene and polypropylene, which are thermoplastics, as examples of the polyolefin resin. Ex. 1005, [0036]; Ex. 1003, ¶¶ 221-22.

Katayama similarly lists examples of thermoplastic resins for use in the separator, including polyethylene (PE) or copolymer polyolefin. Ex. 1006, [0027]; Ex. 1003, ¶ 223.

18. Claims 9, 22: The [battery separator according to claim 1 or nonaqueous electrolyte battery according to claim 10], wherein the heat-resistant fine particles [of the separator] have an average particle size of 1.5 μm or less.

Kasamatsu discloses examples with average secondary particle sizes of 0.5 μm . See, e.g., Ex. 1005, Table 1 (annotated below), [0045]; Ex. 1003, ¶ 226.

Paste	Fine particle filler material	primary particle size (μm)	Secondary particle size (μm)	Porosity (vol%)
A1	Alumina bonded particles	0.1	0.5	60
A2	Titanium oxide bonded	0.1	0.5	58
A3	Zirconium oxide bonded	0.1	0.5	56
A4	Magnesium oxide bonded	0.1	0.5	56
A5	Zinc oxide bonded particles	0.1	0.5	57
A6	Silicon dioxide bonded	0.1	0.5	58
A7	Silicon monoxide bonded	0.1	0.5	57
B1	Alumina spherical particles	0.5	—	44
B2	Alumina aggregated particles (vibration mill)	0.1	0.5	45
B3	Alumina aggregated particles	0.1	0.5	44

Katayama similarly discloses examples with average particle sizes of 1.5 μm or less, such as 0.3 and 0.4 μm . Ex. 1006, [0124], [0150], [0155]; Ex. 1003, ¶ 227.

19. Claim 10: [10.Pre] A nonaqueous electrolyte batter [sic] comprising:

To the extent the preamble is limiting, Kasamatsu and Katayama disclose a nonaqueous electrolyte battery, such as lithium-ion batteries. *See, e.g.*, Ex. 1005, [0006], [0037]; Ex. 1006, [0015], [0104]; Ex. 1003, ¶¶ 229-31; *see also* Ex. 1028, 7 (equating Petitioner’s “lithium-ion battery” to a “nonaqueous electrolyte batter[y]”).

20. Claim 10: [10.A] a positive electrode having a positive active material capable of intercalating and deintercalating a lithium ion;

A POSITA would have understood that nonaqueous electrolyte batteries of the type disclosed in Kasamatsu and Katayama by definition have a positive electrode made of an active material capable of intercalating and deintercalating a lithium ion. Ex. 1003, ¶¶ 232-35; *see also* Ex. 1028, 9 (stating that a lithium-ion battery “by definition has a positive electrode having a positive active material capable of intercalating and deintercalating a lithium ion”).

Kasamatsu discloses a positive electrode for a lithium-ion secondary battery. Ex. 1005, [0038], [0057]; Ex. 1003, ¶ 232.

Katayama similarly discloses a positive electrode for use in a “conventional lithium secondary battery,” which Katayama describes as capable of intercalating and deintercalating lithium ions. Ex. 1006, [0106]. Ex. 1003, ¶ 233-34.

21. Claim 10: [10.B] a negative electrode having a negative active material capable of intercalating and deintercalating a lithium ion;

A POSITA would have understood that non-aqueous electrolyte batteries such as lithium-ion batteries necessarily have a negative electrode that is capable of intercalating and deintercalating a lithium ion. Ex. 1003, ¶¶ 236-39; *see also* Ex. 1028, 9 (stating that a lithium-ion battery “by definition has a negative electrode having a negative active material capable of intercalating and deintercalating a lithium ion”).

Kasamatsu discloses a negative electrode for a lithium-ion secondary battery, and further states that the negative electrode active material is capable of absorbing (intercalating) and releasing (deintercalating) lithium ions. Ex. 1005, [0041]; Ex. 1003, ¶ 237.

Katayama discloses a negative electrode and states that the only limitation on the negative electrode is that “it is a negative electrode used for a conventional lithium secondary battery, i.e. a negative electrode containing an active material that can *occlude and emit the Li ion.*” Ex. 1006, [0110]; Ex. 1003, ¶ 238.

22. Claim 10: [10.C] a separator interposed between the positive electrode and the negative electrode; and

A POSITA would have understood that a battery separator is necessarily interposed between the positive electrode and the negative electrode to keep the electrodes from touching. Ex. 1003, ¶¶ 240-42.

Kasamatsu discloses a separator interposed between the electrodes and further provides that the separator is used to “electrically insulat[e] the positive and negative electrodes from each other and for retaining electrolyte.” Ex. 1005, [0002]; Ex. 1003, ¶ 241.

Katayama similarly discloses that the separator is “interposed” between the electrodes. Ex. 1006, [0113]; Ex. 1003, ¶ 241.

23. Claim 10: [10.D] a nonaqueous electrolyte,

Kasamatsu discloses, for example, the preparation of various nonaqueous electrolytes for use in the battery. Ex. 1005, [0044] (“The *non-aqueous electrolyte* of the lithium ion secondary battery . . .”), Claim 8; Ex. 1003, ¶ 244. Similarly, Katayama discloses a nonaqueous electrolyte. Ex. 1006, [0114]; Ex. 1003, ¶ 244.

24. Claim 10: [10.E] wherein a heat generation starting temperature of the positive electrode is 180° C. or higher, and

A POSITA would have understood that the heat generation starting temperature of the positive electrode is an inherent property of the positive electrode. Ex. 1003, ¶¶ 247–50. A POSITA would have further understood that the inherent heat generation starting temperature of the positive electrode depends from the active material used. *Id.*

Katayama discloses the use of positive electrode active materials that inherently exhibit heat generation starting temperatures of greater than 180°C. *See Santarus, Inc. v. Par Pharm., Inc.*, 694 F.3d 1344, 1353-54 (Fed. Cir. 2012).

Katayama discloses, for example, that LiMn_2O_4 and LiFePO_4 ⁶ can be used as active materials for the positive electrode. Ex. 1006, [0106]; Ex. 1003, ¶¶ 251-54. These are two of the exact same materials used in the '251 Patent, and which the '251 Patent confirms necessarily have a heat generation starting temperature of 180°C or higher. Ex. 1001, 3:37-58. Ex. 1003, ¶¶ 247-55.

Moreover, Example 3 of the '251 Patent specifically relies on the positive active material LiFePO_4 . Ex. 1001, 15:47-49; Ex. 1003, ¶ 253. When tested, Example 3 had a heat generation starting temperature of the positive electrode of 229°C. *Id.*

⁶ U.S. Patent Publication 2007/0248886 by Shirakata discloses the use of LiFePO_4 as a positive electrode active material. Ex. 1029, [0036]; Ex. 1003, ¶ 254. When comparative example 1 was measured using a differential scanning calorimeter, LiFePO_4 demonstrated a heat generation starting temperature of 274°C. Ex. 1029, [0046]; Ex. 1003, ¶ 254. Shirakata therefore confirms what a POSITA would know— LiFePO_4 has a heat generation starting temperature greater than 180°C. *Id.* This ground is obviousness in view of Katayama and Kasamatsu. Shirakata does not form part of the combination/modification. Rather, Shirakata is provided to establish the POSITA's base knowledge.

TABLE 1

	Heat generation starting temperature of positive electrode (° C.)	Shutdown temperature (° C.)	T ° C.	Thermal shrinkage ratio at T ° C. (%)	Width of separator or heat-resistant layer at T ° C. (mm)
Example 1	229	135	200	2	46.1
Example 2	200	135	190	0	47
Example 3	229	135	200	0	47
Example 4	220	135	200	1	46.5
Comparative Example 1	229	140	200	35	30.6
Comparative Example 2	161	135	151	1	46.5
Comparative Example 3	229	—	200	0	47

25. Claim 10: [10.F] wherein the separator is the battery separator according to claim 1.

Kasamatsu and Katayama disclose the battery separator for at least all the reasons discussed above with respect to claim 1.

26. **Claim 13:** *The nonaqueous electrolyte battery according to claim 10, wherein the positive active material is at least one selected from the group consisting of the following: a spinel-type lithium-containing complex oxide expressed as a general formula $\text{Li}_{1+t}\text{Mn}_{(2-x)}\text{M}^1_x\text{O}_4$ (where M^1 is at least one element selected from the group consisting of Fe, Ni, Mg, Zn, Co, Cr, Al, B, V, Si, Sn, Nb, Ta, Cu, Mo, Ti, and W, $-0.1 \leq t \leq 0.1$, and $0 \leq x \leq 0.6$); an olivine-type lithium-containing complex oxide expressed as a general formula LiM^2PO_4 (where M^2 is Co, Ni, Mn, or Fe); a lithium-containing complex oxide having a layered crystal structure expressed as a general formula $\text{Li}_{(1+a)}\text{M}^3_{2b}\text{Mn}_{(0.5-b)}\text{Ni}_{(0.5-b)}\text{O}_2$ (where M^3 is at least one element selected from the group consisting of Fe, Mg, Zn, Co, Cr, Al, B, V, Si, Sn, Nb, Ta, Cu, Mo, Ti, and W, $-0.1 < a < 0.1$, and $0 \leq b \leq 0.05$); and a lithium-containing complex oxide expressed as a general formula $\text{Li}_{(1+y+a)}\text{Ni}_{(1-y-z-\delta)/2}\text{Mn}_{(1-y-z-\delta)/2}\text{M}^4_z\text{O}_2$ (where M^4 is at least one element selected from the group consisting of Ti, Cr, Fe, Co, Cu, Zn, Al, Ge, Sn, Mg, and Zr, $-0.1 \leq y \leq 0.1$, $-0.05 \leq a \leq 0.05$, $0 \leq z < 0.45$, and $-0.24 \leq \delta \leq 0.6$).*

Katayama discloses the use a lithium-manganese oxide having a spinel structure such as LiMn_2O_4 . Ex. 1006, [0106]; Ex. 1003, ¶ 258. This spinel structure is identical to “a spinel-type lithium-containing complex oxide expressed as a general formula $\text{Li}_{1+t}\text{Mn}_{(2-x)}\text{M}^1_x\text{O}_4$ (where M^1 is at least one element selected from the group consisting of Fe, Ni, Mg, Zn, Co, Cr, Al, B, V, Si, Sn, Nb, Ta, Cu, Mo, Ti, and W, $-0.1 \leq t \leq 0.1$, and $0 \leq x \leq 0.6$),” where t and x are 0 (which is explicitly permissible in the formula). *Id.*

Katayama discloses “an olivine-type compound expressed as LiMPO_4 (M: Co, Ni, Mn, Fe and the like).” Ex. 1006, [0106]; Ex. 1003, ¶ 258. This structure is identical to “an olivine-type lithium-containing complex oxide expressed as a

general formula LiM^2PO_4 (where M² is Co, Ni, Mn, or Fe),” as claimed in the ’251 Patent. *Id.*

27. Claim 20: The nonaqueous electrolyte battery according to claim 10, wherein the shutdown layer of the separator is located on a negative electrode side.

Katayama discloses that the shutdown layer may be located on the negative electrode side. Ex. 1006, [0101] (“Alternatively, ***the first separator layer can be formed on*** the positive electrode or ***the negative electrode***, and the second separator layer can be formed on the other electrode.”); Ex. 1003, ¶ 261. A POSITA would have understood that it would be advantageous to place the shutdown layer on the negative electrode side because there the shutdown layer would be less likely to effect shutdown at undesirable times (i.e. typical battery temperatures), and doing so would prevent degradation of the separator by oxidation. Ex. 1003, ¶¶ 262-64.

28. Claim 21: The nonaqueous electrolyte battery according to claim 10, wherein the shutdown layer of the separator is not in contact with the positive active material.

Katayama discloses that the shutdown layer may be located such that it is not in contact with positive electrode active material. Ex. 1006, [0101] (“Alternatively, ***the first separator layer can be formed on*** the positive electrode or ***the negative electrode***, and the second separator layer can be formed on the other electrode.”); Ex. 1003, ¶ 265. A POSITA would have understood the benefit of separating the shutdown layer from the positive electrode because the shutdown layer would be

less likely to effect shutdown at undesirable times (i.e. typical battery temperatures), and doing so would prevent degradation of the separator by oxidation. Ex. 1003, ¶¶ 266-68.

29. Claims 23, 27: The [battery separator according to claim 1 or nonaqueous electrolyte battery according to claim 10], wherein the shutdown layer [of the separator] has a thickness of 16 μm or less.

Kasamatsu and Katayama disclose this claim for at least the reasons provided with respect to limitation 1.F. *See also* Ex. 1003, ¶¶ 269-72. Kasamatsu discloses that the shutdown layer preferably has a thickness of 8–30 μm . Ex. 1005, [0036]. Kasamatsu further discloses examples with a shutdown layer thickness of 15 μm . *See, e.g., id.*, [0056]; [0078]; [0082]; [0086].

Katayama similarly discloses a shutdown layer range of 1–15 μm thick. Ex. 1006, [0082]; Ex. 1003, ¶ 271.

30. Claims 24, 28: The [battery separator according to claim 1 or nonaqueous electrolyte battery according to claim 10], wherein a content of the binder in the heat-resistant layer [of the separator] is 1 to 20 vol % of a total volume of components in the heat-resistant layer.

A POSITA would have understood that the concentration of heat-resistant particles in the heat-resistant layer is inversely related to the concentration of binder, such that the concentration of binder in the heat-resistant layer is equal to 100% less the concentration of heat-resistant particles. Ex. 1003, ¶¶ 273-76.

Katayama discloses that the preferred volume-percent of heat-resistant particles is at least 80 vol. %. Ex. 1006, [0082]; Ex. 1003, ¶ 274. Katayama further discloses the use of a binder. *See* discussion *supra* at limitation 1.D. Thus, a POSITA would have understood that Katayama discloses a concentration of binder higher than 0 vol. % but lower than 20 vol. %. Ex. 1003, ¶¶ 273-76. For example, Katayama discloses a binder concentration of 13 vol. % in Example 10. Ex. 1006, [0156]; Ex. 1003, ¶ 275.

- 31. Claims 25, 29: The [battery separator according to claim 1 or nonaqueous electrolyte battery according to claim 10], wherein the binder [of the separator] includes at least one selected from the group consisting of an ethylene-vinyl acetate copolymer (having 20 to 35 mol % of a structural unit derived from vinyl acetate); an ethylene-acrylic acid copolymer; fluoro-rubber; styrene-butadiene rubber; carboxymethyl cellulose; hydroxyethyl cellulose; polyvinyl alcohol; polyvinyl butyral; polyvinyl pyrrolidone; poly-N-vinylacetamide; a cross-linked acrylic resin; polyurethane; and an epoxy resin.**

Katayama discloses the claimed binders, such as styrene-butadiene rubber (SBR) and carboxymethyl cellulose. Ex. 1006, [0068]-[0069]; Ex. 1003, ¶¶ 277-78.

32. Claims 26, 30: The [battery separator according to claim 1 or nonaqueous electrolyte battery according to claim 10], wherein the heat-resistant [fine]⁷ particles [of the separator] have an average particle size of 0.3 μm or more.

Kasamatsu and Katayama disclose this claim for at least the reasons provided above with respect to claims 9 and 22. See also Ex. 1003, ¶¶ 279-81.

33. Claims 32, 34: The [battery separator according to claim 1 or nonaqueous electrolyte battery according to claim 10], wherein the heat-resistant layer has a porosity of 20% to 60%.

Kasamatsu discloses in Table 1 a porosity range of 44–60% in the heat-resistant layer.

Paste	Fine particle filler material	primary particle size (μm)	Secondary particle size (μm)	Porosity (vol%)
A1	Alumina bonded particles	0.1	0.5	60
A2	Titanium oxide bonded	0.1	0.5	58
A3	Zirconium oxide bonded	0.1	0.5	56
A4	Magnesium oxide bonded	0.1	0.5	56
A5	Zinc oxide bonded particles	0.1	0.5	57
A6	Silicon dioxide bonded	0.1	0.5	58
A7	Silicon monoxide bonded	0.1	0.5	57
B1	Alumina spherical particles	0.5	—	44
B2	Alumina aggregated particles (vibration mill)	0.1	0.5	45
B3	Alumina aggregated particles	0.1	0.5	44

Ex. 1005, Table 1 (annotated); Ex. 1003, ¶ 283.

⁷ Claim 26 has a typographical error. The word “line” should be “fine.”

Similarly, Katayama discloses a preference for a porosity of the heat-resistant layer of 10–50%. Ex. 1006, [0051]; Ex. 1003, ¶ 284.

34. Claims 33, 35: The [battery separator according to claim 1 or nonaqueous electrolyte battery according to claim 10], wherein the whole separator has a porosity of 30% to 70%.

Katayama discloses a preference for a porosity of the separator of 15–70%, and more preferably 20–60%. Ex. 1006, [0083]; Ex. 1003, ¶¶ 286-88.

35. Claims 36, 37: The [battery separator according to claim 1 or nonaqueous electrolyte battery according to claim 10], wherein the microporous film is formed by a solvent extraction method, a dry drawing method, or a wet drawing method.

Katayama discloses a solvent extraction method, which includes “applying a composition (a liquid composition such as a slurry or the like) for forming a first separator layer containing the resin A and/or the resin B . . . on a porous base; [and] subsequently drying at a predetermined temperature.” Ex. 1006, [0091], [0098]-[0099]; Ex. 1003, ¶¶ 289-91.

B. Ground 1B: Claims 2, 11, and 12 are unpatentable under pre-AIA 35 U.S.C. §103(a) over Kasamatsu, Katayama, and Miyatake

1. Overview of Ground 1B

i. Overview of Miyatake

Miyatake discloses a battery separator with a heat-resistant material for use in a lithium-ion battery. Ex. 1007, [0001], [0011]; Ex. 1003, ¶ 293. Miyatake discloses that “by disposing a battery material having high heat resistance in the positive

electrode active material layer and the separator, it is possible to sufficiently suppress temperature increase due to heat generation during battery internal short circuits and battery external short circuits,” (Ex. 1007, [0011]), and that, by using the heat-resistant material in the separator, shrinkage is suppressed to “0 to 30% in all regions within a temperature range of 100 to 200°C.” Ex. 1007, [0047]; Ex. 1003, ¶¶ 293-95.

ii. Motivation to Combine

A POSITA would have been motivated to combine Kasamatsu and Katayama for reasons described above. Ex. 1003, ¶ 297. In addition, Kasamatsu discloses that “because the fine particulate filler is highly heat resistant, the heat shrinkage of the separator can be inhibited . . .” Ex. 1005, [0015], [0024]; Ex. 1003, ¶ 298. Katayama similarly discloses that thermal shrinkage can be suppressed and the thermal shrinkage rate can be 1% or less at 150°C when using a heat-resistant layer. Ex. 1006, [0023], [0090]; Ex. 1003, ¶ 298. However, Kasamatsu and Katayama do not disclose the specific thermal shrinkage ratio at 200°C. Ex. 1003, ¶ 298.

Understanding the importance of suppressing heat shrinkage at higher temperatures, a POSITA would have turned to a reference that disclosed the specific thermal shrinkage ratio. Ex. 1003, ¶¶ 299-302. Miyatake discloses the use of heat-resistant materials, including ceramic and alumina, such that the shrinkage

rate of a separator is within 0 to 30% in all regions when heated between 100 to 200°C. Ex. 1007, [0047]; Ex. 1003, ¶ 299. Indeed, Miyatake indicates a preference for less than 5% in this temperature range. *Id.* Miyatake does not limit the “compounding amount of the heat-resistant material,” necessary to exhibit the disclosed thermal shrinkage rate. Ex. 1007, [0052]; Ex. 1003, ¶ 300.

Lithium-ion chemistry was predictable at the time of these references. Ex. 1003, ¶ 40. A POSITA would have had a reasonable expectation of success because Kasamatsu and Katayama disclose that thermal shrinkage of the separator is prevented or suppressed when a heat-resistant layer containing inorganic filler (such as alumina) is used. Ex. 1005, [0014], [0018]; Ex. 1006, [0054], [0090]; Ex. 1003, ¶ 301-02. Miyatake discloses such an inorganic filler. Ex. 1007, [0050]; Ex. 1003, ¶¶ 299, 302.

2. *Claim 2: The battery separator according to claim 1, wherein a thermal shrinkage ratio in a width direction is 10% or less at 200° C.*

Miyatake discloses that the thermal shrinkage rate of the material used for the separator in Miyatake was “0 to 30% in all regions within a temperature range of 100 to 200°C,” and further specifies preferences between 0 to 25%, 0 to 20%, 0 to 10%, and 0 to 5% in that temperature range. Ex. 1007, [0047]; Ex. 1003, ¶ 304. Miyatake specifies that the thermal shrinkage ratio is less than these percentages at 200 °C “in all regions.” Ex. 1007, [0047]; Ex. 1003, ¶ 305. When using alumina,

Miyatake indicates a thermal shrinkage rate of 1% or less. Ex. 1007, [0051]; Ex. 1003, ¶ 304.

- 3. Claim 11: The nonaqueous electrolyte battery according to claim 10, wherein a thermal shrinkage ratio of the separator is 10% or less at a temperature T ($^{\circ}$ C.) that is 10° C. lower than the heat generation starting temperature of the positive electrode (where an upper limit of T is 200° C.).**

As discussed above with respect to Ground 1A, Katayama discloses a heat generation starting temperature of 180°C or higher. See discussion *supra* at VII.A.24. Thus, a POSITA would understand that temperature (T) referred to in claim 11 could be anywhere from 170 – 200°C . Ex. 1003, ¶ 309. As discussed above with respect to claim 2, Miyatake discloses a thermal shrinkage rate of less than 10% in the temperature range of 100 – 200°C in all regions. See discussion *supra* at VII.B.2. Miyatake therefore discloses a thermal shrinkage ratio of less than 10% at the claimed temperature (T). Ex. 1003, ¶¶ 309-10.

- 4. Claim 12: The nonaqueous electrolyte battery according to claim 10, wherein a width of the separator is larger than that of the negative electrode at a temperature T ($^{\circ}$ C.) that is 10° C. lower than the heat generation starting temperature of the positive electrode (where an upper limit of T is 200° C.).**

Miyatake discloses that “[i]f the heat-resistant material has such a shrinkage rate [i.e. the shrinkage rate disclosed in claims 2 and 11], it is possible to effectively prevent the short-circuit between the electrodes of the battery by preventing the shrinkage at the time of the abnormal heat generation.” Ex. 1007, [0046]; Ex. 1003,

¶ 311. As discussed with respect to claims 2 and 11, Miyatake further discloses that “such a shrinkage rate” (e.g. below 10%) is achieved by the material in the temperature range of 100–200°C in all regions. *See* discussion *supra* at VII.B.2–3. A POSITA would have known that the fact that the separator did not shrink enough to cause a short circuit necessarily means that the width of the separator is larger than that of a negative electrode. Ex. 1003, ¶¶ 311-13.

C. Ground 2A: Claims 1, 4–10, 13, 15–23, 26–27, and 30–35 are unpatentable under pre-AIA 35 U.S.C. §103(a) over Yoshida, Nagayama, Takezawa, and Amagi

1. Overview

i. Overview of Yoshida, Nagayama, Takezawa, and Amagi

Yoshida discloses a nonaqueous electrolyte battery separator and battery; wherein the separator comprises a shutdown layer and a heat-resistant layer made. Ex. 1008, [0001], [0006]-[0016], [0018], [0020]-[0023], [0025]-[0027], [0036], [0042], [0053]; Ex. 1003, ¶¶ 314-22.

Nagayama discloses a battery separator and battery; wherein the separator comprises a thermoplastic resin layer and a heat-resistant layer. Ex. 1009, [0006], [0021], [0009], [0028]; Ex. 1003, ¶¶ 323-29.

Takezawa discloses that these positive electrode active materials can be used in conventional non-aqueous secondary batteries. Ex. 1010, [0012]; Ex. 1003, ¶ 331-32. Takezawa discloses positive electrode active materials having high capacities,

including examples having heat generation starting temperatures ranging from 202 to over 400°C. Ex. 1010, [0002], [0087]; Ex. 1003, ¶¶ 330-32.

Amagi discloses inorganic filler in various particle sizes and distributions, including the same type of inorganic filler disclosed for use in the separators of Yoshida and Nagayama. Ex. 1022, [0006]; Ex. 1003, ¶¶ 333-35.

ii. Motivation to Combine

A POSITA would have considered Yoshida, Nagayama, Takezawa, and Amagi in combination because a POSITA would have understood that each of the references are directed to non-aqueous secondary batteries and/or heat-resistant materials for use in non-aqueous secondary batteries. *See, e.g.*, Ex. 1008, [0001], [0006]; Ex. 1009, [0001]; Ex. 1010, [0002]; Ex. 1022, [0004]-[0005]; Ex. 1003, ¶ 337.⁸

A POSITA would have understood Yoshida discloses a separator with a shutdown temperature range of 60–150°C. Ex. 1008, [0022]; Ex. 1003, ¶¶ 316, 404. A POSITA would have understood that Yoshida discloses a heat-resistant

⁸ Although the resin disclosed in Amagi is used for a rotating machine, Amagi is pertinent to the problem to be solved—increasing the heat-resistant properties of the heat-resistant layer in a battery separator. Ex. 1003, ¶ 327; *Innovention Toys, LLC v. MGA Entm't, Inc.*, 637 F.3d 1314, 1321 (Fed. Cir. 2011).

layer made of greater than 50 vol. % heat-resistant fine particles preferably at most 0.5 μm and a binder, and integrated with a shutdown layer made of a thermoplastic resin. Ex. 1008, [0022], [0025]-[0027], [0042]; Ex. 1003, ¶¶ 337-41, 373, 382. While Yoshida specifically teaches a POSITA to control particle size distribution and to the extent it is argued that the Yoshida does not teach or suggest the distribution of the claims, the POSITA would have looked to identify a particular particle that satisfies its specified particle size distribution. Ex. 1003, ¶ 341.

A POSITA would have known and understood that the alumina particles (AA-03) disclosed in Amagi, which have an average particle size of 0.3 μm and less than 10 vol. % of particles below 0.2 μm or above 2 μm , met the requirements of Yoshida and would have further improved the Yoshida system. Ex. 1022, [0023], Fig 1; Ex. 1003, ¶ 342. Indeed, the POSITA would have selected alumina particles (AA-03) because AA-03 was effective in improving cooling efficiency and alumina was commonly used as an inorganic filler. Ex. 1022, [0048], [0011]; Ex. 1003, ¶ 342.

Lithium-ion chemistry was predictable at the time of these references. Ex. 1003, ¶ 40. A POSITA would have had a reasonable expectation of success in using these standard manufactured alumina particles because Yoshida already taught a POSITA that the average particle size of preferably at most 0.5 μm would work in the Yoshida separator. Ex. 1008, [0026]; Ex. 1003, ¶¶ 341, 343. Indeed, a

POSITA would have understood that AA-03 had been used in separators.⁹ Ex. 1003, ¶ 343.

Yoshida further emphasizes that separator thickness is important. Ex. 1008, [0026] (disclosing that the film thickness can become “too large”); Ex. 1003, ¶ 344. Yoshida, however, does not provide specific implementation details for its separator. Thus, a POSITA would have been motivated to turn to other analogous references that disclose Yoshida’s optimal thickness, such as Nagayama. Ex. 1003, ¶ 344.

Looking to Nagayama, a POSITA would have understood Nagayama discloses a 3–7 µm thick heat-resistant layer made of heat-resistant fine particles and a binder, and a 12–23 µm thick shutdown layer made of a thermoplastic resin. Ex. 1009, [0044], [0025]; Ex. 1003, ¶¶ 345-46. Nagayama discloses that these

⁹ U.S. 6,447,958 (“Shinohara”) explicitly discloses the use of AA03 in a battery. Ex. 1025, 23:17-20 (“... 150 g of an alumina fine particle (manufactured by Sumitomo Chemical Co., Ltd.; Sumicorundum, having an average particle size of 0.3 µm and a particle size distribution of 0.1 to 1.0 µm. . .”). This ground is obviousness in view of Yoshida, Nagayama, Takezawa, and Amagi. Shinohara does not form part of the combination/modification. Rather, Shinohara is provided to establish the POSITA’s base knowledge.

thicknesses are optimal for maintaining the high energy density, ion conductivity, and discharge characteristics. Ex. 1009, [0044], [0025], Ex. 1003, ¶ 345. Nagayama further discloses a heat-resistant layer thickness of 3–7 μm because if the heat resistant layer is too thick, it “swells excessively and thus the discharge characteristics are degraded,” (Ex. 1009, [0025]) and that the porosity of the heat-resistant layer affects discharge characteristics. Ex. 1009, [0025]; Ex. 1003, ¶ 345. Each of these benefits would have motivated the POSITA to rely on Nagayama. Ex. 1003, ¶ 346.

A POSITA would have had a reasonable expectation of success in applying the thickness of Nagayama to the separator of Yoshida at least because Yoshida and Nagayama disclose similar types of separators, and using the Nagayama’s separator thickness instead of Yoshida’s is just a simple substitution. Ex. 1003, ¶ 346.

Yoshida also suggests the presence of electrode materials, but does not specifically recite the electrode materials. Ex. 1003, ¶ 347. As such, a POSITA would look to Nagayama, which discloses examples of positive electrode materials having heat generation starting temperatures of 180°C or higher, including $\text{LiNi}_{0.45}\text{Mn}_{0.45}\text{Mg}_{0.1}\text{O}_2$ and $\text{LiNi}_{0.4}\text{Mn}_{1.6}\text{O}_4$. Ex. 1009, [0002], [0005]-[0005], [0011]-[0012], [0034]-[0035], Table 4; Ex. 1003, ¶¶ 347-49, 444-49. A POSITA would have had a reasonable expectation of success in using these active materials

because doing so would be a simple substitution of the active materials in Yoshida with the active materials of Nagayama. Ex. 1003, ¶ 348. Moreover, Nagayama discloses heat generation starting temperatures up to 179 °C when the battery was charged to 4.4 V, which a POSITA would have understood would necessarily have been higher at lower charge states (such as the 4.25 V disclosed in the '251 Patent). Ex. 1009, Table 4; Ex. 1003, ¶¶ 348-49, 451-53.

Although Nagayama discloses materials that would exhibit a heat generation temperature of 180°C or more, Nagayama does not explicitly provide measurements of heat generation temperatures over 180°C. Ex. 1003, ¶ 349. Understanding the importance of a high heat generation temperatures and maximizing battery capacity, the POSITA would have identified references that specifically disclose cathode materials that maximize battery capacity and have even higher heat generation temperatures. *Id.*, Ex. 1009, [0009]-[0010] (describing the need for “high power output non-aqueous electrolyte secondary batter[ies].”).

A POSITA would have turned to the cathode materials of Takezawa. Takezawa discloses high-capacity positive electrode active materials having heat generation temperatures ranging from 202 to over 400°C. *Id.*; Ex. 1010 [0021], [0044], [0087]; Ex. 1003, ¶¶ 350-52. Again, a POSITA would have had a reasonable expectation of success because it would only require a simple substitution of the positive electrode active material of Yoshida with the positive

electrode active material of Takezawa. Ex. 1003, ¶¶ 352-57. Further, a POSITA would have had a reasonable expectation of success because the heat-resistant layers of Yoshida and Nagayama were designed explicitly to provide additional heat resistance when using higher capacity positive electrode active materials, such as those disclosed in Nagayama and Takezawa. Ex. 1003, ¶¶ 354-57; Ex. 1008, [0004], [0006]; Ex. 1009, [0009]-[0010].

2. 1[Pre]

To the extent the preamble is limiting, Yoshida, Nagayama, and Takezawa disclose a battery separator. *See, e.g.*, Ex. 1008, [0001] (“The present invention relates to a **separator for a battery . . .**”) (emphasis added); Ex. 1009, [0007]-[0008], [0044]; Ex. 1010, [0139]; Ex. 1003, ¶¶ 358-60.

3. [1.A]

Yoshida discloses the use of “fine particles having higher heat resistance.” Ex. 1008, [0011]; Ex. 1003, ¶ 364. Like the ’251 Patent, Yoshida lists examples of “particles having high heat resistance,” including “[o]rganic or inorganic material such as silica, alumina, titanium oxide or clay.” Ex. 1008, [0025]; Ex. 1001, 5:3-20; Ex. 1003, ¶¶ 361-64. Yoshida discloses that the particles are fine, having a particle size that is “at most 0.5 μm .” Ex. 1008, [0026]; Ex. 1003, ¶ 364.

Nagayama discloses a heat-resistant layer containing “insulating filler particles.” Ex. 1009, [0021]; Ex. 1003, ¶ 365. Nagayama discloses that “the

insulating filler is preferably an inorganic oxide,” (Ex. 1009, [0009] which is “a compound having a high specific heat,” such as “alumina, titania, zirconia and magnesia.” *Id.* at [0028]; Ex. 1003, ¶ 365. Nagayama confirms that “solid *fine* particles” were used in the prior art as “inorganic filler.” *Id.* at [0004] (emphasis added). Ex. 1003, ¶ 365.

Amagi similarly discloses using an alumina filler having an average particle size of 0.3 μm for its heat-resistant properties. Ex. 1022, Fig. 1; Ex. 1003, ¶ 366.

4. [1.B]

Yoshida, Nagayama, and Takezawa disclose a thermoplastic resin, such as polyethylene or polypropylene. Ex. 1008, [0022]; Ex. 1009, [0044]; Ex. 1010, [0058]; Ex. 1003, ¶¶ 368-72.

5. [1.C]

Yoshida discloses that “fine particles having high heat resistance is used as the second porous layer 3b component.” Ex. 1008, [0025]. Ex. 1003, ¶ 373. Yoshida discloses mixing a binder with the heat-resistant particles to form the heat-resistant layer. Ex. 1008, [0027]; Ex. 1003, ¶ 373.

Nagayama similarly discloses using heat-resistant particles and binder to form a heat-resistant layer. *See, e.g.*, Ex. 1009, [0021], [0009]; Ex. 1003, ¶ 374.

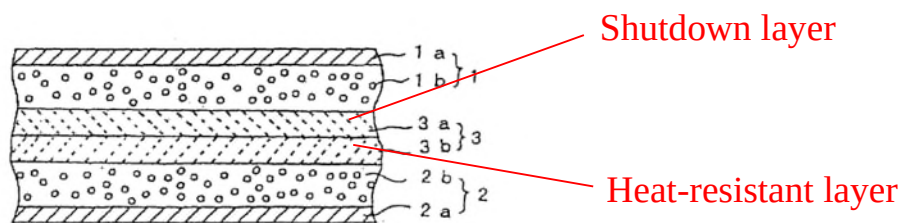
6. [1.D]

Yoshida, Nagayama, and Takezawa disclose that a thermoplastic resin could be used as a shutdown layer formed of heat-shrinkable microporous film. Ex. 1008, [0036], [0022] (“Referring to the thermoplastic resin which is a main component of the first porous layer 3a. . .”); Ex. 1009, [0044]; Ex. 1010, [0058]; Ex. 1003, ¶¶ 376-80.

7. [1.E]

Yoshida discloses a separator (3) interposed between two electrodes (1 and 2) and having an integrated structure, the separator (3) comprising multiple layers: the shutdown layer (3a) and the heat-resistant layer (3b).

FIG. 1



Ex. 1008, Fig. 1, Ex. 1003, ¶ 382. Yoshida further discloses that the two layers are integrated because separator 3 “is obtained by laminating a first porous layer 3a containing a thermoplastic resin as a main component onto a second porous layer 3b

whose heat resistance is higher than that of the first porous layer 3a.” Ex. 1008, [0021], Ex. 1003, ¶ 382.

8. [1.F]

Nagayama discloses that “the thickness of the separator made of resin is more preferably in the range of 12 to 23 μm .” Ex. 1009, [0044]; Ex. 1003, ¶ 385. Nagayama further discloses that the heat-resistant layer (B) is “preferably 3 to 7 μm .” Ex. 1009, [0025]; Ex. 1003, ¶ 385. Thus, a POSITA would have understood that the sum of A and B is 15–30 μm , and the ratio of A/B is 1.71–7.67. Ex. 1003, ¶¶ 386-87.

9. [1.G]

As discussed above with respect to Ground 1A, a POSITA would have understood that the importance of a high concentration of heat-resistant particles. In Example 1, Yoshida discloses 10 weight % of binder (poly(vinylidene fluoride)), which a POSITA would have understood to mean that there was 90 weight % alumina in the heat-resistant layer. Ex. 1008, [0031]; Ex. 1003, ¶ 391. A POSITA would have understood that to convert weight % to vol. % is a simple calculation using the known densities of alumina (3.965 g/cm³) and poly(vinylidene fluoride) (1.82 g/cm³). Ex. 1008, [0031]; Ex. 1003, ¶ 391; Ex. 1031; Ex. 1032, 658. The concentration of alumina in this example is therefore 80.51 vol. % ($100 \times (90/3.965) / (90/3.965 + 10/1.82)$). Ex. 1008, [0031]; Ex. 1003, ¶¶ 391-92.

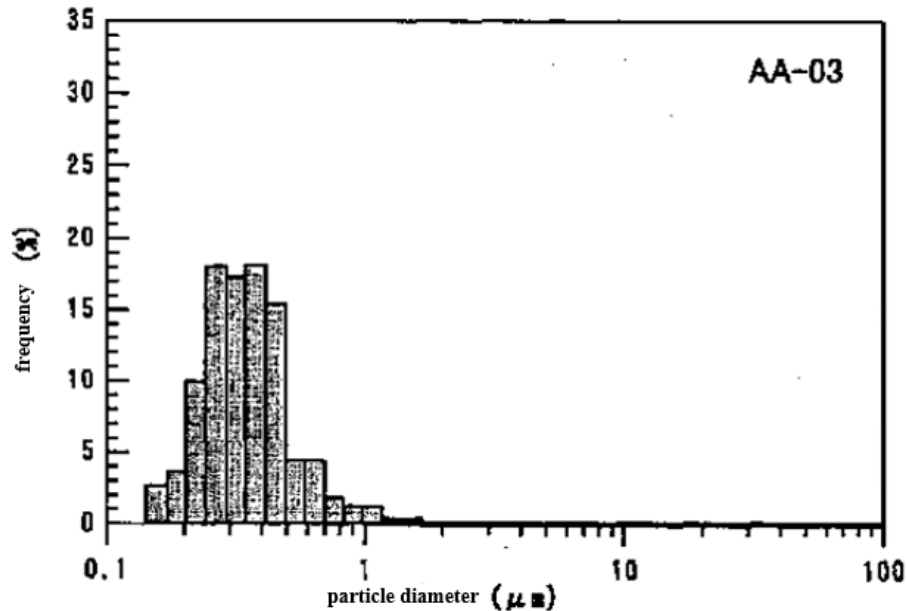
In Example 3, Yoshida discloses that the heat-resistant layer is made of ultra-fine alumina and 30 weight % binder (poly(vinylidene fluoride)), which a POSITA would have understood meant there was 70 weight % of alumina. Ex. 1008, [0042]; Ex. 1003, ¶ 393. The concentration of alumina in this example is therefore 51.71 vol. % ($100 \times (70/3.965) / (70/3.965 + 30/1.82)$). Ex. 1008, [0042]; Ex. 1003, ¶¶ 393-94.

10. [1.H]

As discussed above with respect to Ground 1A, a POSITA would have understood the importance of the size distribution of the heat-resistant particles. Yoshida confirms this, stating that when particles are too small, there is not sufficient ion conductivity, but when particles are too large, film thickness becomes too large. Ex. 1008, [0026]; Ex. 1003, ¶ 395. Yoshida further discloses that “[t]he average particle size of the [heat resistant fine] particles is preferably at most 0.5 μm.” Ex. 1008, [0026]; Ex. 1003, ¶¶ 395-97.

. To the extent it is argued that Yoshida does not disclose limitation 1.h, Amagi confirms that the claimed size distribution was well-known. See Motivation to Combine. Amagi discloses an example of a heat-resistant fine particles (alumina, referred to by the manufacturer as “Sumicorundum AA-03” or “AA-03”) having an average particle size of 0.3 μm and the following particle size distribution:

[FIG. 1]



Ex. 1022, Fig. 1; Ex. 1003, ¶ 398. Amagi therefore discloses that less than 6 weight % (6 vol. %) of the heat-resistant particles are 0.2 μm or less, and effectively 0 weight % (effectively 0 vol. %) of heat-resistant particles are larger than 2 μm. Ex. 1003, ¶¶ 398-402.

11. [1.I]

As discussed above with respect to Ground 1A, a POSITA would have understood that the shutdown temperature range of a separator may be adjusted as a matter of routine optimization. Yoshida discloses a shutdown temperature range of 60–150°C. Ex. 1008, [0022]; Ex. 1003, ¶ 404. “Selecting a narrow range from within a somewhat broader range disclosed in a prior art reference” is prima facie obvious under 35 U.S.C. §103(a). *In re Peterson*, 315 F.3d 1325, 1329-30 (Fed. Cir. 2003).

12. Claims 4, 15

Yoshida discloses “an organic or inorganic powder (fine particles)” as the heat-resistant layer. Ex. 1008, [0024]; Ex. 1003, ¶ 407. Nagayama similarly discloses an insulating filler, specifying that “the insulating filler is preferably an inorganic oxide.” Ex. 1009, [0009]; Ex. 1003, ¶ 407. Amagi similarly discloses alumina particles (an inorganic oxide). Ex. 1022, [0011], [0023]; Ex. 1003, ¶ 407.

13. Claims 5, 16

Yoshida, Nagayama, and Amagi disclose inorganic oxides such as alumina and silica. *See, e.g.*, Ex. 1008, [0025]; Ex. 1009, [0028]; Ex. 1022, [0011]; Ex. 1003, ¶¶ 409-11.

14. Claims 6, 17

Yoshida discloses that the heat-resistant layer may be formed out of “an organic or inorganic powder (fine particles), an organic or inorganic fiber, or an **organic or inorganic plate** whose softening temperature is at least 120°C.” Ex. 1008, [0024]; Ex. 1003, ¶¶ 412-14.

15. Claims 7, 18

Nagayama discloses that the “thickness of the porous heat resistant layer is preferably 3 to 7 μm .” Ex. 1009, [0025]; Ex. 1003, ¶¶ 415-17.

16. Claims 8, 19

A POSITA would have understood that a polyolefin is an example of a thermoplastic resin. Yoshida discloses that the “thermoplastic resin” may be a “polyolefin such as polypropylene or polyethylene . . .” Ex. 1008, [0022]; Ex. 1003, ¶¶ 418-20. Nagayama and Takezawa similarly disclose the use of polyolefins like polyethylene or polypropylene. Ex. 1009, [0044]; Ex. 1010, [0058]; Ex. 1003, ¶¶ 418-20.

17. Claims 9, 22

Yoshida discloses that the average particle size is “at most 0.5 μm .” Ex. 1008, [0026]; Ex. 1003, ¶ 422. Amagi discloses an average particle size of alumina of 0.3 μm . Ex. 1022, Fig. 1; Ex. 1003, ¶ 423.

18. [10.Pre]

To the extent the preamble is limiting, Yoshida, Nagayama, and Takezawa disclose nonaqueous electrolyte batteries, such as lithium-ion batteries. *See, e.g.*, Ex. 1008, [0053]; Ex. 1009, [0001]; Ex. 1010, [0055]; Ex. 1003, ¶¶ 425-27. As discussed with respect to Ground 1A, a POSITA would have understood that a lithium-ion battery is a nonaqueous electrolyte battery.

19. [10.A]

Yoshida, Nagayama, and Takezawa disclose positive electrodes capable of deintercalating and intercalating lithium ions because they disclose positive

electrodes in lithium-ion batteries. *See, e.g.*, Ex. 1008, [0003]; Ex. 1009, [0007]; Ex. 1010, [0055]; Ex. 1003, ¶¶ 428-30. As discussed with respect to Ground 1A, a POSITA would have understood that a positive electrode for use in a lithium secondary battery necessarily is capable of deintercalating and intercalating lithium ions. *See* Ex. 1028, 9.

20. [10.B]

Yoshida, Nagayama, and Takezawa disclose negative electrodes capable of deintercalating and intercalating lithium ions because they disclose positive electrodes in lithium-ion batteries. *See, e.g.*, Ex. 1008, [0003]; Ex. 1009, [0007]; Ex. 1010, [0055]; Ex. 1003, ¶¶ 431-33. As discussed with respect to Ground 1A, a POSITA would have understood that a negative electrode for use in a lithium-ion battery necessarily is capable of deintercalating and intercalating lithium ions. *See* Ex. 1028, 9-10.

21. [10.C]

Yoshida, Nagayama, and Takezawa similarly disclose that the separator is interposed between the electrodes. *See, e.g.*, Ex. 1008, [0013] (“The first battery of the present invention comprises a separator ***interposed*** between a positive electrode and a negative electrode . . .”); Ex. 1009, [0007]; Ex. 1010, [0139]; Ex. 1003, ¶¶ 434-36.

22. [10.D]

Yoshida, Nagayama, and Takezawa similarly disclose a nonaqueous electrolyte. *See, e.g.*, Ex. 1008, [003] (“... and non-aqueous solution is filled to constitute the ion conductive layer.”); Ex. 1009, [0007] (“A non-aqueous electrolyte secondary battery of the present invention includes a positive electrode, a negative electrode and a non-aqueous electrolyte.”); Ex. 1010, [0055]; Ex. 1003, ¶¶ 437-39. A POSITA would have understood that a nonaqueous electrolyte battery necessarily has a nonaqueous electrolyte. *See* Ground 1A.

23. [10.E]

As discussed above with respect to Ground 1A, a POSITA would have understood that heat generation temperature is an inherent property that depends from the active material of the positive electrode. *See also* Ex. 1003, ¶¶ 440-43. Nagayama discloses examples of positive electrode active materials that are identical to the active materials claimed by the '251 Patent and disclosed as having a heat generation starting temperature of 180°C or higher, such as $\text{LiNi}_{0.45}\text{Mn}_{0.45}\text{Mg}_{0.1}\text{O}_2$ and $\text{LiNi}_{0.4}\text{Mn}_{1.6}\text{O}_4$. Ex. 1009, [0011]-[0012], [0034]-[0035]; 1003, ¶¶ 444-50. The '251 Patent admits that these active materials exhibit heat generation starting temperatures of 180°C or higher. Ex. 1001, 3:37-63; Ex. 1003, ¶¶ 444-50.

Moreover, Nagayama also discloses a heat generation temperature as high as 179 °C when the battery is charged to 4.4 V:

	(Heat generation starting temperature) (°C)	Initial discharge capacity (mAh)	Discharge capacity ratio (%)
Battery 2	165	847	92
Battery 12	170	831	92
Battery 13	168	847	93
Battery 14	160	855	94
Battery 15	121	859	94
Battery 16	123	857	92
Battery 17	161	855	94
Battery 18	168	843	93
Battery 19	160	819	91
Battery 20	124	845	93
Battery 21	155	845	93
Battery 22	173	843	92
Battery 23	179	802	92
Battery 24	165	845	92
Battery 25	167	842	93
Battery 26	167	842	92
Battery 27	168	843	93
Battery 28	165	841	93
Battery 29	155	845	67
Battery 30	156	845	85
Battery 31	156	844	87
Battery 32	153	829	90
Battery 33	160	840	92
Battery 34	161	840	92
Battery 35	163	838	93

Ex. 1009, Table 4; Ex. 1003, ¶ 451. A POSITA would have understood 179 °C is effectively the same as 180 °C. Ex. 1003, ¶ 452. Indeed, a POSITA would have been capable of increasing the temperature from 179 °C to above 180 °C. Ex. 1003, ¶ 452. Where a patent claim and a prior art reference teach non-overlapping ranges for a

particular element, that difference is generally not considered patentable if it was within the capabilities of one skilled in the art. *In re Huang*, 100 F.3d 135, 139 (Fed. Cir. 1996) (*citing In re Aller*, 220 F.2d 454, 456 (C.C.P.A. 1955)).

Moreover, because the battery was charged to 4.4 V, the heat generation starting temperature must necessarily be greater than that when the battery is in a lower charged state. Ex. 1003, ¶ 453. For example, when the battery is only charged to 4.25 V like in the '251 Patent, a POSITA would have understood that the heat generation temperature would be much higher for any given active material and would have certainly been 180°C or higher for certain of the materials in Nagayama. *Id.*

Irrespective, Takezawa discloses various heat generation starting temperatures in the range of 202 to 400°C. Ex. 1010, [0087]; Ex. 1003, ¶ 454. Takezawa discloses, for example, “the positive electrode active material a-6 represented by the chemical formula: LiFePO_4 .” Ex. 1010, [0086]; Ex. 1003, ¶ 455. LiFePO_4 is identical to the structure in Claim 13 (*infra*). Ex. 1003, ¶ 455. Takezawa discloses the heat generation starting temperature of LiFePO_4 is over 400°C, demonstrating that it was well-known for the claimed materials to have a heat generation starting temperature over 180°C. Ex. 1010, [0087]; Ex. 1003, ¶ 455.

24. [10.F]

Yoshida, Nagayama, Takezawa, and Amagi disclose the battery separator according to claim 1 for at least all the reasons discussed with respect to claim 1. Ex. 1003, ¶ 457.

25. Claim 13

Nagayama discloses examples of positive electrode active materials that are identical to the active materials claimed by the '251 Patent, such as $\text{LiNi}_{0.45}\text{Mn}_{0.45}\text{Mg}_{0.1}\text{O}_2$ and $\text{LiNi}_{0.4}\text{Mn}_{1.6}\text{O}_4$. Ex. 1009, [0011]-[0013], [0034]-[0035]; Ex. 1003, ¶¶ 458-64. Takezawa discloses: “the positive electrode active material a-6 represented by the chemical formula: LiFePO_4 .” Ex. 1010, [0086]; Ex. 1003, ¶ 465.

26. Claim 20

Nagayama discloses that the shutdown layer may be located on the negative electrode side. Ex. 1009, [0008] (“It is preferable that a microporous separator made of resin is disposed between the positive electrode and the porous heat resistant layer or between the negative electrode and the porous heat resistant layer.”); Ex. 1003, ¶¶ 467-69.

27. Claim 21

Nagayama discloses that the shutdown layer may be located such that it is not in contact with the positive active material. Ex. 1009, [0008]; Ex. 1003, ¶¶ 470-72; *see also* Claim 20.

28. Claims 23, 27

Nagayama discloses this claim for at least the reasons provided above with respect to limitation 1.F. Ex. 1003, ¶¶ 473-74. Indeed, Nagayama discloses that the preferred thickness of the “separator made of resin is preferably in the range of 12 to 23 μm .” Ex. 1009, [0044].

29. Claims 26, 30

Nagayama and Amagi disclose this claim for at least the reasons provided above with respect to claims 9 and 22. Ex. 1003, ¶¶ 475-78.

30. Claim 31: *The nonaqueous electrolyte battery according to claim 10, wherein the shutdown layer of the separator is not in contact with the positive active material, and a charging potential of the positive electrode is 4.3 V or more.*

A POSITA would have been motivated to keep the separator layer separate from the positive electrode to prevent the separator layer from melting on the positive electrode during normal operation temperatures and to prevent oxidation. Ex. 1003, ¶ 479. Nagayama teaches measuring the heat generation starting temperatures of various batteries after “[e]ach battery was charged at a constant

current of mA until the battery voltage reached 4.4 V.” Ex. 1009, [0072]; Ex. 1003, ¶ 480; Claim 21.

31. Claims 32, 34

As discussed above with respect to Ground 1A, a POSITA would have optimized the porosity of the heat-resistant layer. Nagayama discloses the “porosity of the porous heat-resistant layer is preferably 30 to 65%, and more preferably 40 to 55%.” Ex. 1009, [0026]; Ex. 1003, ¶ 483. Nagayama discloses that porosity is important because if the porosity is too high, the strength may be reduced, but if it is too low, then there might be a reduction in discharge characteristics. *Id.*

32. Claims 33, 35

Nagayama discloses “[t]he porosity of the separator [made of resin, i.e. the shutdown layer] is preferably 20 to 70%, and more preferably 30 to 60%,” and the “porosity of the porous heat-resistant layer is preferably 30 to 65%.” Ex. 1009, [0044], [0072]; Ex. 1003, ¶ 486. A POSITA would have understood this means the porosity of “the whole separator,” (i.e. the shutdown layer plus the heat-resistant layer) is between 20 to 70% because the limiting porosity is of the layer that is the least porous. Ex. 1003, ¶¶ 485-87.

D. Ground 2B: Claims 2, 11, and 12 are unpatentable under pre-AIA 35 U.S.C. §103(a) over Yoshida, Nagayama, Takezawa, Amagi, and Miyatake

1. Overview

i. Motivation to Combine

A POSITA would have been motivated to combine Yoshida, Nagayama, Takezawa, and Amagi for the reasons discussed above.

While Yoshida discloses the importance of the thermal shrinkage ratio (Ex. 1008, [0020]), Yoshida, Nagayama, Takezawa, and Amagi do not disclose a specific thermal shrinkage ratio. Ex. 1003, ¶¶ 489-90.

A POSITA would have turned to a reference that disclosed the specific thermal shrinkage ratio. Ex. 1003, ¶ 491. Miyatake discloses the use of heat-resistant materials, including ceramic and alumina, such that the shrinkage rate of a separator is within 0 to 30% in all regions in the temperature range of 100–200°C. Ex. 1007, [0047]; Ex. 1003, ¶ 491-94; Ground 1B.

Lithium-ion chemistry was predictable at the time of these references. Ex. 1003, ¶ 40. A POSITA would have had a reasonable expectation of success because Yoshida discloses that thermal shrinkage of the separator is “controlled” when a heat-resistant layer containing inorganic filler (such as alumina) is used. Ex. 1008, [0020], [0025]. Miyatake discloses such an inorganic filler. Ex. 1007, [0050]; Ex. 1003, ¶¶ 495-96.

2. Claim 2

Miyatake discloses this limitation for the reasons discussed above with respect to Ground 1B. Ex. 1003, ¶¶ 497-500.

3. Claim 11

Miyatake discloses this limitation for the reasons discussed above with respect to Ground 1B. Ex. 1003, ¶¶ 501-04.

4. Claim 12

Miyatake discloses this limitation for the reasons discussed above with respect to Ground 1B. Ex. 1003, ¶¶ 505-07.

E. Ground 2C: Claims 3, 14, 24–25, 28–29, and 36–37 are unpatentable under pre-AIA 35 U.S.C. §103(a) over Yoshida, Nagayama, Takezawa, Amagi, and Katayama

1. Overview

i. Motivation to Combine

A POSITA would have been motivated to combine Yoshida, Nagayama, Takezawa, and Amagi for the reasons discussed above. In addition, Nagayama teaches the importance of balancing a high concentration of heat-resistant particles with the need for using a binder in the heat-resistant layer. Ex. 1009, [0024] (“... the ratio of the binder relative to the total of the insulating filler and the binder is preferably 1 to 10% by weight. . .”); Ex. 1003, ¶¶ 508-09. However, Nagayama does not explicitly disclose a vol. % of heat-resistant particles.

A POSITA would have been motivated to optimize the concentration of heat-resistant fine particles according to the disclosure of Katayama. Katayama discloses a preference for at least 80 vol. % of heat-resistant particles in the heat-resistant layer. Ex. 1006, [0051], [0059], [0156]; Ex. 1003, ¶¶ 510-12.

A POSITA would have had a reasonable expectation of success in following this disclosure because Nagayama already taught the need for a high concentration of heat resistant particles and that a concentration of heat-resistant particles greater than 90 weight-percent would work, and because lithium-ion chemistry was predictable at the time of these references. Ex. 1009, [0024]; Ex. 1003, ¶¶ 40, 513.

Moreover, a POSITA would have understood that Yoshida and Nagayama both disclose the use of binders generally. Ex. 1008, [0027]; Ex. 1009, [0009], [0021]. A POSITA would have understood that the claimed binders are all commonly used binders, it would have been a simple substitution to use the binders of Katayama in the separator of Yoshida/Nagayama, and lithium-ion chemistry was predictable at the time of these references. Ex. 1003, ¶¶ 40, 514.

The same is true for the methods of forming a microporous layer. A POSITA would have understood that Yoshida, Nagayama, and Takezawa disclose the use of microporous films (shutdown layers). Ex. 1008, [0036], [0022]; Ex. 1009, [0044]; Ex. 1010, [0058]. A POSITA would have understood that the three claimed methods were common ways to manufacture those microporous layers, it

would have been a simple substitution to use the microporous film of Katayama in place of the microporous film of Yoshida/Nagayama/Takezawa, and lithium-ion chemistry was predictable at the time of these references. Ex. 1003, ¶¶ 40, 514.

2. Claims 3, 14

Yoshida discloses this limitation for the reasons discussed above with respect to limitation 1.G in Ground 2A. Ex. 1003, ¶¶ 515-16.

Katayama discloses this limitation for the reasons discussed above with respect to Ground 1A. Ex. 1003, ¶¶ 515-16.

3. Claims 24, 28

Yoshida discloses this limitation for the reasons discussed above with respect to limitation 1.G in Ground 2A. Ex. 1003, ¶¶ 517-18.

Katayama discloses this limitation for the reasons discussed above with respect to Ground 1A. Ex. 1003, ¶¶ 517-18.

4. Claims 25, 29

Katayama discloses this limitation for the reasons discussed above with respect to Ground 1A. Ex. 1003, ¶¶ 519-20.

5. Claims 36, 37

Katayama discloses this limitation for the reasons discussed above with respect to Ground 1A. Ex. 1003, ¶¶ 521-22.

VIII. THIS PETITION CONTAINS NEW ARGUMENTS AND PRIOR ART NOT PREVIOUSLY PRESENTED TO THE OFFICE.

The Board relies on a two-part framework to analyze denial under 35 U.S.C. §325(d). *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, No. IPR2019-01469, Paper 6 at 7 (PTAB Feb. 13, 2020) (precedential). When considering the first prong, the PTAB considers the prosecution of the patent. *Id.*, 7-8.

As to the first prong, none of the references or combination of references were relied upon by the Examiner in an Office Action, which favors institution. Moreover, the art relied upon by the Examiner was materially different. For example, US 2007/0264577 (Katayama '577) is distinct from the Katayama relied upon herein.

In order to distinguish Katayama '577, Applicant argued that Katayama '577 teaches a POSITA to use *less* than 50 vol. % of heat-resistant fine particles when the size distribution is less than 10 vol. % of particles less than 0.2 μm or greater than 2.0 μm . Ex. 1002, 879. To support this, the Applicant noted that Examples 1 and 4 of Katayama '577 use heat-resistant particles with the claimed size distribution, but argued that the concentration of heat-resistant particles in Examples 1 and 4 is less than 50 vol. %. *Id.*, 874-75 (citing Katayama '577, [118], [0121]). Katayama is not so flawed.

In contrast to Katayama '577, Katayama teaches the effectiveness of *both* the claimed concentration of particles *and* the claimed size distribution of particles *at*

the same time in an effective separator. *See, e.g.*, Ex. 1009, [0124]-[0125] (disclosing the use heat-resistant particles with a 0.3–0.7 μm size distribution *and* a concentration of 58 vol. %).

Katayama was distinguished in the specification of the '251 Patent because of an alleged need to further improve “ the safety of the battery at even higher temperatures.” Ex. 1001, 1:59-64. Even if Patent Owner were to argue that it claimed “safety of the battery at even higher temperatures,” which it did not, Katayama alone or in combination with Kasamatsu discloses such improvements. *See supra*.

As to the second prong, it was material error not to consider the references cited herein. The PTAB provided examples of “material errors,” including whether the office overlooked a specific teaching of the relevant prior art or an error of law, such as misconstruing a claim term. *Advanced Bionics*, Paper 6 at 8 n.9. As demonstrated above and given the breadth of the claims, Katayama and Kasamatsu render the claims obvious. It was a material error to not address the claims in view of the cited references. *See Shure Inc. v. ClearOne, Inc.*, No. PGR2020-00079, Paper 14 at 29 (PTAB Feb. 16, 2021).

IX. THE NHK SPRING DECISION IS INAPPLICABLE.

The claims of the '251 Patent have never been tested in view of the most relevant prior art. Now, and in view of the strong prior art challenges and given that

the district court proceeding is in its infancy, the Board should refuse to entertain a discretionary denial under §314(a). *See NHK Spring Co. v. Intri-Plex Techs., Inc.*, No. IPR2018-00752, Paper 8 at 19-20 (PTAB Sept. 12, 2018) (precedential). Further, the *Apple Inc. v. Fintiv, Inc.*, No. IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020), factors do not support denial of institution:

Factor 1 (stay) does not support discretionary denial. There are currently two district court lawsuits pending between the parties, the first filed by Petitioner in the District of New Jersey (“DNJ”) and the second filed by Patent Owner in the Waco division of the Western District of Texas (“WDTX”). In these actions, the parties filed motions to dismiss for lack of personal jurisdiction and under the first-to-file rule (or, alternatively, to transfer venue). The DNJ case is the first-filed case and the one most likely to proceed. Irrespective of the outcome of the jurisdictional disputes, Petitioner will likely move for a stay in either venue.

Even if Patent Owner argues that the WDTX action will proceed and not be stayed, the Board “will not attempt to predict how the district court in the related district court litigation will proceed.” *Sand Revolution II, LLC v. Cont’l Intermodal Grp.-Trucking LLC*, No. IPR2019-01393, Paper 24 at 7 (PTAB Jun. 16, 2020) (Informative).

Factor 2 (Trial Date Proximity) does not support a discretionary denial. As noted above, there is uncertainty as to which court will hear the related district court case.

If the matter proceeds (as expected) in DNJ, the matter is in its infancy as no scheduling order has been issued and no trial date has been set. If the matter proceeds in WDTX, the Court will not set the true trial date (rather than a placeholder) until *after* the *Markman* hearing. See Ex. 1030, 11 (“[t]he Court expects to set [the trial date] at the conclusion of the *Markman* hearing”). Because the *Markman* hearing will not proceed until the resolution of dispositive and transfer motions, it is likely that tentative trial date of 2/7/23 will be postponed. Ex. 1035 (the court will postpone *Markman* hearings in view of unresolved transfer motions).

Irrespective, the proximity of a trial date is not dispositive. “[Factor 2] is not considered in isolation, but holistically along with other factors.” *Facebook, Inc. v. USC IP P’ship, L.P.*, No. IPR2021-00034, Paper 13 at 11 (PTAB Apr. 30, 2021) (instituting where trial date was set five months before the Final Written Decision). Indeed, the PTAB has instituted IPR even where a district court trial is scheduled to occur five months before the PTAB’s decision where, as here, the petition was filed in the early stages of litigation. *Id.*

Factor 3 (Investment in District Court Proceeding) favors institution. Investment in the district court has been minimal other than (unresolved) briefing on

jurisdictional issues. In both districts, very little has occurred. Invalidity contentions were served on September 10, 2021 in WDTX and are not yet due in DNJ. Indeed, all discovery (except of venue, jurisdiction, and claim construction) is stayed in WDTX until after the *Markman* hearing, which will not proceed until the resolution of the jurisdictional issues. No discovery has occurred in DNJ. In view of the circumstances, there will have been minimal, if any, investment in the validity of the patents in the co-pending cases at time of an institution.

Factor 4 (overlap) favors institution. Once jurisdiction is resolved, Petitioner will address whether a stipulation is necessary to eliminate any risk of duplicative efforts between the Board and the district court. *See, e.g., Sand Revolution II*, Paper 24 at 11-12.

Factor 5 (Parties). Amperex’s status as both Petitioner and defendant is at best a neutral factor given above stipulation and the resultant efficiency gained by addressing the asserted grounds in this proceeding.

Factor 6 favors institution because the grounds provide a strong showing of obviousness. “[I]f the merits of a ground raised in the petition seem particularly strong on the preliminary record, this fact has favored institution.” *Fintiv*, Paper 11 at 14-15; *see also, e.g., VMWare, Inc. v. Intellectual Ventures I LLC*, No. IPR2020-00470, Paper 13 at 21-22 (PTAB Aug. 18, 2020).

The *Fintiv* factors weigh strongly against discretionary denial.

X. CONCLUSION

Petitioner requests cancellation of the challenged claims.

XI. MANDATORY NOTICES UNDER 37 C.F.R. §42.8

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

The real party-in-interest is Petitioner, Amperex Technology Limited.

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

Pursuant to 37 C.F.R. §42.8(b)(2), Petitioner is aware of the following pending lawsuits or related matters involving the '251 Patent:

- *Amperex Tech. Ltd. v. Maxell, Ltd.*, No. 2:21-cv-08461-KM-MF (D.N.J. Apr. 6, 2021).
- *Maxell Holdings, Ltd. v. Amperex Tech. Ltd.*, No. 6:21-cv-00347-ADA (W.D. Tex. Apr. 8, 2021)

Petitioner is simultaneously filing petitions for IPR of U.S. Patent Nos. 8,691,446, 9,350,019, and 9,077,035.

C. Designation of Counsel Under 37 C.F.R. §42.8(b)(3)

Petitioner provides the following designation of counsel.

Lead Counsel	Backup Counsel
Christopher TL Douglas Reg. No. 56,950 ALSTON & BIRD LLP 101 South Tryon Street, Suite 4000 Charlotte, NC 28280 Tel: 704.444.1000 Fax: 704.444.1111 Email: christopher.douglas@alston.com	Lauren E. Burrow Reg. No. 70,447 ALSTON & BIRD LLP 101 South Tryon Street, Suite 4000 Charlotte, NC 28280 Tel: 704.444.1000 Fax: 704.444.1111 Email: lauren.burrow@alston.com
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Pursuant to 37 C.F.R §42.10(b), a Power of Attorney is being submitted with this Petition.

D. Service Information

Please address all correspondence and service to the address listed above.

Petitioner consents to electronic service directed to

christopher.douglas@alston.com, lauren.burrow@alston.com, and
maddy.byrd@alston.com.

Date: September 23, 2021

By: /Christopher TL Douglas/
Christopher TL Douglas

CERTIFICATION UNDER 37 C.F.R. §42.24

Under the provisions of 37 CFR §42.24, the undersigned hereby certifies that the word count for the foregoing Petition for *inter partes* review totals 13,998 words (Sections I-X), which is less than the 14,000 allowed under 37 CFR §42.24(a)(i).

Date: September 23, 2021

By: /Christopher TL Douglas/
Christopher TL Douglas

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§42.6(e), 42.105, the undersigned hereby certifies service on the Patent Owner of a copy of this Petition and its respective exhibits to Patent Owner via UPS Next Day Air on the correspondence address of record for U.S. Patent No. 9,166,251 as follows:

BIRCH STEWART KOLASCH & BIRCH, LLP
8110 Gatehouse Road
Suite 100 East
Falls Church VA 22042-1248

Petitioner also certifies that a courtesy copy of this Petition was sent via email to Patent Owner's litigation counsel:

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