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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

KERR CORPORATION,
Petitioner,

v.

3M INNOVATIVE PROPERTIES COMPANY,
Patent Owner.

Case No. IPR2019-00370
U.S. Patent No. 6,572,693

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 6,572,693

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Petitioner Kerr Corporation ("Kerr") respectfully requests *inter partes* review of Claims 1-25 of U.S. Patent No. 6,572,693 ("'693 Patent"), purportedly owned by 3M Innovative Properties Company ("3M").

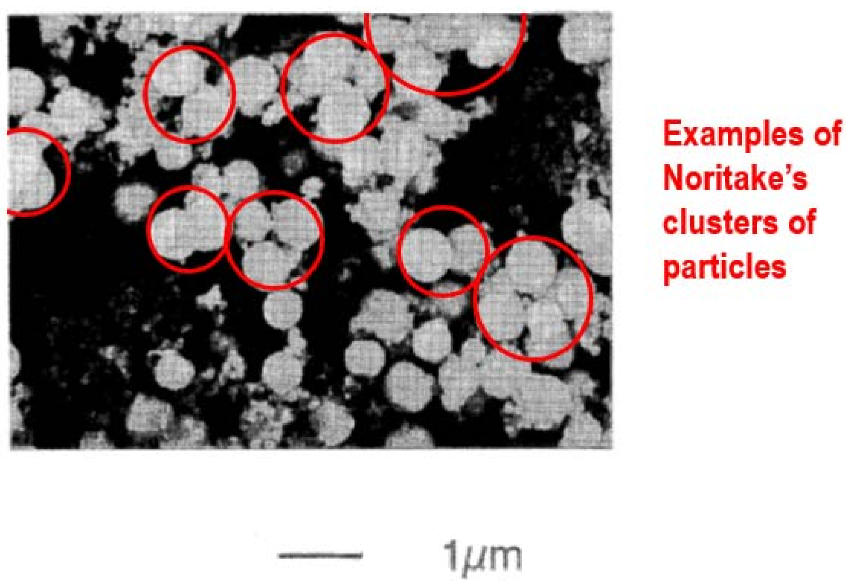
I. INTRODUCTION

This *inter partes* review involves dental composites which are used to fill cavities. The composite is a paste that includes (1) a resin (glue) that can be hardened by curing, and (2) a filler. The filler is typically formed of small particles. When exposed to an energy source, such as UV light, the resin cures, resulting in the composite hardening so it can be polished. The end result is a durable and aesthetic dental restoration that mimics the appearance of natural teeth.

The '693 Patent describes a filler containing clusters of nano-sized particles and non-agglomerated nano-sized particles. The patent requires clusters that are "not fully densified," contrasting it with particles that are fully densified and therefore "near theoretical density" having "substantially no open porosity." Ex. 1001 at 4:42-45. It asserts that such clusters would result in the smaller nano-sized particles filling the interstitial spaces between clusters, thereby minimizing voids in the composite. *Id.* at 2:30-34. 3M asserts that its claimed clusters with interstitial pores distinguish its patent from the prior art. *See* Ex. 1012 at 3.

Nothing about the '693 Patent's claimed dental material was new. Hardenable resins and fillers, including clusters and non-agglomerated nano-sized particles, were conventional in the prior art. Indeed, the composite claimed in the '693 Patent had already been developed in Japan. The prior art Noritake patent described a dental composite with a filler containing nano-sized particles. Noritake's filler included clusters of "strongly aggregated particles" that were not fully densified as empirically measured by the presence of micro pores. Ex. 1005 at 2:9-10, 4:52-58, Fig. 1. Noritake included images of its clusters:

FIG. 6



Ex. 1005 at Fig. 6 (annotated).

Noritake is highly pertinent to patent validity. During prosecution of a European counterpart to the '693 Patent, the European Patent Office identified Noritake as a particularly relevant "X" reference, Ex. 1009 at 81, and characterized it as "the closest prior art," *id.* at 173. To overcome Noritake, 3M amended its European claims to add narrowing limitations not present in its U.S. patent. *Id.* at

164-66, 220-21. But Noritake was never substantively discussed during prosecution of the ’693 Patent. The Board should cancel all claims of the ’693 Patent as obvious over Noritake and the other prior art presented in this Petition.

II. MANDATORY NOTICES PURSUANT TO 37 C.F.R. § 42.8(A)(1)

Pursuant to 37 C.F.R. § 42.8(a)(1), the mandatory notices identified in 37 C.F.R. § 42.8(b) are provided below as part of this Petition.

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

The real parties-in-interest are Petitioner Kerr Corporation; Danaher Corporation; DH Acquisition Holding GmbH; DH Holdings Corp.; DH Holdings Germany LLC; DH Holdings Germany LLC & Co KG; DH Verwaltungs GmbH; Ormco Corporation; QFC Finance Corp.; QHC Holding Company; and Sybron Dental Specialties, Inc.

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

3M has asserted Claims 1-4, 6-8, 11-14, and 16-18 of the ’693 Patent against Kerr in a pending patent infringement lawsuit: *3M Company and 3M Innovative Properties Company v. Kerr Corporation*, No. 1:17-cv-01730-LPS-CJB (D. Del.) (“District Court Litigation”).

C. Lead and Backup Counsel (37 C.F.R. § 42.8(b)(3))

Kerr provides the following designation of counsel:

Lead Counsel	Back-up Counsel
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Pursuant to 37 C.F.R. § 42.10(b), a Power of Attorney accompanies this Petition. The above identified Lead and Back-up Counsel are registered practitioners associated with Customer No. 20,995 listed in that Power of Attorney.

D. Service Information (37 C.F.R. § 42.8(b)(4))

Service information for lead and back-up counsel is provided in the designation of lead and back-up counsel above. Kerr hereby consents to service by email at the following email address: BoxKERRCL001@knobbe.com.

E. Payment Of Fees Pursuant To 37 C.F.R. § 42.103

The fee set forth in 37 C.F.R. § 42.15(a) for this Petition has been paid. The undersigned authorize payment for any additional fees that may be due in connection with this Petition to be charged to Deposit Account No. 11-1410.

III. REQUIREMENTS FOR REVIEW UNDER 37 C.F.R. § 42.104

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

Kerr certifies that the ’693 Patent is available for review and that Kerr is not barred or estopped from requesting IPR of the challenged claims.

B. Claims and Statutory Grounds (37 C.F.R. § 42.104(b)(1) & (b)(2))

Kerr respectfully requests that trial be instituted for Claims 1-25 of the ’693 Patent in view of the following prior art:

- U.S. Patent No. 5,609,675 to Noritake *et al*. (“Noritake”) (Ex. 1005) was issued by the U.S. Patent Office on March 11, 1997. Ex. 1005 at 1. The ’693 Patent was filed on October 27, 2000 and purports to claim priority to applications filed on October 28, 1999. Noritake is analogous art to the ’693 Patent. Kalyon Decl. ¶52. Because Noritake is a printed publication dated more than one year before the earliest filing date of the ’693 Patent, it qualifies as prior art under pre-AIA 35 U.S.C. § 102(b).
- U.S. Patent No. 4,503,169 to Randklev (“Randklev”) (Ex. 1006) was issued by the U.S. Patent Office on March 5, 1985. Ex. 1006 at 1. Randklev is

analogous art to the '693 Patent. Kalyon Decl. ¶56. Because Randklev is a printed publication dated more than one year before the earliest filing date of the '693 Patent, it qualifies as prior art under pre-AIA 35 U.S.C. § 102(b).

- Bayne et al., *Update on Dental Composite Restorations*, J. AM. DENTAL ASSN., Vol. 125:687-701 (June 1994) ("Bayne") (Exs. 1007-1008), was published in the June 1994 edition (Volume 125) of the Journal of the American Dental Association. Bayne bears a library date stamp of June 13, 1994 from the University of Wisconsin Health Sciences Library. Ex. 1007 at ii. A second copy of Bayne with a June 14, 1994 date stamp from the University of California Los Angeles Biomedical Library confirms publication. Ex. 1008 at ii. Bayne is analogous art to the '693 Patent. Kalyon Decl. ¶60. Because Bayne was published more than one year before the earliest filing date of the '693 Patent, it qualifies as prior art under pre-AIA 35 U.S.C. § 102(b).

The proposed statutory grounds of rejection for the '693 Patent are:

- <u>Ground 1</u>: Claims 1-9 and 11-19 of the '693 Patent are unpatentable as obvious in view of Noritake.
- <u>Ground 2</u>: Claims 10 and 20 of the '693 Patent are unpatentable as obvious in view of Noritake over Randklev.

- Ground 3: Claims 21-25 of the ’693 Patent are unpatentable as obvious in view of Noritake over Bayne.

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

A detailed explanation of the proposed claim constructions is provided below in Section IV.E.

D. Unpatentability of Construed Claims (37 C.F.R. § 42.104(b)(4))

A detailed explanation of how the challenged claims of the ’693 Patent are unpatentable, including an identification of where each claim limitation is found in the prior art, is provided below in Section V

E. Supporting Evidence (37 C.F.R. § 42.104(b)(5))

An Exhibit List with exhibit numbers and a brief description of each exhibit is included herewith. Kerr also submits the declaration of Professor Dilhan Kalyon, in support of this petition in accordance with 37 C.F.R. § 1.68. Exs. 1003-1004. Professor Kalyon is Professor of Chemical Engineering and Materials Science at the Stevens Institute of Technology. Kalyon Decl. ¶5. He has extensive academic and industry experience in composites and nano particles and is a leading expert in the technical fields related to the ’693 Patent. *Id.* ¶¶3-14.

IV. BACKGROUND

A. The ’693 Patent

The ’693 Patent describes a composite dental material that 3M asserts is inventive. Ex. 1001 at 2:35. The material is a paste that includes (1) a hardenable resin that can be hardened by curing; and (2) a filler. *Id*. at 2:35-40. The filler contains “clusters of nano-sized particles” and “non-agglomerated nano-sized particles.” *Id*. at 2:35-42. The patent explains that “the clusters are not fully densified,” contrasting them with particles that “are fully densified” and thus “near theoretical density, having substantially no open porosity.” *Id*. at 4:42-45. In the litigation, 3M argued that having clusters “being not fully densified” having “interstitial pores (spaces)… among the nano-sized particles in the clusters…. distinguishes the clusters from conventional large, solid particles of the prior art.” Ex. 1012 at 3.

It asserts this combination of clusters and non-agglomerated nano-sized particles would result in “the smaller nano-sized particles fill[ing] the interstitial spaces between the larger clusters thereby minimizing voids in the composite dental material.” Ex. 1001 at 2:30-34. According to the patent, this composite results in improved aesthetic quality, polishability, wear resistance, and strength. *Id*. at 3:10-14; *see also id*. 3:22-26.

Independent Claim 1 is representative and recites:

1. A material comprising:

(a) a hardenable resin; and

(b) a filler comprising (i) ***clusters of nano-sized particles, said clusters comprising non-heavy metal oxide particles and heavy metal oxides and being not fully densified*** and (ii) non-agglomerated ***nano-sized particles*** selected from the group consisting of non-heavy metal oxide particles, heavy metal oxide particles, and combinations thereof, wherein said material is a dental material.

Id. at 25:12-21 (emphasis indicating terms the parties have proposed for construction in co-pending litigation).[1]

B. <u>Overview of The Prior Art</u>

1. <u>Dental Composite Technology Before the ’693 Patent</u>

Dental composites are not new. Kalyon Decl. ¶23. Using a hardenable resin with a filler composed of small particles to restore teeth was well known and conventional in the dental field long before the purported invention of the ’693 Patent. *Id*.

Hardenable resins were well-known. *Id*. ¶24. The most popular dental composite resins used for more than 30 years contain methacrylic groups: “As has been true for the past 30 years, 80-90% of commercial dental composites utilize

[1] Unless otherwise indicated, emphasis has been added to quoted material throughout this Petition.

the Bis-GMA (2.2-bis[4-(2-hydroxy-3-methacryloyloxypropoxy)phenyl]propane) monomer developed by Dr. Rafael Bowen as their matrix-forming resin." Ex. 1014 (Ferracane) at 309; Ex. 1013 (Söderholm) at 140. Use of hardenable resins including methacrylic monomers was conventional before the '693 Patent. *See, e.g.*, Ex. 1005 at 1:16-24, 10:9-18; Ex. 1014 (Ferracane) at 309; Kalyon Decl. ¶24.

"The addition of inorganic **filler particles** to dental resin systems was introduced as early as 1951." Ex. 1013 (Söderholm) at 140. Ferracane recognized the importance of fillers "to provide strengthening… increased stiffness… reduced dimensional change when heated and cooled. . . reduced setting contraction… radiopacity… enhanced esthetics, and improved handling." Ex. 1014 (Ferracane) at 303. Use of fillers was conventional before the '693 Patent. Kalyon Decl. ¶¶25-26.

Using **non-heavy metal oxide particles** in dental fillers was also conventional. Kalyon Decl. ¶27. Silica is an example of a commonly used non-heavy metal oxide particle. *Id*. By 1985, "most commercial dental composites contain[ed] fillers such as quartz, colloidal ***silica***, silica glasses containing barium or strontium, and lithium-aluminum silicate." Ex. 1013 (Söderholm) at 140. In short, using silica in dental composites was conventional prior to the '693 Patent. *See, e.g.*, *id.*; Ex. 1005 at 2:56-3:11, 3:56-4:2; Ex. 1006 at 5:18; Ex. 1007 at 689; Ex. 1014 (Ferracane) at 303; Ex. 1015 (Rheinberger) at 5:5-21; Kalyon Decl. ¶27.

Heavy metal oxides were conventionally used to ensure the dental composite was radiopaque. Kalyon Decl. ¶28. By 1985, "[t]he two dominant types of radiopaque glasses for use in dental composites today are barium- and strontium-containing glasses." Ex. 1013 (Söderholm) at 140. By the mid-1990s, "[m]ost current composites [were] filled with radiopaque silicate particles based on oxides of barium, strontium, zinc, aluminum, or zirconium." Ex. 1014 (Ferracane) at 303. Before the '693 Patent, using heavy metal oxides in dental composites was well known. *See, e.g.*, Ex. 1005 at 2:56-3:11; Ex. 1006 at 5:36; Ex. 1014 (Ferracane) at 303; Ex. 1015 (Rheinberger) at 5:5-21; Kalyon Decl. ¶28.

Using **clusters** of particles in dental materials was also known before the purported invention of the '693 Patent. Kalyon Decl. ¶¶29-31. These are variously referred to in the '693 Patent and the literature as "clusters," "agglomerates," or "aggregates." *Id*. ¶29. 3M argues it invented clusters it characterized as "being not fully densified," but that is not a term of art, *id*. ¶78, and its claimed clusters already existed in the prior art, *id*. ¶¶29-33, 90-100. By 1995, Söderholm noted that "spherical fillers tend in turn to form agglomerates (Fig. 1)." Ex. 1013 (Söderholm) at 143. Söderholm provided images of the nano-sized particles clustering, showing that particle "agglomeration always occurs":

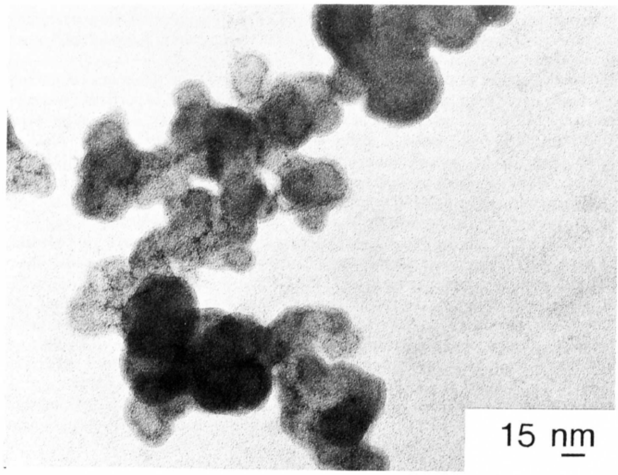


Fig. 1. Transmission electron microscopic (TEM) picture of AEROSIL showing the spherical shape of these particles and their tendency to form agglomerates.

Ex. 1013 (Söderholm) at Fig. 1; *see also* Ex. 1016 (Bayne 1992) at 307 ("[t]ransmission electron microscope studies of microfiller particles indicate that some agglomeration always occurs (Soderholm, 1985).").

A 1992 article by Bayne noted that in dental materials "microfiller particles [were] suspected to agglomerate into clusters." Ex. 1016 (Bayne 1992) at 305, Figs. 3-4. The same reference depicted the clustering and observed that "[i]n most hybrid composites that contain microfiller, the particles probably are somewhat agglomerated . . . ." *Id.* at 307, Figs. 3-4. Ferracane noted that silica "agglomerates" in a microfill. Ex. 1014 (Ferracane) at 303. Like the other features of the '693 Patent claims, clustering of small particles in dental composites was well-known. *See, e.g.*, Ex. 1005 at 2:3-12, Figs. 1-6, 4:52-59; Ex. 1013 (Söderholm) at 143, Fig. 1; Ex. 1016 (Bayne 1992) at 305, 307, Figs. 3-4; Ex. 1014 (Ferracane) at 303; Ex. 1015 (Rheinberger) at 5:5-21; Kalyon Decl. ¶¶29-31.

Use of small particles, including non-agglomerated **nano-sized particles**, was also well-known in dental materials before the ’693 Patent. Kalyon Decl. ¶¶32-35. Ferracane observed that “[t]he use of smaller particles minimizes the space between particles and the extent of filler plucking [*sic*] and surface degradation during chewing, thus reducing the rate of abrasive wear” and mentioned “use of nanofillers, particles anywhere from 1 to 100 nm in size.” Ex. 1014 (Ferracane) at 306, 308; *see also, e.g.*, Ex. 1007 (Bayne) at 690. Bayne provided an overview of the use of small particles in dental materials, including a range of particle sizes under 1 μm, including a “nanofill” of “0.005 – 0.01 μm [5 – 10 nm].” Ex. 1007 at 688-89. Indeed, the non-agglomerated nano-sized particles used in the ’693 Patent were known commercial products provided by Nalco Chemical Co. *See* Ex. 1001 at 5:12-24; Kalyon Decl. ¶35. Other references also teach use of nano-sized particles in dental fillers. *See, e.g.*, Ex. 1005 at 2:3-12; Ex. 1007 at 689-90; Ex. 1015 (Rheinberger) at 5:5-15.

Further, hybrid dental composites containing **combinations of different-sized particles** were also almost universal before the ’693 Patent. Kalyon Decl. ¶¶36-37. 3M admitted in litigation that using “hybrid” composites was a known “approach” before the ’693 Patent. *See* Ex. 1012 at 1. Fillers containing two or more different sizes were conventionally called “hybrids.” Ex. 1014 (Ferracane) at 304; Ex. 1007 at 688 (“Generally, any composite that contains a mixture of filler particle sizes is called a hybrid.”). Around 1995, “[t]he term ‘hybrid’ [was] no longer used, since nearly all dental composites are now ‘hybrids’ of two size ranges…” Ex. 1014 (Ferracane) at 304. Bayne explained how hybrid microfills were commonly used and noted that “[m]ost new systems are moving toward minifill hybrids” with relatively larger and smaller size particles. Ex. 1007 at 688-89. Other references also disclosed dental fillers with both clusters and non-agglomerated nano-sized particles. *See, e.g.*, Ex. 1005 at 2:3-12; Ex. 1015 (Rheinberger) at 5:5-21, 1:14-17, 6:8-12.

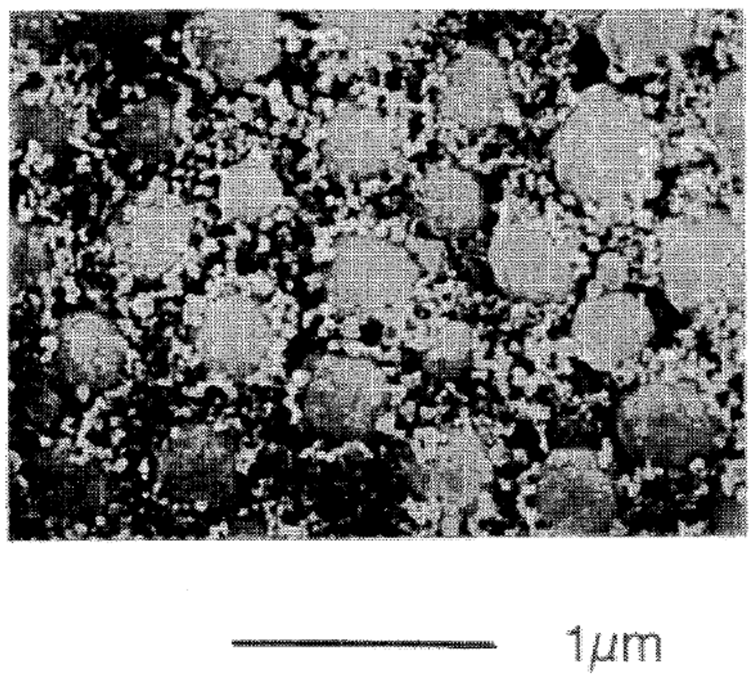
Prior to the ’693 Patent, dental composites with an **aesthetic appearance** close to natural teeth were well-known. Kalyon Decl. ¶¶39-40. Indeed, dental composites became popular initially because they had a better appearance than metal fillings. *Id.* ¶39; *see also* Ex. 1005 at 1:24-27; Ex. 1014 at 302 (noting “tooth-matching ability” of dental composites). “One of the most important considerations in the selection of a filler is the optical characteristics of the composite.” Ex. 1014 (Ferracane) at 303. The prior art had recognized the importance of semi-transparent dental composites having an “appearance [that] is close to natural teeth.” Ex. 1005 at 1:24-27. This appearance could not be obtained using fillers with high refractive indexes which “appear optically opaque, creating an esthetic and curing problem.” Ex. 1014 (Ferracane) at 303. One well-known solution were dental composites with a “low visual opacity, that is, it should be substantially transparent" to provide a "lifelike lustre [*sic*]" that "could be pigmented to match natural dentition." Ex. 1006 at 1:29-32, 13:26-36. Thus, optimizing a dental composite with optical properties that closely matched the appearance of natural teeth was not innovative. Kalyon Decl. ¶¶39-40.

Simply put, the '693 Patent purports to claim a dental composite that was already known in the field. None of the conventional materials, properties, or methods claimed were inventive. 3M's assertion that clusters "being not fully densified" was novel is unsupportable. *See* Ex. 1012 at 3. The following exemplary prior art submitted in this Petition's Grounds demonstrate the obviousness of all claims of the '693 Patent.

2. <u>Noritake (Ex. 1005)</u>

Noritake taught a dental composite (C) that includes (A) and (B) particles in a resin that can be hardened through curing. Ex. 1005 at 2:3-12, 10:9-18, 18:28-32; Kalyon Decl. ¶¶45-52. Noritake's (A) particles contained "60 to 99% by weight of spherical inorganic oxide particles having a mean particle diameter greater than 0.1 μm [100 nm] but not greater than 1 μm [1000 nm]." Ex. 1005 at 2:4-7. The (B) particles were "40 to 1% by weight of inorganic oxide fine particles having a mean particle diameter not greater than 0.1 μm [100 nm]." *Id.* at 2:7-9. The particles formed clusters of "strongly aggregated particles" that were not fully densified, as measured by the presence of micro pores among the particles in the clusters. *Id*. at 2:9-12, 4:52-56, Fig. 1; Kalyon Decl. ¶¶93-100. Noritake's non-agglomerated (B) particles were "mixed and highly dispersed together." Ex. 1005 at 1:61-63. Noritake's particles are shown in micrographs from a scanning electron microscope (SEM):

FIG. 5



Id. at Fig. 5. Noritake explained that these photographs showed that the "particles are well dispersed" in the composite. *Id*. at 18:26. Its composite had "excellent wear resistance, smoothness, and mechanical strength" and noted the importance of having an "appearance [that] is close to natural teeth." *Id*. at 1:10-14, 1:24-27; *see also id*. 1:42-46.

Although Noritake is cited on the face of the '693 Patent, it was listed on an IDS form with over 150 other references, and was never discussed or used to reject claims during the original prosecution. Ex. 1001 at 2; Ex. 1002 at 53. During prosecution of 3M's European counterpart application, and the examiner indicated 3M's patent was not novel over Noritake. *See infra* § IV.C.

3. Randklev (Ex. 1006)

Like Noritake, the Randklev patent also taught a dental "composite containing non-vitreous microparticles." Ex. 1006 at 1:8-9; Kalyon Decl. ¶54-55. It was known that "[t]he small particles… are combined with binders (e.g. polymerizable resins) to form composites" including metal oxides that are radiopaque. Ex. 1006 at 1:17-23. The small particles included silica and zirconia. *Id*. at 5:18, 5:35. Randklev taught that the "dental composite should also have low visual opacity, that is, it should be substantially transparent or translucent to visible light. Low visual opacity is desired so that the cured dental composite will have a "lifelike lustre [*sic*]." *Id*. at 1:29-33.

Randklev taught measurement of the composite's "direct light transmission" using a "MacBeth transmission densitometer Model TD-504 equipped with a visible light filter." *Id*. at 13:27-31. The measured "densitometer value of 0.30," or "visual opacity value," demonstrated the "greater translucency" of the composite and noted that the composite "readily could be pigmented to match natural dentition." *Id*. at 13:31-36.

Similar to Noritake, Randklev was listed on an IDS form with over 150 other references during prosecution of the ’693 Patent. *See* Ex. 1001 at 1; Ex. 1002 at 52.

4. <u>Bayne (Exs. 1007-1008)</u>

Prior to the ’693 Patent, the 1994 Bayne publication provided an overview of hybrid dental composites and their clinical applications. Kalyon Decl. ¶¶58-59. Bayne explained that dental composites were “well-accepted in general practice,” and noted their evolution through “the development of smaller average particle sizes,” including nano-sized particles. Ex. 1007 at 687, 689-90. It described the well-known properties that “[c]omposites that contain high filler levels have the best physical, chemical, and mechanical properties, but clinically composites with small filler particles are easiest to finish.” *Id*. at 687. These composites routinely included “silica-based fillers” and radiopaque particles including “zirconium.” *Id*. at 689.

As a result, “clinicians routinely used… hybrid” composites containing “a mixture of filler particle sizes,” including “nanofillers.” *Id*. at 688. The “extremely small” particle size of “nanofillers” did “not scatter or absorb visible light,” resulting in transparent restorations promoting “esthetic properties.” *Id*. at 688-89. Bayne described a method for resurfacing composite restorations where the surface to be restored was primed and bonded before the new composite material was "place[d], contour[ed], and cure[d]." *Id*. at 691. Then the composite was finished and polished to the correct anatomy before being post-cured for another 20-60 seconds. *Id*. at 691.

Bayne was not listed on the face of the '693 Patent and does not appear to have been considered during prosecution. *See* Ex. 1001 at 1-3.

C. **<u>The Prosecution History of the '693 Patent And Related Applications</u>**

The '693 Patent claims priority to a string of earlier applications, the earliest filed on October 28, 1999. Ex. 1001 at 1. The '693 Patent was filed on October 27, 2000. *Id*. During prosecution, 3M submitted an information disclosure statement containing over 150 references that included Noritake and Randklev. Ex. 1002 at 50-56. The examiner initially rejected the claims as indefinite, anticipated, and for double patenting over prior art that is distinct from the prior art presented in this Petition. *See id*. 1002 at 60-72. Most of the claims were allowed after the claims were amended. *Id*. at 104. The remainder were allowed after an interview. *Id*. at 135, 137. 3M subsequently obtained two certificates of correction. *See* Ex. 1001.

Noritake received considerably more attention in the European Patent Office (EPO). During prosecution of European Application No. 00975425, a foreign counterpart to the '693 Patent, the EPO identified Noritake as a "X" reference in its International Search Report, indicating it was a "document of particular relevance" because the "claimed invention cannot be considered novel" over Noritake. Ex. 1009 at 81.

The EPO explained that the subject matter of the claims "is not new" over Noritake because it "independently discloses a dental material comprising (a) a hardenable resin and (b) fillers comprising (i) clusters of nano-sized particles comprising non-heavy metal oxide particles and heavy metal oxides being not fully densified and (ii) non-agglomerated, non-heavy metal oxide nano-sized particle [*sic*] or non-agglomerated, heavy metal oxide nano-sized particle [*sic*]." *Id*. at 152. As a result, the EPO characterized Noritake (Document D1) as "the closest prior art." *Id*. at 173.

To overcome Noritake, 3M ignored that Noritake's clusters had micro pores, instead arguing that its "particles are dense and are not substantially porous." *Id*. at 159. It also narrowed independent Claim 1 in Europe through amendment to require "substantially amorphous" clusters and "particles having an average diameter of less than 100 nm," *id*. at 160, limitations not present in the independent claims of the '693 Patent at issue, *see* Ex. 1001 at Claims 1, 11, 21, 25.

D. <u>Level of Ordinary Skill in the Art</u>

In the pending litigation, the parties generally agreed on the level of ordinary skill in the art for the '693 Patent. *See* Ex. 1011 at 7; Ex. 1012 at 9. A person of ordinary skill in the art of the ’693 Patent would have either a Ph.D., or its equivalent, in the field of materials science, chemistry, polymer science, chemical engineering, or related disciplines, with about two to four years of experience generally regarding dental materials or composites, or a Bachelor’s or Master’s degree with a proportionately greater degree of work experience. Kalyon Decl. ¶¶69-70. 3M agreed with this definition, except that it proposed one to four years of experience instead of two to four years. *See* Ex. 1011 at 7; Ex. 1012 at 9. This difference does not impact the conclusion of obviousness. Kalyon Decl. ¶71.

E. Claim Construction

Patent claim terms in an IPR are construed using the same *Phillips* claim construction standard that is used in the federal district courts. 37 C.F.R. § 42.100(b) (amended Nov. 13, 2018); *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (*en banc*). Under *Phillips*, “the words of a claim are generally given their ordinary and customary meaning.” *Phillips*, 415 F.3d 13-3, 1312-13 (Fed. Cir. 2005) (internal quotation marks omitted). “[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention….” *Id*. at 1313. Claim construction is determined “in the context of the written description and prosecution history.” *Id*.

The parties have proposed, and are briefing, claim constructions for the ’693 Patent in the District Court Litigation. Exs. 1010-1012. The Patent Office may consider these prior claim construction rulings. *See, e.g.*, 37 C.F.R. § 42.100(b) (amended Nov. 13, 2018). The Board may also rely on party admissions. *See, e.g.*, *Rovalma, S.A. v. Bohler-Edelstahl GmbH & Co.*, 856 F.3d 1019, 1027-28 (Fed. Cir. 2017) (noting “[it] is well established… that a tribunal may use a party’s own submissions against it”).

1. “not fully densified” (Claims 1, 11)

The parties’ proposed constructions are as follows:

Kerr’s Construction	3M’s Construction
Indefinite; if it can be construed: “not near theoretical density”	“where the association among the nano-sized particles is such that the cluster has open porosity with respect to such particles and therefore is not near theoretical density”

Ex. 1010 at 5. Under either party’s claim construction, the prior art renders this term obvious.

In the litigation, Kerr explained that “not fully densified” limitation in Claim 1 is indefinite because it includes a term of degree whose boundaries cannot be objectively ascertained. Ex. 1011 at 8-9. Indeed, 3M has struggled to define it through an evolving series of proposed construction. *See id.* at 4-5. If this term can be construed, Kerr has proposed that it means “not near theoretical density.”

Id. at 7. This construction finds support in the ’693 Patent specification, which describes the opposite condition of a “fully densified” composite:

> Unlike conventional filler particles, the clusters are not fully densified. The phrase “***fully densified***,” describes a particle that is ***near theoretical density***, having substantially no open porosity detectable by standard analytical techniques.

Ex. 1001 at 4:41-45; Kalyon Decl. ¶78. Although even with this construction the claim is still indefinite, Ex. 1011 at 7, Noritake’s dental material would still satisfy it because its clusters are not near theoretical density. *See infra* § V.B.1.b; Ex. 1005 at 2:3-12, 4:52-59, Figs. 1-6, Table 4; Kalyon Decl. ¶89-107.

3M’s proposed construction likewise does not save its claim. Relying on the ’693 specification, 3M proposes that “not fully densified” means “where the association among the nano-sized particles is such that the cluster has open porosity with respect to such particles and therefore is not near theoretical density.” Ex. 1012 at 13-14. To support its construction, 3M contends that “a cluster is ‘not fully densified’ if there are interstitial pores (spaces) among its component nano-sized particles.” *Id*. at 15. 3M’s construction improperly seeks to read in a limitation from the specification. *See, e.g.*, *Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 913 (Fed. Cir. 2004); Ex. 1011 at 11-12.

Even if 3M’s construction were adopted, Noritake satisfies it. Noritake teaches or suggests clusters that are not near theoretical density and contain interstitial spaces as shown in the micro pores which were described and measured in Noritake's dental composite. Ex. 1005 at 4:52-59, Figs. 1-6, Table 4; *see infra* §V.B.1.b. Noritake's images also show clusters with micro pores. Ex. 1005 at Fig. 6; Kalyon Decl. ¶93. Because 3M's position is that clusters with pores are not fully densified, Ex. 1012 at 15, Noritake's porous clusters render this claim term obvious even under 3M's construction.

Under either proposed construction, the claims are obvious.

2. **<u>"nano-sized particles" (Claims 1, 6, 11, 16) and "said nano-sized particles" (Claims 7, 17)</u>**

Kerr's Construction	3M's Construction
"particles that are less than 1 micron in size"	"particles with an average diameter of less than 200 nm"

Ex. 1010 at 6.

The limitation "nano-sized particles" should be construed as "particles that are less than 1 micron in size." The metric system uses various prefixes to indicate distances of less than a meter, including "milli-" (mm or 10^{-3} meters), "micro-" (µm or 10^{-6} meters), and "nano-" (nm or 10^{-9} meters). Ex. 1017 (Chemistry text) at 14-15; Kalyon Decl. ¶81. The prefix "nano" means 10^{-9} meters (0.000000001 meters). *Id*. Thus "nano-sized particles" refers to any particles between a micrometer and a nanometer, or "particles that are less than 1 micron [µm] in size." Kalyon Decl. ¶81.

3M's proposed construction in the litigation, which seeks to construe "nano-sized particles" as "particles with an average diameter of less than 200 nm," is yet another improper attempt to import a limitation from the '693 specification. *See, e.g.*, *Liebel-Flarsheim*, 358 F.3d at 913. Here there is no indication that 3M intended to act as its own lexicographer and provide a specific definition of "nano-sized particles." The '693 specification merely explains that "[t]he average diameter of the nano-sized particles, preferably based on TEM, is less than 200 nm, preferably less than 100 nm, more preferably less than 50 nm, and most preferably less than 20 nm." Ex. 1001 at 4:14-18. The claims are not limited by this description of a preferred embodiment, particularly since the claimed size, "nano-sized particles," is not directed to average diameter.

In any event, claim construction is not dispositive of patentability. As is explained in detail in this Petition, Noritake discloses nano-sized particles that not only have average diameters that are under 200 nm, but also have overall sizes under 1 μm, thereby satisfying both parties' proffered constructions. *See, e.g.*, Ex. 1005 at 2:55-59 (describing "spherical inorganic oxide particles (A) having a mean particle diameter greater than 0.1 μm [100 nm] but not greater than 1 μm [1000 nm]"); Ex. 1005 at 3:57-59 (describing "inorganic oxide fine particles (B) having a mean particle diameter of not larger than 0.1 μm [100 nm]"). Thus, the claims are obvious under either proposed construction.

The parties have also proposed constructions for a related term, “said nano-sized particles,” in Claims 7 and 17. Ex. 1010 at 7. Kerr has proposed in litigation that this term is indefinite because it is unclear which particles it references in Claim 1, Ex. 1011 at 20, while 3M argues it should have the same construction as “nano-sized particles,” Ex. 1012 at 17-19. 3M argued that Claims 7 and 17 are not indefinite because the term “said nano-sized particles” must refer to the non-agglomerated nano-sized particles recited in independent Claims 1 and 11. Ex. 1012 at 17-18. Assuming this claim term can be interpreted, Noritake renders it obvious under 3M’s proposed construction because it teaches both clusters and non-agglomerated particles within the claimed ranges. Ex. 1005 at 2:3-9; Kalyon Decl. ¶82.

V. THE ’693 PATENT CLAIMS ARE UNPATENTABLE

There is more than a reasonable likelihood that the claims of the ’693 Patent are unpatentable as obvious. Kerr submits a combination of three grounds for finding all claims of the ’693 Patent obvious: (1) Noritake alone for Claims 1-9 and 11-19; (2) Noritake and Randklev for Claims 10 and 20; and (3) Noritake and Bayne for Claims 21-25.

A. Legal Standards for Obviousness

A claim is obvious “if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." 35 U.S.C. § 103. The obviousness analysis includes an assessment of the *Graham* factors: (1) the scope and content of the prior art; (2) any differences between the claims and the prior art; (3) the level of ordinary skill in the art; and (4) where in evidence, objective indicia of nonobviousness. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007) (citing *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966)).

A "patent for a combination which only unites old elements with no change in their respective functions… obviously withdraws what already is known into the field of its monopoly and diminishes the resources available to skillful men." *KSR*, 550 U.S. at 415-16.

B. Ground 1: Obviousness of Claims 1-9 and 11-19 Over Noritake

Noritake renders obvious Claims 1-9 and 11-19 of the '693 Patent.

1. Differences Between The Prior Art and the '693 Patent

Noritake teaches or suggests nearly all of the limitations of Claims 1-9 and 11-19. To the extent that 3M argues, or the Board concludes, that Noritake does not disclose particular limitations, they would have been obvious to one of ordinary skill in the art.

a. <u>“clusters of nano-sized particles”</u>

As shown in the following claim charts, Noritake teaches or suggests a dental material with “clusters of nano-sized particles” as required by the claims. *See, e.g.*, Ex. 1001 at 25:15-18; Kalyon Decl. ¶¶86-88.

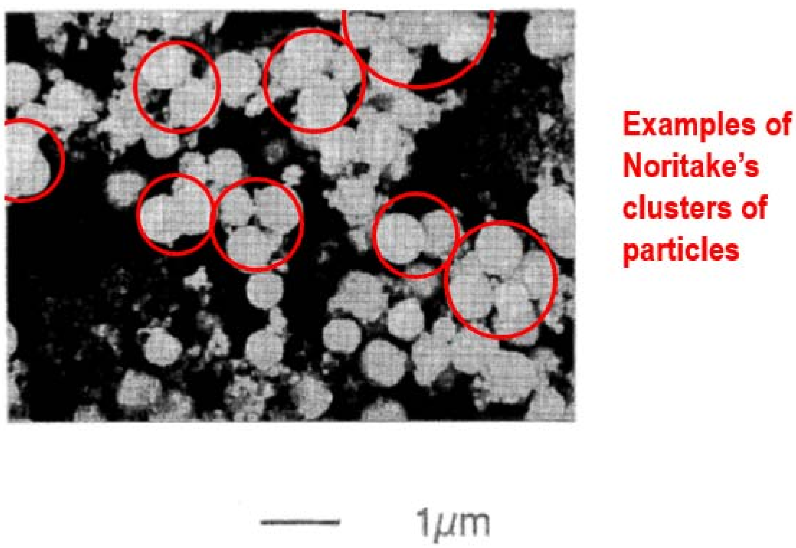
In Noritake, the particles formed clusters satisfying the claims. Clusters are evidenced by Noritake’s composite having “micro pores due to ***strongly aggregated particles***…” Ex. 1005 at 2:9-10; Kalyon Decl. ¶90. Persons of skill would understand that these “strongly aggregated particles” disclosed in Noritake teach or suggest the clusters described in the ’693 Patent, which explains that “[t]he term ‘cluster’ refers to the nature of the association among” the particles where “[t]ypically the non-heavy metal oxide particles are associated by relatively weak intermolecular forces that clause them to clump together, i.e. to ***aggregate***.” Ex. 1001 at 4:21-26; Kalyon Decl. ¶90. The patent later clarifies that “‘aggregated’ means a strong association of particles.” Ex. 1001 at 7:42-45.

The formation of clusters would have been obvious to a skilled artisan. Kalyon Decl. ¶¶89-93. Noritake included nano-sized silica and zirconia particles. Ex. 1005 at 2:56-3:11. It was well known that these small particles naturally tend to clump. Kalyon Decl. ¶92; *cf.* Ex. 1001 at 4:24-27. Söderholm observed that “spherical fillers tend in turn to form agglomerates,” Ex. 1013 (Söderholm) at 143, and subsequent authors agreed that “agglomeration always occurs.” Ex. 1016

(Bayne 1992) at 307; *see also* Ex. 1014 (Ferracane) at 303 (noting silica "agglomerates" in a microfill). Even the '693 Patent recognizes it. Ex. 1001 at 4:21-26. Thus, the clustering of silica and zirconia particles in Noritake would have been obvious to a skilled artisan. Kalyon Decl. ¶89-93.

Noritake also depicts the particle clustering, as shown below:

FIG. 6



Ex. 1005 at Fig. 6 (annotated). Figure 6 shows that the particles have strongly aggregated together in clusters with smaller particles dispersed in between. *Id.*; Kalyon Decl. ¶¶93, 100, 109. As explained in the next section, clustering is further shown by Noritake's observation of micro pores indicating interstitial spaces among the particles. Ex. 1005 at 2:9-12; Kalyon Decl. ¶¶93-100.

Noritake further taught or suggested "clusters of nano-sized particles" that comprise "non-heavy metal oxide particles and heavy metal oxides." Ex. 1001 at

25:15-17; Kalyon Decl. ¶¶86-87. Noritake explained that its dental material contains (A) particles that are nano-sized: "spherical inorganic oxide particles having a mean particle diameter greater than ***0.1 µm [100 nm]*** but not greater than 1 µm [1000 nm]." Ex. 1005 at 2:5-7. These particles have average diameters that fall in the ranges proposed by both parties' claim constructions. *See supra* § IV.E.2; Kalyon Decl. ¶86. Thus, Noritake renders this claim term obvious. *See, e.g.*, *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1311 (Fed. Cir. 2006) ("Where a claimed range overlaps with a range disclosed in the prior art, there is a presumption of obviousness."); *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003).

Noritake listed "concrete examples" of (A) particles that included non-heavy metal oxide particles and heavy metal oxides. *See* Ex. 1005 at 2:65-3:14; Kalyon Decl. ¶¶42-44, 87, 109. Noritake states that (A) particles "may be mixed particles consisting of two or more groups." Ex. 1005 at 3:15-19. Noritake teaches or suggests this limitation.

b. <u>"not fully densified"</u>

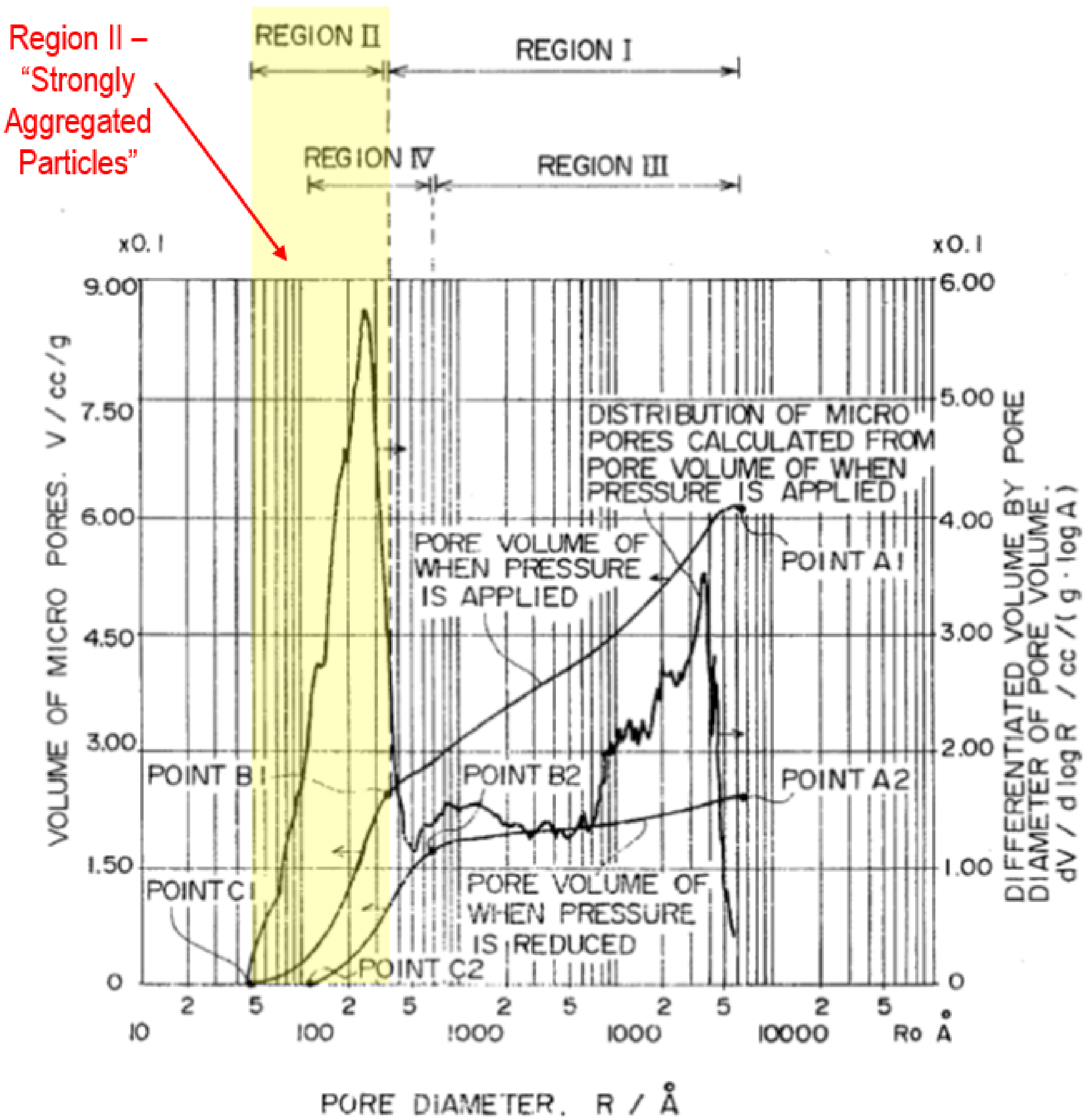
i. <u>Noritake taught or suggested this limitation</u>

To the extent this term can be construed, Noritake taught or suggested "clusters" that are "not fully densified." Ex. 1001 at 25:15-18; Kalyon Decl. ¶¶89-107. The parties dispute the construction of this term. *See supra* § IV.E.1.

Although this claim term is hardly a model of clarity, Noritake nonetheless renders it obvious if this term can be construed. Indeed, 3M's assertion that clusters are not fully densified if there are interstitial pores among the component nano-sized particles, Ex. 1012 at 15, shows that Noritake's clusters render this limitation obvious.

Noritake quantified the presence of clusters that are not fully densified through its observation and measurement of micro pores. Kalyon Decl. ¶¶93-99. Noritake explained that "the micro pores due to strongly aggregated particles refer to those micro pores that exist among the particles but not inside the particles." Ex. 1005 at 5:1-3. It undertook extensive analysis of the properties of the micro pores in its composite using mercury porosimetry. *Id.* at 4:57-59. This method uses mercury to measure the distribution of micro pores present in "porous materials by gradually increasing the pressure exerted on mercury by which the sample is surrounded." *Id.* at 4:59-65. Micro pores existed among both strongly and weakly aggregated particles, but weakly aggregated pores tended to extinguish under pressure. *Id.* at 5:10-18. The measured micro pores were not present on the surface of the particles themselves, which Noritake observed had "no micro pore." *See, e.g.*, *id.* at 13:33-35, 14:38-39, 15:10-11. Thus, the micro pores indicates spaces between the strongly aggregated particles of the clusters. Kalyon Decl. ¶¶99-100; Ex. 1005 at 5:1-3.

Noritake measured the presence of micro pores in its dental composite and provided empirical data, plotting the relationship between pore diameter and the volume of micro pores as shown below in Figure 1:



Ex. 1005 at Fig. 1 (annotated), 6:45-7:10. Noritake characterized its measurements using four regions I-IV as shown in Figure 1. Noritake contrasted "region I (point

A1 to point B1) where the pore diameters are large and micro pores are broadly distributed" with "region II (point B1 to C1) where the pore diameters are small and micro pores are sharply distributed." *Id.* at 6:47-51. Noritake reduced the pressure to obtain the measurements labeled regions III and IV, and Noritake noted a relationship between regions I and III and regions II and IV. *Id.* at 6:51-58; *see also* Kalyon Decl. ¶¶94-99.

Noritake found that the micro pores in region II and IV "are due to ***strongly aggregated particles***" in Noritake's clusters. Ex. 1005 at 7:7-10; Kalyon Decl. ¶97. This is because when using "a starting powder having a small particle diameter, in particular, the aggregation is little dispersed and micro pores due to strongly aggregated particles can be easily observed." *Id.* at 7:38-42. Even in regions I and III that include weakly aggregated particles, "there exist micro pores due to some strongly aggregated particles having pore diameters of not smaller than 0.08 μm in an amount not larger than 0.06 cc/g." *Id.* at 6:66-7:1; Kalyon Decl. ¶¶97-98.

Simply put, Noritake's dental composite includes clusters having micro pores. Kalyon Decl. ¶¶90-99. They were present even in regions largely characterized by weakly aggregated particles. *Id.* ¶98; Ex. 1005 at 6:66-7:1. Although the '693 Patent provides no quantitative boundary for measuring whether a cluster is "not fully densified," *see* Ex. 1012 at 13-15; Kalyon Decl. ¶78, Noritake's measurement of various micro pore sizes and volumes in its composite samples demonstrate the presence of clusters having this feature, *see* Ex. 1005 at Table 2; Kalyon Decl. ¶¶93, 100.

These disclosures demonstrate that Noritake taught or suggested clusters that are "not fully densified." Kalyon Decl. ¶¶90-99. The micro pores in Noritake's clusters are interstitial spaces, suggesting the particles are not maximally packed and therefore not near their theoretical density. *See, e.g.*, Ex. 1005 at Figs. 1, 6, 5:1-3, 7:7-10, 7:38-42; Kalyon Decl. ¶¶99. Thus, Noritake satisfies the "not fully densified" limitation if this term can be construed. Kalyon Decl. ¶99-100.

Noritake also satisfies the claim term under 3M's proposal. 3M's construction requires that "the association among the nano-sized particles is such that the cluster has open porosity with respect to such particles and therefore is not near theoretical density." Ex. 1012 at 13-14. Noritake teaches the "micro pores exist[ed] among the particles." Ex. 1005 at 5:1-3. Noritake's micrographs and associated measurements depict open porosity among the clusters. *Id*. at Fig. 6; Kalyon Decl. ¶93. 3M contends that "interstitial pores (spaces) among its component nano-sized particles" indicate the clusters are not fully densified. *See* Ex. 1012 at 15. Under 3M's own construction, Noritake's disclosure of micro pores demonstrate its clusters are not fully densified. Ex. 1005 at 2:9-10, 7:7-10, Figs. 1-6; Kalyon Decl. ¶100. Thus, Noritake satisfies both parties' claim constructions. *See* Ex. 1010 at 5.

Persons of skill in the art would have been motivated to create a dental composite using a hybrid filler comprising clusters and non-agglomerated nano-sized particles with a reasonable expectation of success. Kalyon Decl. ¶101. Skilled artisans were familiar with using hybrid composites composed of small and nano-sized particles, including particles that formed clusters. *See* Ex. 1005 at 2:3-12, Figs. 1-6; Ex. 1013 at 143, Fig. 1; Ex. 1016 at 307, Figs. 3-4; Kalyon Decl. ¶¶36-37, 101-103. Thus persons of ordinary skill would have been motivated to experiment with various nano-sized particles to obtain an optimal combination with a suitable particle packing fraction having desirable properties for dental applications. Kalyon Decl. ¶48-50, 101.

ii. <u>Noritake does not teach away from this limitation</u>

To teach away, a reference must "criticize, discredit, or otherwise discourage investigation into the invention claimed." *Galderma Labs., L.P. v. Tolmar, Inc.*, 737 F.3d 731, 738 (Fed. Cir. 2013). In a nullity proceeding in Germany challenging the European counterpart to the '693 Patent, 3M asserts that Noritake teaches away from clusters that are fully densified. 3M's argument does not withstand scrutiny.

In the nullity proceeding, 3M acknowledged that Noritake taught "strongly aggregated particles," Ex. 1005 at 2:9-10, but nonetheless argued Noritake's disclosures that "no micro pore was present in the particles," *see, e.g.*, Ex. 1005 at 13:34-35, showed the clusters were fully densified and therefore taught away from the claims. 3M presented a similar argument during the original European prosecution. Ex. 1009 at 159 (arguing "spherical" particles and, after firing, "the resulting particles had no micropore [*sic*]" and "[t]his indicates that the resulting particles are fully densified").

3M's teaching away argument is not supported by Noritake. Kalyon Decl. ¶104. Noritake's statement that "no micro pore was present in the particles" referred to the initial preparation of Noritake's (A) particles, A-1 to A-6, that were later used in forming the clusters. *See* Ex. 1005 at 14:30-36, 13:33-35, 13:49-52, Table 1, 14:38-39, 15:10-11. Noritake performed BET testing on the (A) particles and confirmed that no micro pores were present in the particles themselves. *Id.*; Kalyon Decl. ¶94. This is consistent with Noritake's teaching that micro pores "exist among the particles but not inside the porous particles." Ex. 1005 at 5:1-3.

However, after the particles were processed into clusters in Examples 2-13, Ex. 1005 at 16:59-18:36 (processing of Examples 1-13); Kalyon Decl. ¶¶102-03, Noritake observed "micro pores due to strongly aggregated particles" in every sample of its composite:

TABLE 2

	Inorganic composition (% by weight)							Volume of micro pores due to strongly aggregated particles (cc/g)		Flow index	Adhesive force index	Final tapping density
Example	A-1	A-2	A-3	A-5	A-6	B-1	B-3	A	B	a	1/b	(g/cc)
2	90					10		0.01	0.04	0.32	8.8	1.25
3	70					30		0.02	0.05	0.36	[illegible]	[illegible]
4		95					5	0.01	0.12	0.35	[illegible]	[illegible]
5		90					10	0.01	0.12	0.36	[illegible]	[illegible]
6			60			40		0.06	0.06	0.32	[illegible]	[illegible]
7				90		10		0.01	0.05	0.29	[illegible]	[illegible]
8				80		20		0.01	0.03	0.32	[illegible]	[illegible]
9				70		30		0.02	0.07	0.35	[illegible]	[illegible]
10				70	20	10		0.05	0.04	0.37	[illegible]	[illegible]
11				80		10	10	0.06	0.17	0.36	9.4	1.24
12				80			20	0.06	0.20	0.37	8.7	1.06
13					80		20	0.03	0.18	0.37	9.7	1.02

Micro pores in Noritake's samples

Volumes A, B of micro pores due to strongly aggregated particles are as follows:
A: Volume of micro pores due to strongly aggregated particles having pore diameters of not smaller than 0.08 μm.
B: Volume of micro pores due to strongly aggregated particles having pore diameters over a range of 0.1 to 0.8 times as large as the mean particle diameters of inorganic oxide fine particles (B) denoted by B-1 and B-2.

Table 2 (annotated); Kalyon Decl. ¶100. Table 2's observations showed that the micro pores resulted from the formation of clusters. Kalyon Decl. ¶¶99-100. As 3M argues, the presence of micro pores in the clusters shows the clusters are not fully densified. *See* Ex. 1012 at 15 (3M: "a cluster is 'not fully densified' if there are interstitial pores (spaces) among its component nano-sized particles"). Instead of teaching away, Noritake's description of the process to create clusters with micro pores using non-porous particles teaches skilled artisans how to create the claimed clusters and renders the claims obvious. Kalyon Decl. ¶¶102-104.

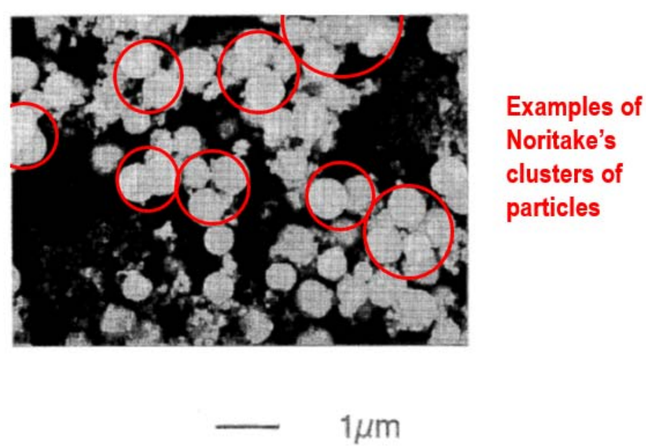
Noritake's preference for an optimum level of micro pores also does not teach away from the claimed clusters. Kalyon Decl. ¶¶104-107. Noritake taught that in "inorganic compositions" where "the aggregated particles are little dispersed," the "mechanical strength of the cured product can be effectively improved by decreasing the aggregation among the particles… and increasing the dispersion property." Ex. 1005 at 5:52-59. It explained one could "reduc[e] the micropores due to strongly aggregated particles." *Id.* at 6:22-23. Instead of a teaching away, these statements support that clusters were present in Noritake's composite, and that Noritake merely preferred that the concentration of micro pores be within an optimal range. Kalyon Decl. ¶105. Indeed, Noritake measured and tabulated the presence of micro pores in every sample of its composite in Table 2. *See, e.g.*, Ex. 1005 at 6:45-51, Fig. 1, Table 2.

Noritake's preference that fewer micro pores could improve strength does not teach away. Kalyon Decl. ¶¶102-104. "[M]erely express[ing] a preference for an alternative invention" is insufficient. *Galderma*, 737 F.3d at 738. "A known or obvious composition does not become patentable simply because it has been described as somewhat inferior" in the prior art. *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994). Such a preference does not detract from Noritake's teachings that micro pores were present and observed in its composite, even in regions I and III with weakly aggregated particles. *See* Ex. 1005 at 6:66-7:1; Kalyon Decl. ¶¶95-98. "[J]ust because better alternatives exist in the prior art does not mean that an inferior combination is inapt for obviousness purposes." *In re Mouttet*, 686 F.3d 1322, 1334 (Fed. Cir. 2012).

2. Charts for Claims 1-9 and 11-19

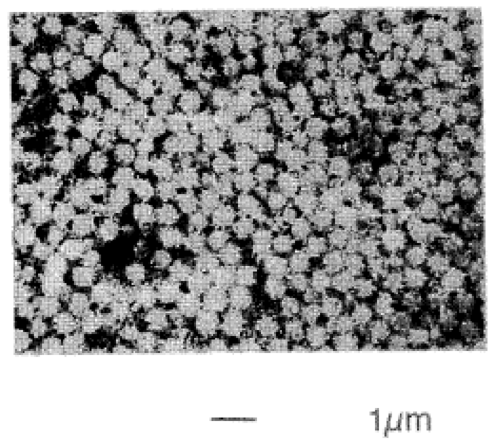
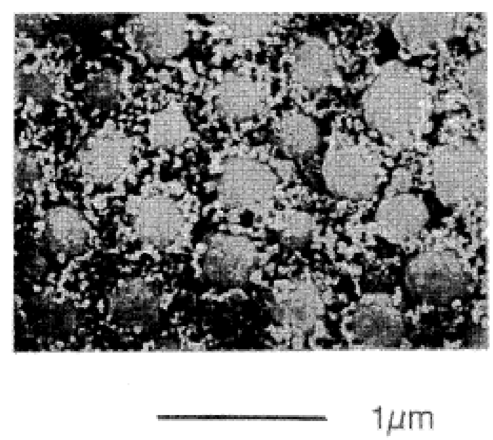
These claim charts, and the accompanying Declaration of Professor Kalyon, contain specific citations to Noritake showing obviousness of Claims 1-9 and 11-19. Kalyon Decl. ¶¶109-126.

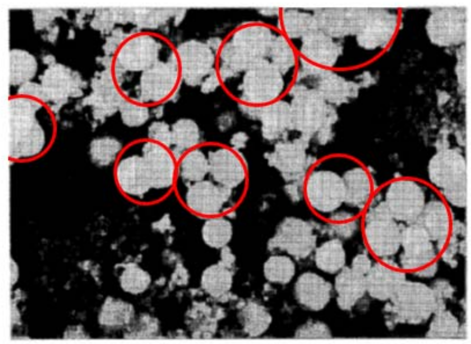
’693 Patent, Claim 1	Noritake
1. A material comprising:	“The present invention relates to an inorganic composition, to a composite composition containing the above inorganic composition and, particularly, to ***a composite composition suited for dental applications***.” Ex. 1005 at 1:7-10.
(a) a hardenable resin; and	“More specifically, the invention provides a composite composition that is suitably used for obtaining a ***composite cured product for dental applications***, having excellent wear resistance, smoothness and mechanical strength.” Ex. 1005 at 1:10-14. Noritake teaches a hardenable resin, or “polymerizable monomer,” for example that includes a “methacrylic group.” It was well-known in the art that a polymerizable monomer with a methacrylic group was a hardenable resin. Kalyon Decl. ¶24; *cf.* Ex. 1001 at 11:17-50, Claims 8, 18. “The inorganic composition, when mixed with a ***polymerizable monomer*** and a catalyst, provides a composite useful for dental applications…” Ex. 1005 at Abstract. “***There is no particular limitation on the radical-polymerizable monomer that constitutes the composite composition*** and any monomer can be used provided it is radical-polymerizable. The radical-polymerizable

’693 Patent, Claim 1	Noritake
	monomer is present in the composite composition in an amount of 50 to 5% by weight. There can be used any known monomer that has generally been used as a dental restorative. The most representative example is an ***acrylic ester radical-polymerizable monomer having an acrylic group and/or a methacrylic group***.” Ex. 1005 at 10:9-18; *see also* Ex. 1005 at 10:19-11:41 (describing examples of polymerizable resins). *See also* Ex. 1005 at 12:67-13:2 (examining wear on restoration based on “the density of ***composite resin***” described in the patent.)
(b) a filler comprising	Noritake teaches a filler, “inorganic composition (C) which comprises” inorganic oxides “(A)… and (B).” Ex. 1005 at 2:3-12; *see also* Claim 1[b](i)-(ii).
[b](i)[A] clusters of nano-sized particles, said clusters comprising non-heavy metal oxide particles and heavy metal oxides and	FIG. 6  Ex. 1005 at Fig. 6 (annotated). “[T]he present invention is concerned with an inorganic composition (C) which comprises (A) 60 to 99% by weight of ***spherical inorganic oxide particles having a mean particle diameter greater than 0.1 μm [100 nm] but not***

’693 Patent, Claim 1	Noritake
	greater than 1 µm [1000 nm], and (B) 40 to 1% by weight of inorganic oxide fine particles having a mean particle diameter not greater than 0.1 µm [100 nm], wherein a volume of micro pores due to ***strongly aggregated particles*** having pore diameters not smaller than 0.08 µm is not greater than 0.1 cc per gram of the inorganic composition (C).” Ex. 1005 at 2:3-12. “One of the components constituting the inorganic composition of the present invention comprises ***spherical inorganic oxide particles*** (A) having a ***mean particle diameter greater than 0.1 µm [100 nm] but not greater than 1 µm [1000 nm]***. Any widely known spherical inorganic oxide can be used without any particular limitation provided the mean particle diameter lies within the above-mentioned range. Preferably, the spherical inorganic oxide particles (A) comprise a siliciferous compound or an aluminiferous compound. Concrete examples of the spherical inorganic oxide particles (A) that are usually preferably used include such spherical particles as ***amorphous silica, silica-zirconia, silica-titania, silica-titania-barium oxide, quartz, alumina and the like***. It is also allowable to use particles of a ***composite oxide in which an oxide of a metal of the Group*** IA of periodic table is made present in a small amount in the above-mentioned inorganic oxide particles, so that there can be obtained inorganic oxide particles in a dense form when the inorganic oxide particles are being fired at high temperatures. For the dental applications, ***spherical particles of a composite oxide containing silica and zirconia as chief constituent components*** can be particularly preferably used as spherical

’693 Patent, Claim 1	Noritake
	inorganic oxide particles (A)…” Ex. 1005 at 2:56-3:11. One of skill would have appreciated that Noritake’s description of using silica-zirconia is a combination of a heavy-metal oxide such as zirconia (zirconium oxide), and a non-heavy metal oxide silica, thus rendering this limitation obvious. Kalyon Decl. ¶109 (claim chart). “The spherical inorganic oxide particles (A) used in the present invention ***need not necessarily be the inorganic oxide particles of a single group but may be mixed particles consisting of two or more groups*** having different mean particle diameters…” Ex. 1005 at 3:15-19. It was well-known in the art that silica, silica-titania, and alumina are non-heavy metal oxides. Kalyon Decl. ¶42; Ex. 1018 at 72, 1825, 2038. It was well-known in the art that silica-zirconia and silica-titania-barium oxide are comprised of non-heavy metal oxides particles silica and titania, and heavy metal oxides zirconia and barium oxide. Kalyon Decl. ¶¶42-44. “As a result, the inventors have learned that… the cured product can be improved by using an inorganic composition in which ***inorganic oxide particles having particle diameters of the order of submicrons*** and fine inorganic oxide particles having particle diameters of not larger than 0.1 μm are mixed and highly dispersed together.” Ex. 1005 at 1:55-62.
[b](i)[B] being not fully densified and	Noritake’s “inorganic composition (C)” with “***strongly aggregated particles*** having [micro] pore diameters not smaller than 0.08 μm is not greater than 0.1 cc per gram of the inorganic

’693 Patent, Claim 1	Noritake
	composition (C).” Ex. 1005 at 2:3-12. Noritake depicts these micro pores: FIG. 4  FIG. 5  Ex. 1005 at Figs. 4-5; 17:34-18:26; Table 2 (describing “Volume of micro pores due to strongly aggregated particles” of 0.06 and 0.20 cc/g for Example 12); *see also id*. at Figs. 2-6.

<table>
<tr><th>’693 Patent, Claim 1</th><th>Noritake</th></tr>
<tr><td></td><td>FIG. 6


Ex. 1005 at Fig. 6 (annotated); 22:14-26; Table 4 (describing “Volume of micro pores due to strongly aggregated particles” of 0.2 and 0.31 cc/g for Comparative Example 5).

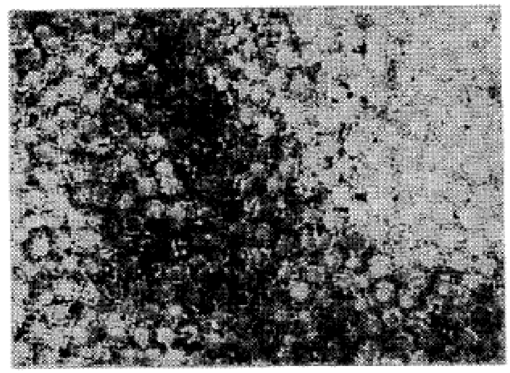
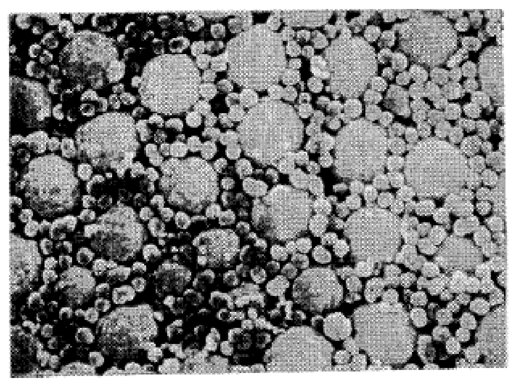
“The most important requirement in the present invention is that the volume of micro pores due to strongly aggregated particles having micro pore diameters of not smaller than 0.08 μm is not greater than 0.1 cc per gram of the inorganic composition (C).

The micro pore diameters and micro pores due to strongly aggregated particles can be measured by a mercury porosimetry.” Ex. 1005 at 4:52-59.

“[In FIG. 1]: It will be further understood that the micro pores appearing in the region II are not almost extinguishing in the region IV, manifesting that they are due to strongly aggregated particles.” Ex. 1005 at 7:7-10.

“When attention is given to a starting powder having a small particle diameter, in particular, the aggregation is little dispersed, and micro pores due to strongly aggregated particles can</td></tr>
</table>

’693 Patent, Claim 1	Noritake
	be easily observed.” Ex. 1005 at 7:38-42. Ex. 1005 at 2:13-19 (discussing “micro pores due to strongly aggregated particles”), 3:15-27, 3:53-55, 4:16-19, *cf.* Ex. 1001 at 22:54-56. *See also* Kalyon Decl. ¶¶48-50.
[b](ii) non-agglomerated nano-sized particles selected from the group consisting of non-heavy metal oxide particles, heavy metal oxide particles, and combinations thereof,	“As a result, the inventors have learned that… the cured product can be improved by using an inorganic composition in which inorganic oxide particles having particle diameters of the order of submicrons and ***fine inorganic oxide particles having particle diameters of not larger than 0.1 µm [100 nm]*** are mixed and ***highly dispersed*** together. Astonishingly, furthermore, it was learned that the filling ratio of the inorganic composition in the composite composition can be increased and the mechanical strength of the cured product can be increased ***if fine particles of not larger than 0.1 µm***, which so far did not contribute to improving the filling ratio, ***are highly dispersed*** to satisfy particular conditions.” Ex. 1005 at 1:55-2:2. Noritake’s Figures 2 and 3 show its fine particles are highly dispersed and exhibit only minor aggregation:

’693 Patent, Claim 1	Noritake
	FIG. 2  1μm FIG. 3  1μm Ex. 1005 at Figs. 2-3. Persons of ordinary skill in the art would understand that non-agglomerated particles are highly dispersed. Kalyon Decl. ¶109 (claim chart); *cf.* Ex. 1001 at 7:32-33 (’693 Patent: describing “unassociated” particles that are “non-agglomerated”). “Another component constituting the inorganic composition of the present invention comprises ***inorganic oxide fine particles (B) having a mean particle diameter of not larger than 0.1 μm [100 nm].*** Any widely known inorganic

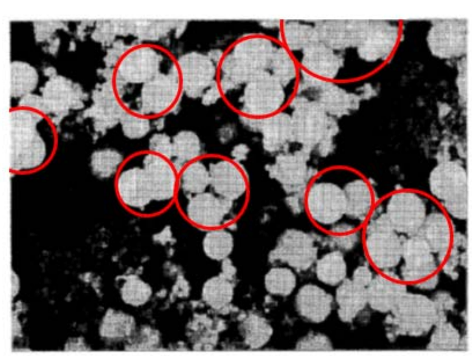
’693 Patent, Claim 1	Noritake
	oxide fine particles can be used without any limitation provided their mean particle diameter lies within the above-mentioned range. ***Preferably, the inorganic oxide fine particles (B) comprise an oxide of an element of the Group IIIA, the Group IVA or the Group IVB of the periodic table***. The inorganic oxide fine particles need not necessarily be those consisting of a single group but may be fine particles of a mixture consisting of two or more different groups provided their mean particle diameter lies within the above-mentioned range.” Ex. 1005 (Noritake) at 3:56-4:2. “Concrete examples of the ***inorganic oxide fine particles*** (B) having particle diameters lying within the above-mentioned range that can be generally preferably used include which is a fumed ***silica***, fumed ***alumina***, fumed zirconia, fumed ***titania***, amorphous ***silica***, silica-zirconia, silica-titania, silica-titania-barium oxide, quartz, ***alumina***, etc. It is also allowable to use fine particles of a composite oxide in which an oxide of a metal of the Group IA of periodic table is made present in a small amount in the above-mentioned inorganic oxide fine particles, so that there can be obtained inorganic oxide fine particles in a dense form when the inorganic oxide fine particles are being fired at high temperatures.” Ex. 1005 at 4:7-19. It was well-known in the art that silica, titania, and alumina are non-heavy metal oxide particles. Kalyon Decl. ¶42; Ex. 1018 at 72, 1825, 2038. It was well-known in the art that zirconia is a heavy metal oxide and silica-zirconia and silica-titania-barium oxide are combinations of non-

'693 Patent, Claim 1	**Noritake**
	heavy and heavy metal oxides. Kalyon Decl. ¶¶42-44; *cf*. Ex. 1001 at 5:34-36. "[T]he present invention is concerned with an inorganic composition (C) which comprises (A) 60 to 99% by weight of spherical inorganic oxide particles having a mean particle diameter greater than 0.1 µm [100 nm] but not greater than 1 µm [1000 nm], and (B) 40 to 1% by weight of ***inorganic oxide fine particles having a mean particle diameter not greater than 0.1 µm [100 nm]***." Ex. 1005 at 2:3-9. *See also* Kalyon Decl. ¶¶48-50.
[c] wherein said material is a dental material.	"The present invention relates to an inorganic composition, to a composite composition containing the above inorganic composition and, particularly, to a ***composite composition suited for dental applications***." Ex. 1005 at 1:7-10. "The present inventors have conducted keen study concerning ***dental composite restoratives*** and, particularly, inorganic compositions as fillers that satisfy all of mechanical strength, wear resistance, surface smoothness and wear resistance of antagonistic tooth." Ex. 1005 at 1:51-55.

'693 Patent, Claim 2	**Noritake**
2. The material of claim 1, wherein said non-heavy metal oxide particles are selected from the group consisting of ***silica,*** titanium dioxide, ***aluminum oxide***, and combinations	"Concrete examples of the spherical inorganic oxide particles (A) that are usually preferably used include such spherical particles as amorphous ***silica***, silica-zirconia, silica-titania, silica-titania-barium oxide, quartz, ***alumina*** and the like." Ex. 1005 at 2:65-3:2; *see also* Ex.

thereof.	1005 at 3:2-11. "Concrete examples of the inorganic oxide fine particles (B) having particle diameters lying within the above-mentioned range that can be generally preferably used include which is a fumed ***silica***, fumed ***alumina***, fumed zirconia, fumed ***titania***, amorphous silica, silica-zirconia, silica-titania, silica-titania-barium oxide, quartz, ***alumina***, etc." Ex. 1005 at 4:7-12. It was well-known in the art that titania is another name for titanium dioxide; alumina is another name for aluminum oxide. Kalyon Decl. ¶42; Ex. 1018 at 72, 2038.
'693 Patent, Claim 3	**Noritake**
3. The material of claim 1, wherein said heavy metal oxide comprises a heavy metal having an atomic number greater than 30.	"Concrete examples of the spherical inorganic oxide particles (A) that are usually preferably used include such spherical particles as amorphous silica, ***silica-zirconia,*** silica-titania, silica-titania-barium oxide, quartz, alumina and the like." Ex. 1005 at 2:65-3:2. It was well-known in the art that barium (atomic number 56) and zirconium (atomic number 40) both have atomic numbers greater than 30. Kalyon Decl. ¶43. Zirconia is a heavy metal oxide. *Id.* ¶44.
'693 Patent, Claim 4	**Noritake**
4. The material of claim 1, wherein said heavy metal oxide is selected from the group consisting of ***zirconium oxide***, cerium oxide, tin oxide, yttrium oxide, strontium oxide, ***barium oxide***, lanthanum oxide, zinc oxide, ytterbium oxide, bismuth oxide, and combinations	"Concrete examples of the spherical inorganic oxide particles (A) that are usually preferably used include such spherical particles as amorphous silica, ***silica-zirconia,*** silica-titania, ***silica-titania-barium oxide,*** quartz, alumina and the like… For the dental applications, spherical particles of a composite oxide containing silica and ***zirconia*** as chief constituent components can be particularly preferably used as spherical

thereof.	inorganic oxide particles (A) since they have X-ray contrast property and make it possible to obtain a cured product of composite composition having excellent wear resistance." Ex. 1005 at 2:65-3:14. One of skill would have appreciated that Noritake's description of using silica-zirconia is a combination of a heavy-metal oxide such as zirconia (zirconium oxide), and a non-heavy metal oxide silica, thus rendering this limitation obvious. Kalyon Decl. ¶112. One of skill further would have known that it was an easier process to generate a heavy metal oxide containing a single oxide compared to a combination a heavy metal oxide with a non-heavy metal oxide. Thus, a person of ordinary skill in the art would have appreciated that the heavy metal oxide could be a single type like zirconia or barium oxide. *Id.* It was well-known in the art that zirconia is another name for zirconium oxide. Kalyon Decl. ¶44; Ex. 1018 at 2191.

'693 Patent, Claim 5	**Noritake**
5. The material of claim 1, wherein said clusters have an average diameter of less than about 1 micrometer.	FIG. 6  1μm Ex. 1005 at Fig. 6 (annotated); 22:14-26; Table

	4. It would have been obvious to one of ordinary skill in the art that Noritake's inorganic oxide particles would have included clusters having diameters less than 1 µm. *See* Kalyon Decl. ¶113; Ex. 1005 (Noritake) at 2:4-6. *See also, e.g.*, Ex. 1005 at Figs. 2-5, 17:34-18:26, Table 2.
'693 Patent, Claim 6	**Noritake**
6. The material of claim 1, wherein said non-agglomerated nano-sized particles have an average diameter of less than about 100 nanometers.	"Another component constituting the inorganic composition of the present invention comprises ***inorganic oxide fine particles (B) having a mean particle diameter of not larger than 0.1 µm [100 nm]***." Ex. 1005 at 3:56-59. *See also*, *e.g.*, Ex. 1005 at 7:52-58 (describing "inorganic oxide fine particles (B) having a diameter of 0.08 µm [80 nm]") 16:14-20 (B-1 particles having a mean diameter of 0.077 µm [77 nm]), 16:30-41 (B-2 particles having a mean diameter of 0.058 µm [58 nm]).
'693 Patent, Claim 7	**Noritake**
7. The material of claim 1, wherein said filler comprises at least about ***60% by weight*** of said clusters and at most about ***40% by weight*** of said nano-sized particles, based on the total filler.	"[T]he present invention is concerned with an inorganic composition (C) which ***comprises (A) 60 to 99% by weight of spherical inorganic oxide particles*** having a mean particle diameter greater than 0.1 µm [100 nm] but not greater than 1 µm [1000 nm], and (B) ***40 to 1% by weight of inorganic oxide fine particles*** having a mean particle diameter not greater than 0.1 µm [100 nm]." Ex. 1005 at 2:3-9. *See also, e.g.*, Ex. 1005 at 4:30-37 (discussing ratios of components).

’693 Patent, Claim 8	Noritake
8. The material of claim 1, wherein said hardenable resin is selected from the group consisting of ***acrylates***, ***methacrylates***, epoxies, and combinations thereof.	“There is no particular limitation on the radical-polymerizable monomer that constitutes the composite composition and any monomer can be used provided it is radical-polymerizable. The radical-polymerizable monomer is present in the composite composition in an amount of 50 to 5% by weight. There can be used any known monomer that has generally been used as a dental restorative. The most representative example is an ***acrylic ester radical-polymerizable monomer having an acrylic group and/or a methacrylic group***.” Ex. 1005 at 10:9-18; *see also* Ex. 1005 at 10:19-11:41 (describing examples of polymerizable resins). *See also* Ex. 1005 at 1:16-24 (discussing composites using methacrylate resins); Kalyon Decl. ¶24.
’693 Patent, Claim 9	**Noritake**
9. The material of claim 1, wherein said material is selected from the group consisting of ***dental resotratives*** [*sic*], dental adhesives, dental mill blanks, dental cements, dental prostheses, orthodontic devices and adhesives, dental casting materials, and dental coatings.	“The present inventors have conducted keen study concerning ***dental composite restoratives*** and, particularly, inorganic compositions as fillers that satisfy all of mechanical strength, wear resistance, surface smoothness and wear resistance of antagonistic tooth.” Ex. 1005 at 1:51-55.

’693 Patent, Claim 11	Noritake
11. A method of making a dental material comprising:	Noritake describes a method for creating a dental composite restorative: “The present invention relates to an inorganic composition, to a composite composition containing the above

’693 Patent, Claim 11	Noritake
	inorganic composition and, particularly, to ***a composite composition suited for dental applications***.” Ex. 1005 at 1:7-10.
[a] providing a hardenable resin;	*See* claim 1(a).
[b] providing a filler comprising	*See* claim 1(b).
[b](i)[A] clusters of nano-sized particles, said clusters comprising non-heavy metal oxide particles and heavy metal oxides and	*See* claim 1[b](i)[A].
[b](i)[B] being not fully densified and	*See* claim 1[b](i)[B].
[b](ii) non-agglomerated nano-sized particles selected from the group consisting of non-heavy metal oxide particles, heavy metal oxide particles, and combinations thereof;	*See* claim 1[b](ii).
[c] surface treating said filler to yield surface-treated filler particles; and	“The inorganic composition (C) of the present invention is usually mixed into the radical-polymerizable monomer in its own form or after ***the surfaces thereof are treated with a silane treating agent*** to obtain a composite composition which can then be used by being polymerized and cured at the time of use.” Ex. 1005 at 9:46-51; *see also, e.g.*, Ex. 1005 at 9:52-62, Claims 11-12. *See also* Ex. 1005 at 16:59-22:66 (Noritake Examples 1-20 and Comparative Examples 1-6).
[d] mixing said surface treated filler particles with said	“The inorganic composition (C) of the present invention is usually ***mixed*** into the radical-

’693 Patent, Claim 11	Noritake
hardenable resin.	polymerizable monomer in its own form or ***after the surfaces thereof are treated with a silane treating agent*** to obtain a composite composition which can then be used by being polymerized and cured at the time of use.” Ex. 1005 at 9:46-51. “Example 1 80 Grams of spherical silica particles having a mean particle diameter of 0.6 μm and 20 g of spherical silica-titania particles having a mean particle diameter of 0.08 μm were introduced into 400 g of pure water solvent, and were dispersed by using an emulsifying/dispersing nanomizer that gives shock under super high pressure of 60 MPa. ***After the surfaces were treated with a γ-methacryloxypropyltrimethoxysilane***, the solvent was distilled off, followed by drying to obtain an inorganic composition…. ***To the surface-treated product was gradually added a matrix monomer bis-GMA/3G (weight ratio of 60/40) which is a radical polymerizable monomer*** in which have been dissolved camphorquinone and ethyldimethylaminobenzoic ester as a polymerization initiator and a reducing agent each in an amount of 0.5% until a limit paste-like state is reached, thereby to obtain a composite composition.” Ex. 1005 at 16:59-17:23. *See also* Ex. 1005 at 16:59-22:66 (Noritake Examples 1-20 and Comparative Examples 1-6).

’693 Patent, Claim 12	**Noritake**
12. The method of claim 11, wherein said non-heavy metal oxide particles are selected from the group consisting of silica, titanium dioxide, aluminum oxide, and combinations thereof.	*See* claim 2.
’693 Patent, Claim 13	**Noritake**
13. The method of claim 11, wherein said heavy metal oxide comprises a heavy metal having an atomic number greater than 30.	*See* claim 3.
’693 Patent, Claim 14	**Noritake**
14. The method of claim 11, wherein said heavy metal oxide is selected from the group consisting of zirconium oxide, cerium oxide, tin oxide, yttrium oxide, strontium oxide, barium oxide, lanthanum oxide, zinc oxide, ytterbium oxide, bismuth oxide, and combinations thereof.	*See* claim 4.
’693 Patent, Claim 15	**Noritake**
15. The method of claim 11, wherein said clusters have an average diameter of less than about 1 micrometer.	*See* claim 5.
’693 Patent, Claim 16	**Noritake**
16. The method of claim 11, wherein said non-agglomerated	*See* claim 6.

nano-sized particles have an average diameter of less than about 100 nanometers.	
’693 Patent, Claim 17	**Noritake**
17. The method of claim 11, wherein said filler comprises at least about 60% by weight of said clusters and at most about 40% by weight of said nano-sized particles, based on the total filler.	*See* claim 7.
’693 Patent, Claim 18	**Noritake**
18. The method of claim 11, wherein said hardenable resin is selected from the group consisting of acrylates, methacrylates, epoxies, and combinations thereof.	*See* claim 8.
’693 Patent, Claim 19	**Noritake**
19. The method of claim 11, wherein said dental material is selected from the group consisting of dental resotratives [*sic*], dental adhesives, dental mill blanks, dental cements, dental prostheses, orthodontic devices and adhesives, dental casting materials, and dental coatings.	*See* claim 9.

C. Ground 2: Obviousness of Claims 10 and 20 Over Noritake In View of Randklev

The combination of Noritake in view of Randklev render obvious Claims 10 and 20.

1. Differences Between The Prior Art and the ’693 Patent

Natural teeth are semi-transparent. Kalyon Decl. ¶¶40, 132. Skilled artisans recognized that semi-transparent dental composites would most closely approximate the appearance of natural teeth. *Id.* ¶40. A high visual opacity value indicates higher opacity and a low value indicates higher transparency. *Id.* ¶129; Ex. 1006 at 1:29-33 (low visual opacity indicates a dental composite is substantially transparent); Ex. 1001 at 3:20-22.

Claims 10 and 20, which depend from claims 1 and 11 respectively, additionally require that “the material, after hardening, has a visual opacity of less than about 0.35 as measured on a MacBeth transmission densitometer Model TD-903.” Ex. 1001 at 25:51-54, 26:28-32. These claims are obvious in view of the combination of Noritake and Randklev.

Although Noritake discussed the desirability of dental materials having an “appearance [that] is close to natural teeth,” Ex. 1005 at 1:24-27, it does not provide a specific visual opacity measurement of its composite as required by Claims 10 and 20. This is supplied by Randklev, a prior art patent assigned to 3M. Ex. 1006. Randklev taught a semi-transparent dental composite with a "visual opacity value" of "0.30" as measured "using a MacBeth transmission densitometer Model TD-504 equipped with a visible light filter." *Id*. at 13:27-36. Randklev's description of measuring a low visual opacity value in a dental composite with a filler of small particles, *Id*. at Abstract, show that these claims are obvious. Kalyon Decl. ¶¶127-136.

Randklev measured the visual opacity of its composite using a MacBeth transmission densitometer Model TD-504. Ex. 1006 at 13:27-33. Using a later-model TD-903 as recited in the '693 Patent claims was not inventive, and it would have been obvious to one of ordinary skill in the art to use an updated model of the same equipment. Kalyon Decl. ¶129. A densitometer simply measures the optical density of a semi-transparent material. *Id*. Selection of the particular equipment to measure a visual opacity within the claimed range was not inventive. *Id*.

2. <u>Reasons to Combine Noritake and Randklev</u>

A person of ordinary skill in the art would have been motivated to combine the teachings of Noritake and Randklev with a reasonable expectation of success. Kalyon Decl. ¶¶130-133. Persons of ordinary skill in the art would have found it desirable to optimize a dental composite to achieve the semi-transparent aesthetics of natural teeth. *Id*. ¶132; Ex. 1012 at 1 (3M: "dental restorative materials… must have certain aesthetic qualities—namely, luster and translucency—so the material looks natural"). It was well known that dental composites could be made semi-transparent by using nano-sized particles "size[d] below the range of wavelengths of visible light and thus they do not scatter or absorb visible light." *See* Ex. 1007 at 689-90; Ex. 1012 at 1 (3M: it was well known that "dental composites with small nano-sized filler particles tended to have greater luster and translucency."). Thus, one of skill reading Noritake and Randklev would have been motivated to optimize the sizes and combinations of nano-sized particles in Noritake to achieve a low visual opacity that mimicked the appearance of teeth. Kalyon Decl. ¶¶130-132.

Skilled artisans would have had a reasonable expectation of success in combining the teachings of Noritake and Randklev. Kalyon Decl. ¶¶130-133. First, both references described similar dental composites. *Id.* ¶131. Randklev taught creating a "dental composite" containing "polymeriseable (or polymerized) resin(s) [and] filler particles of one or more types," Ex. 1006 at 3:1-4, to achieve "low visual opacity, that is, it should be substantially transparent" with "lifelike luster." Ex. 1006 at 1:17-20, 1:29-33. Randklev's filler includes "silica" and the heavy metal oxide zirconia. Ex. 1006 at 5:18, 5:36; *see also id.* at 6:6-10. Randklev's dental composite is very similar to Noritake, which also used a polymerizeable resin and a filler containing different types of particles, including silica and zirconia. Ex. 1005 at 1:17-23, 5:18, 5:35; Kalyon Decl. ¶131. Thus, Randklev's teachings about using small particles to achieve low visual opacity values would have been predictably and successfully applied to Noritake. Kalyon Decl. ¶¶131, 133.

3. Charts for Claims 10 and 20

These claim charts and supporting declaration, contain specific citations to Noritake and Randklev showing obviousness of Claims 10 and 20. Kalyon Decl. ¶¶135-136.

'693 Patent, Claim 10	Noritake & Randklev
10. The material of claim 1, wherein the material, after hardening, has a ***visual opacity of less than about 0.35 as measured on a MacBeth transmission densitometer*** Model TD-903.	"Such a restorative has been widely used among the clinicians since its appearance is close to natural teeth…" Ex. 1005 at 1:24-26. "Cured composite samples were measured for direct light transmission by measuring transmission of light through the thickness of the disk using ***a MacBeth transmission densitometer Model TD-504*** equipped with a visible light filter. The ***densitometer value of 0.30*** thereby obtained was assigned to the composite sample as its ***visual opacity value***. Under visual examination, the cured composite samples had a greater translucency than tooth structure of comparable thickness, and readily could be pigmented to match natural dentition." Ex. 1006 at 13:27-36. "[A] dental composite should also have low visual opacity, that is, it should be substantially transparent or translucent to visible light. Low visual opacity is desired so that the cured dental composite will have a lifelike lustre." Ex. 1006 at 1:29-33.

’693 Patent, Claim 10	Noritake & Randklev
	See also Ex. 1006 at 2:64-68.

’693 Patent, Claim 20	Noritake & Randklev
20. The method of claim 11, wherein said dental material, after hardening, has a visual opacity of less than about 0.35 as measured on a MacBeth transmission densitometer Model TD-903.	*See* claim 10.

D. Ground 3: Obviousness of Claims 21-25 Over Noritake In View of Bayne

The combination of Noritake in view of Bayne render obvious Claims 21-25.

1. Differences Between The Prior Art and the ’693 Patent

Claims 21-25 claim methods of using the dental material to fill teeth, including the steps of placing it on a tooth surface, changing the topography, and hardening it, as well as the resulting restoration. Ex. 1001 at 26:33-65. These steps are obvious over Noritake in view of the background knowledge of one of skill in the art, as demonstrated by the teachings of Bayne. Kalyon Decl. ¶¶137, 141-46.

Noritake disclosed a dental material that can be used to restore teeth. Ex. 1005 at 1:7-10, 9:46-51. However, Noritake did not expressly teach the steps of using the dental material to perform a restoration as required by Claims 21-25. A skilled artisan reading Noritake would have been aware that these routine steps are performed by dentists in filling teeth. These steps are also specifically taught and suggested in the Bayne publication, which provided an overview of existing dental composites and their clinical applications. *See* Ex. 1007. Bayne discussed using dental composites with nano-fillers and the steps of performing restorations, thereby teaching or suggesting the limitations of Claims 21-25. *Id.* at 688, 691. Thus, the combination of Noritake and Bayne render these claims obvious. Kalyon Decl. ¶141-46.

2. <u>Reasons to Combine Noritake and Bayne</u>

One of skill would have been motivated to combine the teachings of Noritake and Bayne to arrive at the purported invention of Claims 21-25 with a reasonable expectation of success. Kalyon Decl. ¶¶139-140.

Persons of ordinary skill in the art familiar with the dental material disclosed in Noritake would have been interested in its clinical applications. *Id.* ¶139. Bayne provided an overview of innovations and applications of hybrid dental composites that used combinations of small filler particles similar to those taught in Noritake. *Id.*; Ex. 1007 at 688; Ex. 1005 at 2:4-9. Bayne taught the well-known concept that dental composites were used, shaped, and cured to achieve clinically and aesthetically successful dental restorations. Ex. 1007 at 691. One of skill would have been motivated to look to Bayne and similar prior art to understand how these composites were being used in patients. Kalyon Decl. ¶139.

A person of ordinary skill would have reasonable success in combining Bayne and Noritake's teachings to restore teeth. Using composites in conventional ways to restore teeth "yields predictable results." *See, e.g.*, *KSR*, 550 U.S. at 416; Kalyon Decl. ¶140. Clinicians have been using dental composites with various fillers to restore teeth for decades. Ex. 1005 at 1:24-27; Ex. 1014 at 302; Kalyon Decl. ¶140. Employing a dental composite that uses nano-particles to restore teeth was not only predictable, but was the very purpose of Noritake's composite. *See* Ex. 1005 at 9:46-51 (Noritake: stating its composite was mixed into a resin and "polymerized and cured at the time of use" in a dental restoration). "[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious." *KSR*, 550 U.S. at 417. Persons of skill would have understood that using Noritake's composite to fill teeth as described in Bayne was entirely predictable. Kalyon Decl. ¶140.

3. <u>Charts for Claims 21-25</u>

These claim charts, and supporting declaration, contain specific citations to Noritake and Bayne showing obviousness of Claims 21-25. Kalyon Decl. ¶¶142-146.

’693 Patent, Claim 21	**Noritake & Bayne**
21. A method of using a dental material comprising:	*See* claim 1, preamble.
[a] placing the material near or on a tooth surface;	“LIST OF STEPS INVOLVED IN RESURFACING COMPOSITE RESTORATIONS…. – ***Place***, contour, and cure ***new composite material to slightly overfill the space created for resurfacing***. – Finish and polish to appropriate anatomical contours. – Post-cure for 20 to 60 seconds.” Ex. 1007 (Bayne) at 691.
[b] changing the topography of the material; and	“LIST OF STEPS INVOLVED IN RESURFACING COMPOSITE RESTORATIONS…. – Place, ***contour***, and cure ***new composite material to slightly overfill the space created for resurfacing***. – Finish and polish to appropriate anatomical contours. – Post-cure for 20 to 60 seconds.” Ex. 1007 (Bayne) at 691.
[c] hardening the material,	“LIST OF STEPS INVOLVED IN RESURFACING COMPOSITE RESTORATIONS…. – Place, contour, and ***cure new composite material to slightly overfill the space created for resurfacing***. – Finish and polish to appropriate anatomical contours. – Post-cure for 20 to 60 seconds.” Ex. 1007 (Bayne) at 691.

’693 Patent, Claim 21	Noritake & Bayne
[d] wherein the dental material comprises a hardenable resin and	*See* claim 1(a).
[e] a filler comprising	*See* claim 1(b).
[e](i)[A] clusters of nano-sized particles, said clusters comprising non-heavy metal oxide particles and heavy metal oxides and	*See* claim 1[b](i)[A].
[e][i][B] being not fully densified and	*See* claim 1[b](i)[B].
[e](ii) non-agglomerated nano-sized particles selected from the group consisting of non-heavy metal oxide particles, heavy metal oxide particles, and combinations thereof.	*See* claim 1[b](ii).

’693 Patent, Claim 22	Noritake & Bayne
22. The method of claim 21, wherein placing, changing, and hardening are performed sequentially.	“LIST OF STEPS INVOLVED IN RESURFACING COMPOSITE RESTORATIONS…. – ***Place, contour, and cure*** new composite material to slightly overfill the space created for resurfacing. – Finish and polish to appropriate anatomical contours. – Post-cure for 20 to 60 seconds.” Ex. 1007 (Bayne) at 691.
’693 Patent, Claim 23	**Noritake & Bayne**
23. The method of claim 21 further comprising finishing the	“LIST OF STEPS INVOLVED IN RESURFACING COMPOSITE

surface of the hardened material.	RESTORATIONS…. – Place, contour, and ***cure*** new composite material to slightly overfill the space created for resurfacing. – ***Finish and polish to appropriate anatomical contours***. – Post-cure for 20 to 60 seconds." Ex. 1007 (Bayne) at 691.

'693 Patent, Claim 24	**Noritake & Bayne**
24. The method of claim 21 wherein the hardened material forms a dental article selected from the group consisting of dental mill blanks, dental prostheses, orthodontic devices, artificial crowns, anterior fillings, ***posterior fillings***, and cavity liners.	"LIST OF STEPS INVOLVED IN RESURFACING COMPOSITE RESTORATIONS…. – Remove enough of the original composite to create a 0.5 to 1 mm thickness space for ***posterior restorations*** and about 1 mm for ***esthetic restorations*** to make ready for resurfacing. – Place, contour, and cure new composite material to slightly overfill the space created for resurfacing. – Finish and polish to appropriate anatomical contours. – Post-cure for 20 to 60 seconds." Ex. 1007 (Bayne) at 691.

'693 Patent, Claim 25	**Noritake & Bayne**
25. A dental article preparable by a method comprising:	*See* claim 1, preamble. "More specifically, the invention provides a composite composition that is suitably used for obtaining a ***composite cured product for dental applications***, having excellent wear resistance, smoothness and mechanical strength." Ex. 1005 at 1:10-14. "LIST OF STEPS INVOLVED IN RESURFACING COMPOSITE RESTORATIONS…. – Remove enough of the original composite to create a 0.5 to 1 mm thickness space for ***posterior restorations*** and about 1 mm for ***esthetic restorations*** to make ready for resurfacing. – Place, contour, and cure

’693 Patent, Claim 25	Noritake & Bayne
	new composite material to slightly overfill the space created for resurfacing. – Finish and polish to appropriate anatomical contours. – Post-cure for 20 to 60 seconds.” Ex. 1007 (Bayne) at 691.
[a] hardening a dental material comprising	“LIST OF STEPS INVOLVED IN RESURFACING COMPOSITE RESTORATIONS…. – Remove enough of the original composite to create a 0.5 to 1 mm thickness space for posterior restorations and about 1 mm for esthetic restorations to make ready for resurfacing. – Place, contour, and ***cure*** new composite material to slightly overfill the space created for resurfacing. – Finish and polish to appropriate anatomical contours. – Post-cure for 20 to 60 seconds.” Ex. 1007 (Bayne) at 691.
[b] a hardenable resin and	*See* claim 1(a).
[c] a filler comprising	*See* claim 1(b).
[d](i)[A] clusters of nano-sized particles, said clusters comprising non-heavy metal oxide particles and heavy metal oxides and	*See* claim 1[b](i)[A].
[d][i][B] being not fully densified and	*See* claim 1[b](i)[B].
[d](ii) non-agglomerated nano-sized particles selected from the group consisting of non-heavy metal oxide particles, heavy metal oxide particles, and combinations thereof; and	*See* claim 1[b](ii).

’693 Patent, Claim 25	Noritake & Bayne
[e] fabricating a dental article selected from the group consisting of dental mill blanks, dental prostheses, orthodontic devices, artificial crowns, anterior fillings, ***posterior fillings***, and cavity liners.	“LIST OF STEPS INVOLVED IN RESURFACING COMPOSITE RESTORATIONS…. – Remove enough of the original composite to create a 0.5 to 1 mm thickness space for ***posterior restorations*** and about 1 mm for ***esthetic restorations*** to make ready for resurfacing. – Place, contour, and cure new composite material to slightly overfill the space created for resurfacing. – ***Finish and polish to appropriate anatomical contours. – Post-cure for 20 to 60 seconds***.” Ex. 1007 (Bayne) at 691.

E. Secondary Considerations, Even If Considered, Fail To Overcome The *Prima Facie* Evidence Of Obviousness

To overcome the strong showing of obviousness set forth above, 3M may attempt to present alleged secondary considerations of non-obviousness. However, secondary considerations do not support a finding of non-obviousness here. Although secondary considerations should be taken into account, they do not control the obviousness conclusion. *Newell Cos., Inc. v. Kenney Mfg. Co.*, 864 F.2d 757, 768 (Fed. Cir. 1988). And where a strong *prima facie* obviousness showing exists, as here, the Federal Circuit has repeatedly held that even relevant secondary considerations supported by substantial evidence may not dislodge the primary conclusion of obviousness. *See, e.g.*, *Leapfrog Enters. Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007).

In the co-pending litigation, 3M has vaguely suggested, without providing supporting evidence, that its "invention was an immediate commercial success" and one of its inventors was recently inducted into the National Inventors Hall of Fame. Ex. 1012 at 2. But 3M has presented no indication of a nexus between the '693 Patent claims and the "commercial success" or its inventor's recognition. *See id*. Nor could it, because the patent's purported innovation of clusters "being not fully densified," *see* Ex. 1012 at 3, had already been developed by others, *see, e.g.*, Ex. 1005 at 2:9-10, 5:1-3, Table 2, Figs. 1, 6; Kalyon Dec. ¶¶89-100. Even if supported, Kerr does not believe that any potential secondary considerations could outweigh the strong *prima facie* case of obviousness presented in this Petition. In the event that 3M puts forth any allegations or evidence regarding secondary considerations of non-obviousness in this proceeding, Kerr will address those allegations in due course.

VI. CONCLUSION

For the reasons set forth above, Kerr requests institution of IPR for Claims 1-25 of U.S. Patent No. 6,572,693, and ultimately a judgment cancelling those claims as unpatentable.

Respectfully submitted,

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Dated: November 30, 2018

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CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that foregoing **PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 6,572,693**, exclusive of the parts exempted as provided in 37 C.F.R. § 42.24(a), contains 13,503 words and therefore complies with the type-volume limitations of 37 C.F.R. § 42.24(a).

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CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing **PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 6,572,693** and **EXHIBITS 1001–1018** are being served on November 30, 2018, via overnight mail on counsel of record for U.S. Patent No. 6,572,693 as addressed below:

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A courtesy copy is also being served on counsel for the patent holder in the pending district court litigation, *3M Company and 3M Innovative Properties Company v. Kerr Corporation*, No. 1:17-cv-01730-LPS-CJB (D. Del.).

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