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Paper 48
Entered: March 18, 2015

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BAXTER HEALTHCARE CORP.,
APATECH, INC., and APATECH LIMITED,
Petitioner,

v.

MILLENIUM BIOLOGIX, LLC,
Patent Owner.

Case IPR2013-00582
Patent RE41,251 E

Before MICHELLE R. OSINSKI, SCOTT E. KAMHOLZ, and BRIAN P. MURPHY, *Administrative Patent Judges*.

MURPHY, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and *37 C.F.R. § 42.73*

I. INTRODUCTION

Baxter Healthcare Corp., ApaTech, Inc., and ApaTech Limited ("Petitioner") filed a Petition (Paper 1, "Pet.") requesting *inter partes* review of claims 1, 6, and 8–13 of U.S. Patent No. RE41,251 E (Ex. 1001, "the '251 patent"). On March 21, 2014, we instituted an *inter partes* review of the challenged claims on the following grounds of unpatentability asserted by Petitioner:

Reference[s]	Basis	Claims challenged
Davies[1]	§ 102(b)	1 and 8–13
Davies and Ichitsuka[2]	§ 103(a)	8
Ruys '93a[3]	§ 102(b)	1 and 8–13
Ruys '93a and Bioceramics[4]	§ 103(a)	6

Decision to Institute (Paper 8, "Dec.") 30.

Patent Owner Millenium Biologix, LLC ("Patent Owner") filed a Patent Owner Response (Paper 20, "PO Resp."), and Petitioner filed a Reply (Paper 23, "Pet. Reply").

Patent Owner did not file a motion to amend claims, but Patent Owner did file a motion to exclude certain of Petitioner's evidence (Paper 28, "PO Mot. Excl."). Petitioner filed an Opposition (Paper 37) and Patent Owner filed a Reply (Paper 41). Petitioner filed a motion to exclude certain of Patent Owner's evidence (Paper 30, "Pet. Mot. Excl."). Patent Owner filed

[1] WO94/26872 to Davies, published November 24, 1994 (Ex. 1015).
[2] EP267624 to Ichitsuka et al., published May 18, 1988 (Ex. 1024).
[3] Ruys, *A Feasibility Study of Silicon Doping of Hydroxyapatite*, 42 INT'L CERAM. REV. 6 (1993) (Ex. 1011).
[4] AN INTRODUCTION TO BIOCERAMICS (Larry L. Hench & June Wilson eds, 1993) (Ex. 1021).

an Opposition (Paper 36) and Petitioner filed a Reply (Paper 42).

Petitioner relies on declarations of Dr. Antonios G. Mikos in support of its Petition (Ex. 1003) and Reply (Ex. 1134). Petitioner further relies on the declaration of Dr. Karin Hing (Ex. 1136) in support of its Reply. Patent Owner relies on the declaration of Dr. Joo L. (Anson) Ong in support of its Response (Ex. 2026). Petitioner relies on deposition testimony of Dr. Ong (Ex. 1133) in support of its Reply. Patent Owner relies on deposition testimony of Dr. Mikos (Ex. 2028; Ex. 2055), including its Motion for Observations on Cross-Examination of Dr. Mikos (Paper 33, "PO Obs."), to which Petitioner filed a Response (Paper 38).

We heard oral argument on November 14, 2014. A transcript is entered as Paper 47 ("Tr.").

We have jurisdiction under 35 U.S.C. § 6(c). This final written decision is entered pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73.

We determine Petitioner has shown by a preponderance of the evidence that claims 1 and 8–13 are unpatentable under 35 U.S.C. § 102(b) and claim 6 is unpatentable under 35 U.S.C. § 103(a).

Petitioner's Motion to Exclude Evidence is *dismissed as moot*.

Sections I–III of Patent Owner's Motion to Exclude Evidence are *dismissed as moot*. Section IV is *denied*.

A. Related Proceedings

The '251 patent is the subject of litigation in the Northern District of Illinois, *Millenium Biologix, LLC v. Baxter Healthcare Corp.*, Civil Action No. 1:13-cv-03084 (N.D. Ill.). Pet. 2; Ex. 1123. The '251 patent is related to U.S. Patent No. 6,585,992, certain claims of which are the subject of the petition in IPR2013-00590 on which we instituted trial. *Id*. Our Final

Written Decision in IPR2013-00590 is being entered concurrently with this Decision.

B. The '251 Patent

The '251 patent is directed to a synthetic biomaterial compound based on stabilized calcium phosphates and adapted for supporting bone cell activity. Ex. 1001, Title, Abstract. The compound, an embodiment of which is referred to in the patent as "Skelite," has treatment applications for the repair and restoration of natural bone compromised by disease, trauma, or genetic influences. *Id*. at 1:25–33. The compound can be made in different forms, one of which is a macroporous structure of interconnected voids having a pore size of approximately 50 to 1000 microns that can serve as a scaffold for the integration of new bone tissue. *Id*. at 21:56–62, 27:1–13. The compound is made by sintering a fine precipitate of a calcium phosphate material at high temperature (in the range from 800º C to 1100º C. (*id.* at 28:55–60)) in the presence of a stabilizing additive having an ionic radius of a size that enables substitution into the Ca—P lattice. *Id*. at 5:31–35. The '251 patent discloses that silicon, having an ionic radius of 0.40Å, is a preferred additive used to stabilize the claimed compound such that it "is essentially insoluble in biological media but is resorbable when acted upon by osteoclasts." *Id*. at 5:39–41.

The '251 patent describes a process for preparing the claimed calcium phosphate biomaterial compound by "processing . . . a fine precipitate, formed from a colloidal suspension and stabilized using an additive . . . that enables substitution into the Ca—P lattice." Ex. 1001, 5:31–35. The characteristic features of the claimed compound "arise during sintering," which provides the conditions necessary to enable silicon substitution into

the Ca—P lattice and interconnection of particles to form a microporous structure. *Id.* at 5:49–54. Formation of a microporous structure is at the heart of the dispute between the parties.

A graphic example of sintering, which causes hydroxyapatite ("HA") particles to fuse together, is shown below in Figure 1, chapter 11 of Bioceramics.[5]

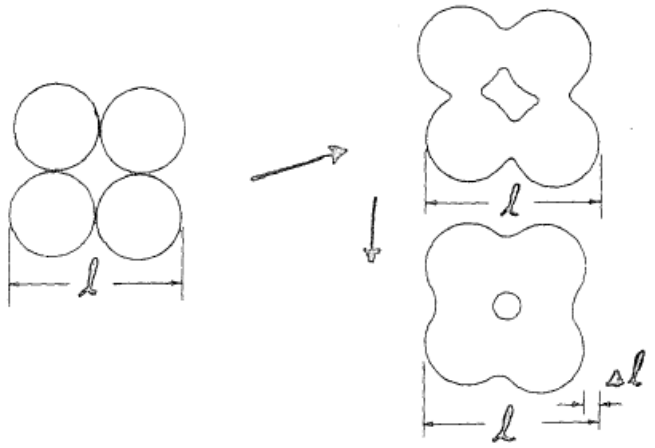

Figure 1, chapter 11 of Bioceramics is a schematic of the sintering process.

Ex. 1021, 129. In the example above, a pore is formed by the fusion of four hydroxyapatite particles during sintering. *Id.* at 128–29. Bioceramics states that the "porosities are usually classified as comprising either micropores (having a diameter of several microns due to the incomplete sintering of the particles) or macropores (having a diameter of several hundred microns allowing bone ingrowth.)." *Id.* at 129. Bioceramics also teaches that "microporous" hydroxyapatite can have pore sizes smaller than one micron,

[5] Hydroxyapatite, $Ca_5(OH)(PO_4)_3$, is a calcium phosphate biomaterial compound that is the primary inorganic component of natural bone. Ex. 1001, 2:66–3:6.

even as small as 2 to 5 nanometers (0.002 to 0.005 microns) in diameter. *Id.* at 119; Ex. 1133, 157:5–13, 158:1–13; Ex. 1134 ¶ 148. Bioceramics, therefore, is instructive for its teaching of how one of ordinary skill in the art would understand the term "microporous."

The '251 patent is a reissue of U.S. Patent No. 6,323,146. Claims 1, 6, and 8 are illustrative and reproduced below. Italicized text indicates language that was added to the claims upon reissuance of the patent. Bracketed text indicates language that was removed.

> 1. An isolated bioresorbable biomaterial compound comprising calcium, oxygen and phosphorous, wherein a portion of at least one of said elements is substituted with an element **[**having an ionic radius of approximately 0.1 to 0.6 Å**]** *Si^{4+}, wherein said compound has a microporous structure*.
>
> 6. The biomaterial compound as claimed in claim **[**5**]** *1* wherein said compound is formed as a macroporous structure comprising an open cell construction with interconnected voids having a pore size of approximately 50 to 1000 microns.
>
> 8. The biomaterial compound as claimed in claim 5, wherein said compound has a nanoporous structure.[6]

[6] Claim 8 depends from a claim canceled in reissue. For purposes of this decision, we interpret claim 8 as depending from claim 1.

II. DISCUSSION

A. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are given their broadest reasonable interpretation in light of the patent specification. 37 C.F.R. § 42.100(b); *In re Cuozzo Speed Tech., LLC*, No. 2014–1301, 2015 WL 448667, *7–*8 (Fed. Cir. Feb. 4, 2015). Claim terms are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). "The specification 'is the single best guide to the meaning of a disputed term.'" *Id.* (quoting *Phillips v. AWH Corp.*, 415 F.3d 1303, 1315 (Fed. Cir. 2005). Any special definition for a claim term must be set forth in the specification with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

1. "isolated . . . compound"

Petitioner argues the broadest reasonable interpretation of "isolated . . . compound" consistent with the specification is "a multi-phasic mixture containing a substituted-TCP[7] phase, which has been separated from other starting materials used to synthetically or otherwise prepare that multi-phase compound." Pet. 15 (citation omitted). Petitioner points out that the '251 patent specification does not use the word "isolated" to describe any calcium

[7] TCP stands for tricalcium phosphate, one of several calcium phosphate species. Ex. 1001, 3:4–15.

phosphate compound.[8] Pet. 14. Petitioner emphasizes that the word "isolated" was added to the claim by amendment during prosecution of the original patent prior to reissue. *Id.* (citing Ex. 1009, 269–274).

Claim 1 recites a silicon-substituted bioresorbable biomaterial compound "comprising calcium, oxygen and phosphorous." The silicon-substituted calcium, oxygen, and phosphorous compounds disclosed in the '251 patent are stabilized calcium phosphates synthesized and isolated as calcium phosphate "phases" or as a calcium phosphate "phase." Ex. 1001, Title,[9] 4:24–28, 5:4–5, 11:14–23, 13:40–61, and Figs. 9, 10, and 16. The '251 patent summary of invention states that a silicon-substituted calcium phosphate (silicon "substituted into the Ca—P lattice") "typically coexists with hydroxyapatite, and is itself a novel stabilized calcium phosphate compound having a microporous morphology . . . ." *Id*. at 5:31–39. Although silicon-substituted TCP is identified and claimed as a preferred compound (*Id*. at 6:5–7 and 34:22–27), the '251 patent states that "[s]pecific compounds of the present invention include but are not limited to" silicon-substituted TCP. *Id*. at 6:5–7. The '251 patent priority application[10] repeatedly and consistently refers to stabilized calcium phosphate phases "to include the various calcium phosphate species *in the sintered product* such as hydroxyapatite, α-TCP, β-TCP, calcium octophosphate, tetracalcium

[8] The '251 patent uses the term "isolated" only in reference to an unrelated description of osteoclast cells isolated from bone marrow to permit *in vitro* observation of osteoclast activity. Ex. 1001, 3:41–4:8.
[9] "Synthetic Biomaterial Compound of Calcium Phosphate Phases Particularly Adapted for Supporting Bone Cell Activity."
[10] The '251 patent claims priority to WO 97/09286 through a chain of continuation-in-part applications.

phosphate and dicalcium phosphate." Ex. 1017, 12:17–20 (emphasis added); *see also* Ex. 1001, 20:62–21:10. Silicon substitution stabilizes a calcium phosphate phase or phases such that they "maintain a consistent crystallographic and chemical structure when placed in ambient conditions or in a physiological environment *in vivo* or *in vitro*" (Ex. 1017, 12:6–9) and are "essentially insoluble in biological media" (Ex. 1001, 5:39–41).

In light of the above and contrary to Petitioner's argument, the claimed "isolated . . . compound" is not limited to compounds including a silicon-substituted TCP phase. Claim 1 uses the open-ended phrase "comprising calcium, oxygen and phosphorous," which includes several different calcium phosphate species in addition to TCP, as indicated in the '251 patent specification and priority application discussed above. The open-ended language of claim 1 also contrasts with the narrower Markush group language contained in independent claims 15 (Si-substituted TCP) and 22 (several Si-substituted calcium phosphate species). *See, e.g., Abbott Labs. v. Andrx Pharm., Inc.*, 473 F.3d 1196, 1210 (Fed. Cir. 2007) ("A Markush group is a form of drafting a claim term that is approved by the PTO to serve a particular purpose when used in a claim—to limit the claim to a list of specified alternatives.") (citation omitted). The'251 patent consistently refers to stabilized "calcium phosphate phases," without any indication of intending to limit the claimed compound solely to compounds including a silicon-substituted TCP phase.

We recognize that Patent Owner added the word "isolated" to distinguish claim 1 (among others) from Davies during prosecution and argued that applicants had developed "a stabilized calcium phosphate phase (claimed in WO 97/09286) from which the presently claimed biomaterial

compound was then further isolated therefrom." Ex. 1009, 304. We do not read this as an intention to limit the claims to a silicon-substituted TCP phase or as providing a special definition for the claimed "isolated compound." *See In re Paulsen*, 30 F.3d at 1480. An interpretation limiting the claim only to compounds including a silicon-substituted TCP phase would contradict Patent Owner's repeated references to stabilized calcium phosphate phases, which may be isolated by the processes disclosed in the '251 patent. Ex. 1001, Title, 4:24–28, 5:4–5 and 31–39, 11:14–23, 13:40–61, 20:62–21:10, Figs. 9, 10, 16; Ex. 1017, 12:17–20. The open-ended claim language, the deliberate use of more limiting language in other claims, the disclosures of the '251 patent and priority application, and the prosecution history all counsel against limiting claim 1 to compounds including a silicon-substituted TCP phase.[11]

The word "isolated" in claim 1 is used in accordance with its plain and ordinary meaning to those skilled in the art—separated from all other substances. *See* Ex. 1005, 4 (right-hand column, "[1]isolate," definition "2").[12] The isolated compounds disclosed in the '251 patent are stabilized calcium phosphates synthesized and isolated as calcium phosphate "phases" or as a calcium phosphate "phase." Therefore, we determine that the broadest reasonable interpretation of "isolated . . . compound" in the context of the claimed invention, consistent with the '251 Specification, is "a stabilized

[11] Patent Owner does not contest our construction of "isolated . . . compound" in its Response to the Petition. PO Resp. 22–23.
[12] "to separate (as a chemical compound) from all other substances: obtain pure or in a free state"

single phase or multi-phase calcium phosphate compound separated from all other substances."

2. "microporous structure"

The '251 patent does not define "microporous structure" as recited in claim 1. The parties dispute the meaning of "microporous structure." We address the parties' claim construction dispute below.

a. Decision to Institute

Petitioner argues the claimed "microporous structure" means a structure having pore sizes of about a micron or less. Pet. 19–20. In its Preliminary Response Patent Owner agreed with Petitioner, subject to the qualification "so long as the material is indeed porous to the flow of fluids, *i.e.* 'or less' does not equate to not porous at all." Prelim. Resp. 27. Patent Owner's qualification must be read in light of the '251 patent's description that, at sintering temperatures of 1250º C and above, the silicon-substituted calcium phosphate particles "show an increasing tendency to form a melt thus eliminating the microporous structure." Ex. 1001, 15:39–42. The implication is that the porosity of the material must not be eliminated by complete sintering (fusion) of the particles. In our Decision to Institute, we construed "microporous structure" to mean "a porous structure of interconnected particles having pore sizes of about 2 microns or less in diameter." Dec. 12 (citing Ex. 1001, 5:31–39 ("a microporous morphology based on inter-connected particles of about 0.2–1.0 μm in diameter"), 13:61–66 ("a range of microporous structures comprised of particles of size range 0.1 to 2.0 μm"); Ex. 1017, 13:26–29, 17:12–20)).

b. Patent Owner's Response and Petitioner's Reply

Patent Owner argues in its Response that the Board's construction requires clarification to limit the claimed "microporous structure" further to a structure having (i) "interconnected microporosity," and (ii) pore sizes greater than 0.1 micron in diameter so as to exclude a "nanoporous structure."[13] PO Resp. 55–57. Patent Owner, relying on the Declaration testimony of Dr. Ong, argues that interconnected microporosity is required to permit "sufficient percolation of physiological fluids" for cellular osteoclast and osteoblast activity to carry out bone resorption and bone growth functions *in vivo*. *Id.* at 56–57 (citing Ex. 2026 ¶¶ 91–93). Patent Owner argues that the '251 patent defines a microporous structure as "interconnected round particles with an interconnected microporosity in said structure." *Id.* at 56 (citing Ex. 1001, 8:10–11). Patent Owner further argues that "no person of skill in the art would understand the claimed microporous structure to cover the nanoporous structure of claim 8." *Id.* at 57 (citing Ex. 2026 ¶ 93).

Petitioner replies that the Board's construction is correct and emphasizes Dr. Ong's agreement that references from the mid-1990s referred to nanometer-sized pores (e.g., 2–5 nanometers in diameter) as "microporous." Pet. Reply 6 (citing Ex. 1133, 157:5–13, 158:1–13; Ex. 1021, 119; Ex. 1134 ¶¶ 143–149). Dr. Mikos adds that not only does the

[13] The parties agree that a person of ordinary skill in the art would understand "nanoporous" to mean a pore size of less than about 0.1 micron (100 nanometers) in diameter (Pet. 20; Prelim. Resp. 27), an interpretation supported by the Declarations of Dr. Mikos (Ex. 1003 ¶ 334) and Dr. Ong (Ex. 2026 ¶ 93).

'251 patent not require a lower limit on the size of the micropores (Ex. 1134 ¶ 146), but many references "clearly show that persons skilled in the art in fact did use the term 'micropore' without a bottom limit, which would necessarily encompass nanopores." Ex. 1134 ¶¶ 147, 148 (citing, e.g., Ex. 1047, 5 ("In ceramic structures, micropores (usually less than 5 μm in size) . . . ."); Ex. 1049, 2 ("Micropores (< 5 μm) . . . ."). Dr. Mikos further opines that although interconnected pores "facilitate" bioactivity and bioresorbability of calcium phosphate materials, interconnected pores "are not required" to attain these properties. Ex. 1134 ¶ 149 (citing Dr. Ong's deposition testimony, Ex. 1133, 150:18–151:1 ("Q. So my point is, is that you don't necessarily need interconnected pores to have a useful calcium phosphate material. . . . A. That is correct.")). Dr. Mikos opines that even a dense form of HA with little or no porosity is still a useful biomaterial compound. Ex. 1003 ¶¶ 68, 69 ("dense HA [generally lacking a porous structure] was considered by some to be more suitable for implantation in load bearing sites.") (citation omitted); Ex. 1021, 128–129.

c. Analysis

Claim 1 of the '251 patent recites "wherein said compound has a microporous structure." Claim 1 does not recite a structure having "interconnected microporosity" or a lower limit on pore size. A comparison with the language of claim 6 is instructive. Claim 6 depends from claim 1 and recites a "macroporous structure . . . with *interconnected voids having a pore size of approximately 50 to 1000 microns*." Ex. 1001, 33:59–63 (emphasis added). Claim 6, unlike claim 1, expressly limits the porous structure to one of "interconnected voids" having a pore size within a range of specific numeric values. Because claim 1 lacks a comparable recitation of

"interconnected voids" or "interconnected micropores" and a lower limit on pore size, the claim language itself does not provide a reason to limit the claim as urged by Patent Owner. *See Enzo Biochem, Inc. v. Applera Corp.*, 599 F.3d 1325, 1333 (Fed. Cir. 2010) (modifying district court's claim construction by removing hybridization requirement because "[Appellants] knew how to claim [the hybridization requirement], as they did in the [related] patents.").

With regard to the issue of "interconnected microporosity," the '251 patent consistently describes the microporous structure or morphology of the claimed compound in terms of interconnected <u>particles</u> exhibiting porosity, not in terms of interconnected micropores. Figure 5, below, most clearly shows the microporous structure.

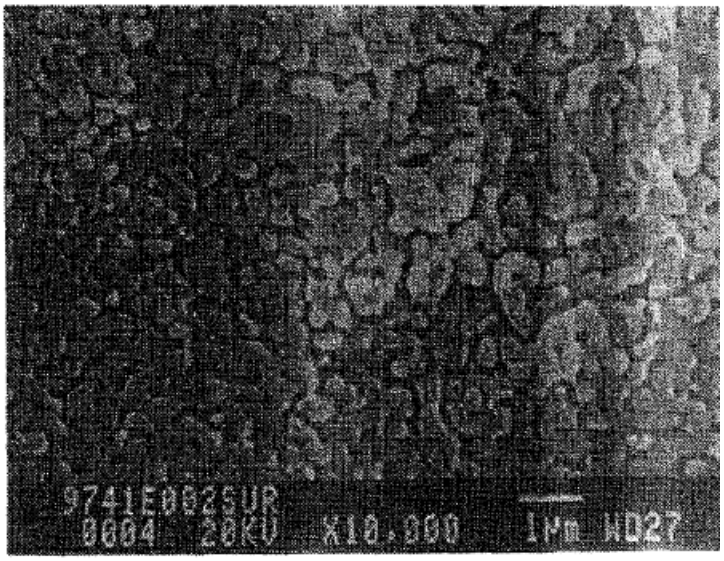

Fig. 5 shows interconnected particles exhibiting porosity.

Ex. 1001, Fig. 5 ("[T]he surface morphology is that of an interconnected set of rounded particles with a high degree of porosity as seen in FIG. 5." (*id.* at 11:50–52)). The patent's repeated descriptions of interconnected particles, fused during sintering to form a microporous structure exhibiting porosity,

do not describe interconnected microporosity as critical or necessary to the microporous structure of the claimed compound. *Id.* at 5:37–38 ("compound having a microporous morphology based on inter-connected particles"); 11:50–52 ("the surface morphology is that of an interconnected set of rounded particles with a high degree of porosity"); 13:61–64 ("The ceramic comprises rounded, inter-connected particles . . . with a large degree of localized porosity."); 22:3–6 ("A characteristic microporous morphology that arises from the agglomeration of particles . . . and the sintering of the material to produce a network of interconnected particles."); Ex. 1134 ¶ 146. Patent Owner does not explain how interconnected microporosity results necessarily from interconnected particles. Interconnected microporosity may be preferred for supporting percolation of physiological fluids and bone cell activity,[14] but interconnected microporosity is neither recited in claim 1 nor required for a functional biomaterial. As established by Dr. Mikos's testimony and Dr. Ong's testimony, dense HA (without interconnected microporosity) is suitable for implantation at load bearing sites in patients. Ex. 1003 ¶¶ 68, 69; Ex. 1134 ¶ 149 (citing Dr. Ong's deposition testimony, Ex. 1133, 150:18–151:1). Therefore, we decline to read "interconnected microporosity" into the construction of "microporous structure."

With regard to Patent Owner's proposed definition of "microporous structure" as including a lower limit of 0.1 micron pore size, the '251 patent

[14] "According to yet a further aspect of the present invention is a synthetic sintered microporous polycrystalline structure for supporting bone cell activity, the structure comprising . . . a globular morphology of interconnected rounded particles with an interconnected microporosity in said structure." (Ex. 1001, 8:10–11; Ex. 2026 ¶¶ 91–92).

does not claim or describe such a lower limit. Tr. 40:19–25 ("JUDGE KAMHOLZ: The '251 patent does not provide definitions of those terms microporosity and nanoporosity. MR. RUTHERFORD: That is correct . . . . it doesn't . . . say, oh yes, nano will be .1 to 1 and micro will be 1 to 3. It does not set it out in that way."); *see* Pet. Reply 6–7 (citing Ex. 1134 ¶ 146 ("[T]he specification does not place a lower limit on the size of the micropores."). Although Patent Owner argues that the "microporous structure" recited in claim 1 cannot include the "nanoporous structure" recited in claim 8 (PO Resp. 57; Tr. 41:1–11), the language of claims 1 and 8 does not require mutually exclusive pore size ranges. The '251 patent, moreover, describes a microporous structure that will vary as a function of particle size and sintering conditions, which can include pore sizes less than 100 nanometers in diameter. Ex. 1001, 11:52–58, 13:59–66, and Figs. 5, 6(a), 6(b). For example, in describing the microporous morphology of the preferred Skelite compound, the '251 patent states that "the underlying structure of the particles is the agglomeration of granules of size range of approximately 1 to 20 nm [nanometers]," thereby invoking the prospect of sintering particles smaller than 0.1 micron (100 nanometers) and forming concomitantly smaller pores. Ex. 1001, 17:43–45, and Figs. 6(a) (showing nanoporosity within the body of the sintered particle), 6(b) (showing underlying unsintered particle size of 5 to 10 nanometers). The only lower limit on pore size of the microporous structure, which we infer from the written description of the patent, is that porosity not be eliminated by complete sintering of the particles. *Id.* at 15:39–42.

Patent Owner argued during the oral hearing that the '251 patent distinguishes the pore sizes of a nanoporous structure from those of a

microporous structure (Tr. 39:6–18 (citing Ex. 1001, 7:41–42)).[15] Patent Owner acknowledged, however, that the '251 patent does not provide definitions of "microporosity" and "nanoporosity," and counsel could not cite evidence in the record to support the assertion that "microporosity" and "nanoporosity" must have non-overlapping pore size ranges. Tr. 40:19–41:11. The cited passage from the patent, moreover, does not impose a lower limit on pore size of a microporous structure or mandate non-overlapping pore size ranges. Therefore, we are not persuaded by Patent Owner's argument. *See Aventis Pharma S.A. v. Hospira, Inc.*, 675 F.3d 1324, 1330 (Fed. Cir. 2012) (proper not to limit plain and ordinary meaning of claim term "perfusion," where specification did not express language of manifest exclusion or clear disavowal of claim scope.).

Our construction also is consistent with the weight of extrinsic evidence that persons skilled in the art used the terms "microporous" or "microporosity" to refer to nanometer-sized pores. Ex. 1021, 119 ("microporous HA cement" with "interconnected microporosity averaging 2–5 nm in diameter"); Ex. 1133, 157:5–13, 158:1–13 (confirms use of "microporous" in Exhibit 1021 page 119 to include pore sizes in the range of 2 to 5 nanometers); Ex. 1134 ¶¶ 143–149 ("microporous structure" includes nanometer-sized pores without a bottom limit); Ex. 1047, 5 ("In ceramic structures, micropores (usually less than 5 μm in size) . . . ."); Ex. 1049, 2

[15] "The biomaterial compound has a distinguishable microporous and nanoporous structure along with a crystallography that is similar yet different from that of α-TCP." The quoted passage from the '251 patent was not cited in Patent Owner's Response regarding claim construction or in the cited passages from paragraphs 91–93 of Dr. Ong's Declaration. PO Resp. 55–57 (citing Ex. 2026 ¶¶ 91–93).

("Micropores (< 5 μm) . . . ."). The extrinsic evidence persuades us that one of ordinary skill in the art of bone implant materials would understand "microporous" and "microporosity" to refer to a range of pore sizes several microns or less in diameter without a finite lower limit.

In sum, although a range of particle sizes and sintering conditions (time and temperature) are described in the '251 patent for forming a microporous structure, the '251 patent does not place a finite lower limit on pore size so as to exclude nanometer-sized pores from the definition of "microporous structure," nor does the extrinsic evidence indicate that such a limitation was implied in use of that term.

For the reasons given above, we decline to alter our claim construction as urged by Patent Owner. Therefore, we maintain our construction of the broadest reasonable interpretation of "microporous structure" to mean "a porous structure of interconnected particles having pore sizes of about 2 microns or less in diameter." Dec. 12.

3. "bioresorbable biomaterial" and "compound comprising calcium, oxygen and phosphorous, wherein a portion of at least one of said elements is substituted with an element Si^{4+}"

In our Decision to Institute, we determined that no express interpretation of the quoted phrases recited in claim 1 is required. Dec. 11–12. The parties do not contest this determination. We maintain that no express interpretation of the phrases "bioresorbable biomaterial" and "compound comprising calcium, oxygen and phosphorous, wherein a portion of at least one of said elements is substituted with an element Si^{4+}" is required for this Final Written Decision.

4. "macroporous structure"

In our Decision to Institute, we determined that Claim 6 defines "macroporous structure" with clarity and precision: "comprising an open cell construction with interconnected voids having a pore size of approximately 50 to 1000 microns." Dec. 13. The parties do not contest this determination. We maintain our construction of "macroporous structure."

5. "nanoporous structure"

In our Decision to Institute, we determined the broadest reasonable interpretation of "nanoporous structure," recited in claim 8, is "a porous structure of interconnected particles having pore sizes of less than about 0.1 micron (100 nanometers) in diameter." Dec. 13. The parties agree and do not contest this determination. Pet. 20; PO Prelim. Resp. 27. We maintain our construction of "nanoporous structure."

B. Anticipation of Claims 1 and 8–13 by Davies

Petitioner argues that Davies (Ex. 1015) discloses the same process described in the '251 patent for applying a colloidal calcium phosphate (CaP) thin film to a quartz substrate, followed by sintering at high temperatures, which necessarily will result in the claimed isolated compound. Pet. 32–33 (citing Ex. 1003 ¶¶ 429–438, 608–09, App. B). Petitioner argues that Davies inherently anticipates claims 1 and 8–13 under 35 U.S.C. § 102(b). *Id.*; *see Schering Corp. v. Geneva Pharmaceuticals, Inc.*, 339 F.3d 1373, 1377 (Fed. Cir. 2003) ("[A] prior art reference may anticipate without disclosing a feature of the claimed invention if that missing characteristic is necessarily present, or inherent, in the single

anticipating reference.") (citation omitted); *SmithKlineBeecham Corp. v. Apotex Corp.*, 403 F.3d 1331, 1343–44 (Fed. Cir. 2005). Patent Owner opposes, arguing that the thin-film-on-quartz embodiment is a non-elected, unclaimed embodiment that is not an "isolated" compound, as recited in claim 1. PO Resp. 21–25 (citing Ex. 2026 ¶¶ 57–59; Ex. 2028 (Mikos Depo.)).

1. Overview of Davies

Davies discloses synthetic CaP-based thin films, applied to a quartz substrate, on which bone cells may be cultured to permit evaluation of bone cell functional properties such as osteoclast activity. Ex. 1015, Abstract, 6:30–35. Procedure 1 of Davies describes the preparation of HA using a two-solution sol-gel process, where Solution A (pH 12) is made with 4.722 grams of calcium nitrate and Solution B (pH 12) is made with 1.382 grams of ammonium dihydrogen phosphate. Ex. 1015, 25:8–26:29; Ex. 1003 ¶¶ 432–437. After mixing Solutions A and B followed by centrifugation, a colloidal CaP sol-gel suspension of HA is formed. *Id*. Procedure 3 describes cleaning a quartz substrate, which contains silicon, and Procedure 4 describes dip coating the cleaned quartz substrate with the colloidal CaP sol-gel prepared in Procedure 1. Ex. 1015, 28:17–29:9; Ex. 1003 ¶¶ 434–35. Procedure 5 describes sintering the CaP-coated quartz substrate at 1000ºC for one hour. Ex. 1015, 29:11–19; Ex. 1003 ¶ 436. X-ray diffraction analysis reveals that, when sintered at 1000ºC, "the film has a majority of tricalcium phosphate and a ratio of approximately 10:90 of calcium hydroxyapatite [HA] to tricalcium phosphate." Ex. 1015, 29:20–35. With regard to claim 1 of the '251 patent, Davies does not disclose expressly the

substitution of silicon in at least one of the calcium, oxygen, or phosphorous elements.

2. Analysis of asserted anticipation of claim 1 by Davies

Petitioner cites the testimony of Dr. Mikos, who testifies that the "'isolated compound' of claim 1 is no different than the multi-phasic mixtures [of HA and TCP] disclosed in [Davies]" as a CaP thin film provided on a quartz substrate. Pet.34 (citing Ex. 1003 ¶ 617). Dr. Mikos further testifies that "[a]s the result of the sintering, the multi-phasic calcium phosphate-based material has been separated from the environment, that is the reagents and the unwanted starting materials . . . ." Ex. 2028, 78:5–79:21. Petitioner argues that the sintering step used in Davies, also used in the '251 patent, would have resulted in removal of residual reactants, thereby yielding the claimed "isolated compound." Pet. 34–35.

Patent Owner argues that non-election of a claimed method for culturing functional bone cells on a CaP thin film, in response to a restriction requirement during prosecution, is evidence that Davies does not disclose the claimed "isolated compound." PO Resp. 22. Patent Owner argues that the "isolated compound" language covers the silicon-substituted powder and macroporous structure embodiments described in Examples 5 and 8 of the '251 patent, but not the thin-film-on-quartz embodiment of Example 3. *Id.* at 22; *see* Tr. 82:11–14 ("If you are going to use it [CaP thin film] for treatment, you would remove it from the quartz . . . . It is not part of the resulting biomaterial that is being created."). Patent Owner concludes that Davies does not disclose a silicon-substituted CaP compound "separated from all other substances" in accordance with our claim construction. PO Resp. 22–23 (citing Ex. 2026 ¶¶ 57–59).

We agree with Patent Owner. The '251 patent and Davies repeatedly and consistently describe the compound as a thin film "formed on," "provided on," or "applied to" a quartz substrate. Ex. 1001, 4:11–13 ("a calcium phosphate-based thin film formed . . . on quartz substrates"), 8:33–34 ("a synthetic sintered film . . . on a substrate"), 16:54–56 ("As provided as a film on a substrate . . . ."), 26:25–26 ("Once the colloidal suspension (sol-gel) is prepared, it may be applied as a thin film to the desired substrate . . . ."); Ex. 1015, Abstract ("Such film, as applied to a support . . . ."), 10:7–8 ("providing the film on a transparent supporting substrate, such as quartz or glass"), 10:24–27 ("Preferably the substrate is of quartz . . . because of the required sintering of the film once applied to the substrate."). The thin film is applied by dipping the quartz substrate into a separately prepared CaP sol-gel suspension, extracting the substrate from the sol-gel suspension at a constant speed ("dip coating"), followed by drying and sintering for one hour at 1000º C. Ex. 1001, 29:27–34; Ex. 1015, 21:35–22:5, 28:34–29:17. Thus, the thin film is created from the CaP sol-gel suspension and applied to or coated on the quartz substrate, such that the CaP thin film compound is bound to, not separated from, another substance.[16]

We are persuaded by Dr. Ong's testimony that Davies does not disclose that "the sintered CaP thin film could be separated and thus 'isolated' from the reagent/substance/substrate on which it was formed." Ex. 2026 ¶ 58. The failure of Davies to disclose an "isolated" CaP

[16] Quartz is "a mineral consisting of silicon dioxide occurring in colorless and transparent or colored hexagonal crystals or in crystalline masses." *Quartz Definition*, MERRIAM-WEBSTER, available at http://www.merriam-webster.com/dictionary/quartz (last visited February 20, 2015). Ex. 3001.

compound is further supported by the prosecution history of the '251 patent. Ex. 1009, 295. The Examiner withdrew a Section 102(b) rejection over Davies (and WO 97/09286), advising patent applicant to "point out [Davies and WO 97/09286] do not teach isolated compounds and have different formulas." *Id.* Patent applicant responded, stating, *inter alia*, "the present invention is directed to this isolated biomaterial compound having elemental substitutions therein that provide a highly bioresorbable compound that can be remodeled *in vivo* and *in vitro* much like natural bone and can be provided as powders, pellets, thick coatings, three-dimensional bulk materials and macroporous structures." *Id.* at 304. Petitioner's reliance on the Reply Declaration of Dr. Mikos, who attempts to alter the Board's claim construction requiring a compound "separated from all other substances" (Ex. 1134 ¶ 64 ("separated from *substantially* all other *unwanted* substances")) to justify his opinion, is not entitled to any weight.

Petitioner, moreover, has not provided evidence that quartz is a "bioresorbable biomaterial" as recited in claim 1. Pet. 32–35 (citing Ex. 1003 ¶¶ 219–224, 313–14, 429–38, 440–450, 609–09, 617; Ex. 1057, 6); Reply 15 (citing Ex. 1134 ¶¶ 62–67). Petitioner attempts to equate the quartz substrate with the CaP thin film biomaterial – the "glass/quartz substrate . . . is part of the CaP *product*, and serves a core purpose," (Pet. Reply 15 (emphasis added) citing Ex. 1134 ¶¶ 62–67) – but a thin-film-on-quartz CaP "product" is not an "isolated bioresorbable biomaterial compound." The quartz acts as a convenient substrate to <u>support</u> the CaP thin film, but only the CaP thin film is a biomaterial compound. Ex. 1001, 16:54–60, 25:53–57. We find Petitioner has not adduced persuasive

evidence that the quartz substrate disclosed in Davies is a bioresorbable biomaterial that should be considered part of the isolated compound.

For the reasons given above, we find that Davies does not disclose an "isolated bioresorbable biomaterial compound" separated from all other substances as recited in claim 1 of the '251 patent. Therefore a preponderance of the evidence does not support Petitioner's contention that Davies anticipates claim 1 of the '251 patent.

3. Analysis of asserted anticipation of claims 8–13 by Davies

Claims 8–13 of the '251 patent all depend, ultimately, from claim 1. We have found, for the reasons given in section II B.2. above, that Davies does not disclose the "isolated bioresorbable biomaterial compound" recited in claim 1. Therefore, we determine Petitioner has not provided persuasive evidence that Davies inherently anticipates dependent claims 8–13 of the '251 patent.

C. Obviousness of Claim 8 over Davies and Ichitsuka

Petitioner argues the "nanoporous structure" limitation of dependent claim 8 would have been obvious to a person of ordinary skill in the art, when Davies is combined with the teachings of Ichitsuka. Pet. 35–37. Petitioner's analysis of Ichitsuka focuses on the "nanoporous structure" limitation and does not address the "isolated bioresorbable biomaterial compound" limitation of claim 1 that we find lacking in Davies. *Id.* at 37. Therefore, we determine Petitioner has not provided persuasive evidence that the combination of Davies and Ichitsuka renders claim 8 unpatentable for obviousness under 35 U.S.C. § 103(a).

D. Anticipation of Claims 1 and 8–13 by Ruys '93a

Petitioner argues that Ruys '93a (Ex. 1011) discloses a silicon-substituted calcium phosphate compound made by a very similar process to the sol-gel/sintering process described in Examples 1, 2, and 5 of the '251 patent. Pet. 42–45, 51, 53–54; Pet. Reply. 1–9. Petitioner argues that Ruys '93a inherently anticipates claims 1 and 8–13 of the '251 patent under 35 U.S.C. § 102(b). Patent Owner opposes, emphasizing differences between the Ruys '93a process and the process described in the '251 patent. PO Resp. 8–21, 24–25.

1. Overview of Ruys '93a

Ruys '93a, titled "A Feasibility Study of Silicon Doping of Hydroxylapatite," discloses an approach to enhancing "the relatively low bioactivity of hydroxylapatite" (Ex. 1011, Abstract) by forming a silicon-doped calcium phosphate compound. Ex. 1011, 3 (left column). Ruys '93a discloses a two-solution sol-gel process to make finely divided (20 nm) stoichiometric HA suspended in ethanol.[17] Ex. 1003 ¶ 383 (citing Ex. 1011, 3 (right column)). Ruys '93a discloses the addition of ethyl silicate to the suspended HA, then excess water, to form colloidal silica. *Id*. The precipitated HA and silica powder are pressed into pellets and sintered at 1100ºC for one hour in air. *Id*. Ruys '93a discloses 11 experimental compositions with varying silicon:HA molar ratios. Ex. 1003 ¶ 385 (citing Ex. 1011, 3 (right column)).

[17] Stoichiometric HA has a Ca:P ratio of 1.67 "consistent with the chemical formula of HA which includes 10 calcium atoms for every 6 phosphorous atoms." Pet. 43 (citing Ex. 1003 ¶ 393).

Ruys ’93a further discloses analytical data for the sintered material, a multi-phase, silicon-substituted calcium phosphate compound that includes TCP as one of “two new apatite phases.” Ex. 1003 ¶ 385 (citing Ex. 1011, 4 (right column)). Ruys ’93a discloses lattice expansion data supporting the author’s conclusion that “silicon substitution probably occurred . . . at the phosphorous site since ionic radii restrictions favour this site to the exclusion of the three alternatives – the calcium, oxygen, and hydroxyl sites.” Ex. 1011, 4 (right column); Ex. 1003 ¶ 384. Ruys ’93a further states that “[t]he formation of $Ca_{10}(PO_4)_4$ $(SiO_4)_2$ shows that *silicon substitution into the phosphorous site can be induced by the sol-gel synthesis method* used in the present work.” Ex. 1011, 4 (right column) (emphasis added). Ruys’93a also discloses data demonstrating the “apparent porosity” of the compound as a function of the silicon:HA molar ratios tested.[18] Ex. 1011, 4 (left column), Fig. 2.

2. Petitioner’s argument and evidence

Petitioner relies on the testimony of Dr. Mikos, who characterizes the process used in Ruys ’93a as “strikingly similar” to the sol-gel method described in the ’251 patent and concludes that the Ruys’93a process “necessarily resulted in products having the same physical, chemical, and biological properties.” Pet. 43 (citing Ex. 1003 ¶¶ 623–625); Ex. 1003

[18] Apparent porosity is a measure of the porosity of a material using a hydrostatic weighing technique where the material is immersed in water or kerosene. Ex. 1011, 4 (Fig. 2); *see also* Ex. 1003 ¶ 134 (“[I]ncomplete sintering of HA ceramics, which is what was observed in Ruys 1993a, was known to result in pores.”); Ex. 2026 ¶ 38 (measuring apparent porosity “does indicate some pores that are accessible to fluid in contact with the outside of the pellet.”).

¶¶ 383, 393–394. Petitioner argues that the sintering step disclosed in Ruys '93a results in an "isolated compound." Pet. 44 (citing Ex. 1003 ¶¶ 386–87). Petitioner next points to the statement in Ruys '93a regarding the creation of silicon "substituted" HA, and further relies on later work of two of the named '251 patent inventors as confirming that the method used in Ruys '93a would have resulted in silicon-substituted TCP. Pet. 43–44 (citing Ex. 1003 ¶¶ 384, 393–94, 628; Ex. 1119). Petitioner further argues that Ruys '93a necessarily results in a "microporous structure," indicated by incomplete sintering of the silicon-doped CaP compound. Pet. 44–45 (citing Ex. 1003 ¶¶ 388–394, 625, 632).

3. Patent Owner's argument and evidence

Patent Owner argues that Ruys '93a does not disclose inherently "microporosity" (i.e. "a microporous structure") of the silicon-doped CaP compound and that Petitioner has failed to meet its burden of proving Ruys '93a inherently anticipates claim 1 of the '251 patent. PO Resp. 8–21. Patent Owner argues the process disclosed in Ruys '93a is not equivalent to the processes disclosed in Example 5 of the '251 patent ("Preparation of Ca–P Powder with Silicon as the Introduced Additive").[19] *Id.* at 10–16. Patent Owner urges that, because of "critical" process differences, the Ruys '93a process "Do[es] Not Necessarily Result in Interconnected Microporosity." *Id.* at 10 (citing Ex. 2026 ¶ 52); *Id.* at 14–15 (citing Ex. 2026 ¶¶ 50–52). Patent Owner further argues the Jarcho prior art reference (Ex. 1010), relied upon by Dr. Mikos, does not teach that inefficient sintering results necessarily in microporosity. *Id.* at 16–21 (citing Ex. 1010 (Jarcho); Ex.

[19] Ex. 1001, 29:50–30:12.

2026 ¶¶ 43, 54, 56; Ex. 2028 (excerpts of Dr. Mikos's May 6, 2014 deposition transcript)). Patent Owner also attempts to distinguish the structure of the Ruys '93a compound from the claimed "microporous structure," because the '251 patent describes "sintering agglomerates substantially larger than the non-agglomerated particles sintered in Ruys." PO Obs. 1–2. Patent Owner does not put forward evidence to rebut Petitioner's evidence supporting the Ruys '93a disclosure of the other limitations in claim 1 apart from the "microporous structure" limitation. PO Resp. 8–21.

4. Analysis

a. "isolated bioresorbable biomaterial compound"

With regard to the limitation of claim 1 reciting an "isolated bioresorbable biomaterial compound comprising calcium, oxygen, and phosphorous" (Ex. 1001, 33:42–43), Ruys '93a discloses a CaP compound, prepared as a powder in the presence of silicon, compressed into pellets, and sintered at high temperature to form an isolated bioresorbable biomaterial compound. Ex. 1011, 3 (right column), 4 (right column); Pet. 43–44 (citing Ex. 1003 ¶¶ 383–87, 393–94, 625). The "isolation" of the silicon-doped CaP compound, which includes a TCP phase, is accomplished by essentially the same process steps – precipitating CaP and silica from a sol-gel followed by sintering at high temperature – that are described in the '251 patent. Pet. 43–44 (citing Ex. 1003 ¶¶ 386–87, 393–94, 625, 628); Ex. 1003 ¶ 627. Patent Owner does not put forward credible evidence to rebut the aforementioned evidence. PO Resp. 8–21. Petitioner's unrebutted evidence is sufficient to persuade us that Ruys '93a discloses an "isolated

bioresorbable biomaterial compound comprising calcium, oxygen, and phosphorous" by a preponderance of the evidence.

b. "substituted with an element Si^{4+}"

Claim 1 further recites "wherein a portion of at least one of said elements is substituted with an element Si^{4+}." Ex. 1001, 33:43–45. Ruys '93a first hypothesizes that elemental silicon substitution will occur at the phosphorous site of the CaP compound (Ex. 1011, 3 (left column)), then presents analytical data indicating that "silicon substitution probably occurred . . . at the phosphorous site" (*id.* at 4 (right column), Figs. 1–3), and states unequivocally that "silicon substitution into the phosphorous site can be induced by the sol-gel synthesis method used in the present work." (*id.* (right column)). Pet. 43–44 (citing Ex. 1003 ¶¶ 383–87, 393–94, 625, 628). Dr. Mikos emphasizes later work of the '251 patent inventors that "'firing a stoichiometric calcium hydroxyapatite precipitate with SiO_2 produces Si-TCP'" (Ex. 1003 ¶ 394), and he concludes that "the methods disclosed in Ruys 1993a necessarily resulted in multi-phasic materials comprising silicon-substituted-TCP." *Id.* ¶¶ 628–29 (citing Ex. 1119).

Patent Owner does not put forward credible evidence to rebut the above-cited evidence of Petitioner. PO Resp. 8–21. Petitioner's unrebutted evidence is sufficient to persuade us that Ruys '93a discloses the claim limitation "wherein a portion of at least one of said elements is substituted with an element Si^{4+}" by a preponderance of the evidence.

c. "microporous structure"

As a preliminary matter, we reject Patent Owner's claim construction-based argument (PO Resp. 11–15 (citing Ex. 2026 ¶¶ 45, 46, 51)) that Ruys

'93a must inherently disclose "interconnected microporosity" in order to satisfy the wherein clause recitation of "a microporous structure" in claim 1 of the '251 patent. *See* section II A.2. above. Further, there is no dispute that Ruys '93a discloses a silicon-substituted CaP compound having a porous structure, graphically demonstrated by the "apparent porosity" curve in Figure 2 of Ruys '93a. Ex. 1011, 4 (left column); Pet. 44 (citing Ex. 1003 ¶¶ 388–391); Pet. Reply (citing Ex. 1003 ¶ 631; Ex. 2026 ¶¶ 38–39; Ex. 1133, 59:14–18, 242:12–15). The silicon-substituted CaP compound analyzed in Ruys '93a demonstrates an apparent porosity as high as 50% of the material tested. Ex. 1011, 4 (Fig. 2); Tr. 20:7–15. Petitioner and Patent Owner both recognize, however, that Ruys '93a does not report pore size. Pet. Reply 4; Tr. 52:22–24. Therefore, the dispute boils down to whether the porous structure of the silicon-substituted CaP compound disclosed in Ruys '93a is inherently "microporous," i.e. whether the method disclosed in Ruys '93a would necessarily result in "pore sizes of about 2 microns or less in diameter," in accordance with our claim construction. *See In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999)("the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference'"(citation omitted)).

Dr. Mikos explains that some of the known processes for making HA were understood to result in a microporous structure, and that micropores are caused by "among other things, incomplete sintering of Ca-P granules," which leave open voids in the material. Pet. Reply 4–5 (citing Ex. 1003 ¶ 70 (citing Ex. 1010, 2 (Jarcho); Ex. 1080, 4; Ex. 1039, 9; Ex. 1011, 4; Ex. 1021, 129); Ex. 1003 ¶¶ 388–392, 631; Ex. 1134 ¶¶ 29–34, 36–41). The method disclosed in Jarcho is the method used in Ruys '93a to prepare the CaP

colloidal suspension. Ex. 1011, 3 (right column). Dr. Mikos acknowledges that "the porosity of the HA (e.g., size and quantity [of pores]) could be manipulated simply by altering the reaction conditions or adding additives to the reaction" (Ex. 1003 ¶ 71), as indicated in Jarcho, but he emphasizes that Ruys '93a's two-solution sol-gel and sintering process is "equivalent" to the two-solution sol-gel and sintering process disclosed in Examples 1 and 5 of the '251 patent. Pet. 42–43(citing Ex. 1003 ¶¶ 393–94, 623–625, 632). Dr. Mikos further reasons that because Ruys '93a indicates "reduced" or "retarded" sintering efficiency at very low levels of silicon addition, resulting in "restraining the green structure of the HAP," one of skill in the art would have understood that the silicon-substituted CaP structure was microporous. Pet. 45 (citing Ex. 1003 ¶¶ 388–391, 625, 632); Pet. Reply 4–5 (citing Ex. 1003 ¶¶ 70, 388–392, 631; Ex. 1134 ¶¶ 29–34, 36–41; Ex. 1133, 111:3–13, 114:6–116:7, 155:12–156:15; Ex. 1124, 2); Tr. 27:16–29:7 (citing Ex. 1003 ¶¶ 373–74).

Patent Owner argues that the method disclosed in Ruys '93a differs from Example 5 of the '251 patent in at least "two critical ways": by size of the HA particles and by sintering temperature. PO Resp. 12–15 (citing Ex. 2026 ¶¶ 46–52).[20] But as to particle size, both the '251 patent and Ruys '93a prepare substantially the same nanometer-sized particles in the CaP sol-gel. Pet. Reply 2–3 (citing Ex. 1001, 11:61–62 ("The underlying granular

[20] Patent Owner also argues that Ruys'93a discloses cold pressing CaP and silicon powder prior to sintering, which contributes to "a denser product with reduced porosity." PO Resp. 14; PO Obs. 2–4. The evidence is clear, however, that in spite of the asserted process differences between Ruys'93a and the '251 patent examples, Ruys'93a results in silicon-substituted CaP having a porous structure.

structure was about 5–10 nm in size."); Ex. 1011, 3 ("Finely divided (approx. 20 nm) HAP was precipitated as an aqueous suspension . . . ."); Ex. 1133, 129:20–130:2; Ex. 1134 ¶¶ 11–14); *see also* Ex. 1001, 17:43–45 ("the underlying structure of the particles is the agglomeration of granules of size range of approximately 1 to 20 nm . . . ."), and Fig. 6(b) ("note underlying particle size of 5-10nm"). Patent Owner acknowledged at the oral hearing that agglomeration of CaP particles, to achieve a preferred size range of 0.2 to 1.0 micron prior to sintering, is not a limitation of the '251 patent claim 1.[21] Tr. 59:4–61:14. Therefore, Patent Owner's attempt to distinguish Ruys '93a from claim 1 based on the Ruys '93a disclosure of an intention to prevent agglomeration, is legally irrelevant. Non-agglomerated CaP particles, such as those disclosed in Ruys '93a, can still form a "microporous structure" after sintering, in accordance with our claim construction.

With regard to sintering temperature, Example 5 of the '251 patent sinters precipitated CaP and silicon powder at 1000° C for one hour, and Ruys '93a sinters precipitated CaP and silicon powder at 1100º C for one hour. Example 2 of the '251 patent states that sintering temperatures between 800º C and 1100º C can be used to produce the claimed compound having a microporous structure on a "consistent basis." Pet. Reply 3 (citing Ex. 1001, 28:66–29:5; Ex. 1133, 135:14–18; Ex. 1134 ¶¶ 15–19). Although sintering temperature can affect, even eliminate, porosity, the evidence of record is clear that the method reported in Ruys '93a results in a porous, silicon-substituted, CaP biomaterial. Pet. Reply (citing Ex. 1003 ¶¶ 388–391, 631; Ex. 2026 ¶ 38; Ex. 1133, 59:14–18, 242:12–15); *see also* Ex.

[21] Ex. 1001, 11:52–12:11.

1133, 111:3–112:5 ("The incomplete sintering results in pores."). The sintering temperature of 1100º C disclosed in Ruys '93a also is within the temperature range described in the '251 patent as capable of achieving a silicon-substituted CaP compound having a microporous structure on a consistent basis.[22] We are not persuaded by Patent Owner's argument that the 1100º C sintering temperature disclosed in Ruys '93a forecloses the formation of silicon-substituted CaP as a "microporous structure."

Petitioner further emphasizes the opinion of Dr. Mikos, supported by multiple literature references, that the silicon-substituted CaP compound disclosed in Ruys '93a would have "necessarily" exhibited a "microporous structure." Pet. Reply 4–5 (citing Ex. 1003 ¶¶ 70, 388–392, 631; Ex. 1134 ¶¶ 29–34 (literature citations omitted)). Although Dr. Ong testified that he could not determine whether the pores formed in the Ruys '93a compound were "micropores, nanopores, macropores, or a mixture of different pore sizes" (Ex. 2026 ¶ 40), he acknowledged at his deposition that as a result of inefficient sintering he would "expect to get a range of pore sizes" and that "some of them would be nanopores." Pet. Reply 5 (citing Ex. 1133, 111:3–13, 114:6–116:7); *see also* Ex. 1133, 111:14–113:7.[23]

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[22] We note that Table II in Jarcho also discloses the formation of porous CaP after sintering at 1150º C (sample E–9) and 1200º C (sample F–67). Tr. 88:1–9 (citing Ex. 1010, 5).

[23] Petitioner argues that, at page 161 of his deposition transcript, Dr. Ong admitted the Ruys '93a method will necessarily result in a range of pore sizes that includes nanopores, micropores, and possibly macropores. Pet. Reply 6 (citing Ex. 1133, 161:2–10). Although we do not exclude this testimony from consideration as requested by Patent Owner in its Motion to Exclude Evidence (Paper 28), we have carefully weighed Dr. Ong's cited deposition testimony in the context of his entire declaration testimony,

Our claim construction of "microporous structure" includes a range of pore sizes less than about 2 microns in diameter, without a bottom limit, so as to include nanometer-sized pores. On the question of pore size, we give substantial weight to the evidence recited above: (i) the similarity of the Ruys '93a process to Examples 1 and 5 of the '251 patent, (ii) the preparation of similarly sized CaP particles in the range of 5–20 nanometers, (iii) the sintering of CaP particles in the presence of silicon at either 1000º C or 1100º C for one hour to achieve silicon substitution, (iv) the recognition in the prior art that incomplete sintering results in a microporous structure, (v) the confirmation of a porous structure from the analytical data in Figure 2 of Ruys '93a, and (vi) the expectation that incomplete sintering would result in a range of pore sizes in the Ruys '93a CaP biomaterial compound, including at least nanometer-sized pores. Upon full consideration of all the evidence bearing on this patentability challenge, we find Petitioner's assertion that Ruys '93a inherently discloses a silicon-substituted CaP compound having a "microporous structure," as recited in claim 1 of the '251 patent, is supported by a preponderance of the evidence.

For the reasons given above, we are persuaded by a preponderance of the evidence that Ruys '93a anticipates claim 1 of the '251 patent.

5. Claims 8–13

For the reasons given immediately above, we find the "nanoporous structure" of claim 8 is disclosed inherently by Ruys '93a. Pet. 51 (citing

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deposition testimony, and other evidence bearing on the issue of pore size. We note that our Decision rests on substantial evidence adduced by Petitioner in addition to Dr. Ong's testimony at page 161 of his deposition transcript.

Ex. 1003 ¶¶ 750–51). Petitioner also presents substantial evidence that Ruys '93a discloses the dependent claim limitations recited in claims 9–13. Pet. 53–54 (citing, *inter alia*, Ex. 1003 ¶¶ 781–787, 791). Patent Owner does not argue separately the patentability of claims 8, 9, and 12–13. We are persuaded by a preponderance of the evidence that claims 8, 9, and 12–13 of the '251 patent are anticipated by Ruys '93a.

Patent Owner contests Petitioner's assertion that claims 10 and 11 are anticipated and relies on the theory that the Board must read a limitation from the specification (*i.e.*, "macroporosity") into those claims because macroporosity allegedly is required for CaP biomaterials to exhibit the properties recited in the claims. PO Resp. 24–25. The '251 patent itself undercuts this assertion. First, the '251 patent states that the thin-film embodiment—which does not have a macroporous structure—is bioresorbable, bioactive, and supportive of osteoclast and osteoblast activity, including progressive replacement of bone material as recited in claims 10 and 11. Pet. Reply 8 (citing Ex. 1001, 4:9–23; Ex. 1003 ¶ 449; Ex. 1134 ¶ 70). Second, the assertion that bone remodeling can be achieved only with macroporous material is contradicted by Patent Owner's '992 patent (Ex. 1006), which claims "thin film" material (claims 9 and 18) as a species of the "biomaterial compound" that supports "osteoclast activity," "osteoblast activity," and "progressive removal and replacement" of bone material "inherent in the natural bone remodeling process." *Id.* at 8–9 (citing Ex. 1006, 33:59–34:29, 35:38–41, 36:9–12). Finally, Dr. Ong and Dr. Mikos both testified that macroporosity was not necessary for bioactivity and bioresorption. *Id.* at 9 (citing Ex. 1133, 282:2–14, 284:11–14; Ex. 1003 ¶ 74; Ex. 1134 ¶¶ 68–72).

For the reasons given above, we are persuaded by a preponderance of the evidence that Ruys '93a inherently anticipates claims 10 and 11 of the '251 patent.

E. Obviousness of Claim 6 over Ruys '93a and Bioceramics

1. Claim 6

Claim 6 of the '251 patent depends from claim 1 and requires the compound to be "formed as a macroporous structure," with an "open cell construction" and "interconnected voids having a pore size of approximately 50 to 1000 microns." Ex. 1001, 33:59–63. The '251 patent describes using a silicon-substituted, microporous, calcium phosphate material to form a "bulk ceramic having a globular microporous structure, an underlying internal microporous structure and an internal macroporous structure allowing cells to migrate and function throughout the entire bulk ceramic unit." *Id*. at 27:16–21. The open cell structure of interconnected macropores, best illustrated in Figure 23, "encourages bone growth and subsequent remodeling in a system more closely resembling physiological [in] vivo bone." *Id*. at 27:5–8, Fig. 23. Example 8 describes the use of sintered, microporous, silicon-substituted calcium phosphate powder to form a slurry in which a piece of open cell (reticulated) polyurethane foam is immersed. *Id*. at 30:53–62. The slurry-coated foam is dried and sintered at 1000ºC for one hour, during which time the foam decomposes and is removed by pyrolysis, leaving a silicon-substituted calcium phosphate product that replicates the shape and open-cell structure of the foam as a macroporous structure. *Id*. at 30:62–67.

2. Analysis

Petitioner acknowledges Ruys '93a does not teach the formation of a macroporous, open-cell structure, but Petitioner argues that formation of such a structure using Ruys '93a's silicon-substituted CaP material would have been an "obvious design choice" for one skilled in the art in view of the Bioceramics reference. Pet. 45 (citing Ex. 1003 ¶ 683). Petitioner, relying on the Declaration of Dr. Mikos, asserts that methods of making a biomaterial compound having a macroporous structure were conventional and well known. *Id*. at 48 (citing Ex. 1003 ¶¶ 147–164, 690); Tr. 34:14–20. Petitioner notes that Bioceramics was not considered during examination of the application resulting in the '251 patent. *Id.* at 46 (citing Ex. 1003 ¶ 523). Petitioner emphasizes the Bioceramics disclosure that "[a]n ideal cancellous bone graft substitute would mimic osteon-evacuated cancellous bone and have a thin lattice interconnected by pores of 500–600 μm" (Ex. 1021, 110) and that "[p]orosity and interconnectivity are key determinants of amount and type of ingrowth" of CaP bone implant material (*id*. at 116–17). Pet. 46–47 (citing Ex. 1003 ¶¶ 155, 528–530, 685–87). Petitioner asserts that one of ordinary skill in the art would have been motivated by the teachings of Bioceramics to form the silicon-substituted CaP compound disclosed in Ruys '93a into a macroporous open cell structure with interconnected voids having pore sizes within the claimed range of 50 to 1000 microns. *Id*. at 47–48 (citing Ex. 1003 ¶¶ 689–90).

Patent Owner argues that, even though techniques for forming CaP compounds into a macroporous structure were well known prior to the '251 patent's August 1996 priority date, there was no prior publication of forming elementally-substituted CaP compounds into a macroporous structure. PO

Resp. 36–37. Patent Owner further argues Petitioner has failed to prove one of ordinary skill in the art would have had a reasonable expectation of success in forming the silicon-substituted CaP powder disclosed in Ruys '93a into the macroporous structure recited in claim 6. *Id.* at 37–39. Patent Owner further relies on asserted secondary considerations in support of Patent Owner's argument for the nonobviousness of claim 6. *Id.* at 27–36, 40–54.

Dr. Ong agreed with Dr. Mikos that interconnected macroporosity was known to be "critical" to vascularization, bone cell differentiation, and bone implantation, as stated in the 1993 Bioceramics textbook. Pet. Reply 9 (citing Ex. 1133, 159:16–160:3). Figure 4 in chapter 10 of Bioceramics illustrates an "[i]dealized microstructure for cancellous bone regeneration" having "a thin lattice interconnected by pores of 500–600 [microns]" in diameter. *Id.*; Ex. 1021, 110–111. Bioceramics, therefore, expressly discloses the claim 6 recitation of a "macroporous structure" of "interconnected voids having a pore size of approximately 50 to 1000 microns," and Bioceramics provides sound physiological reasons for forming a CaP biomaterial compound into a macroporous structure.

Dr. Ong further agreed that Bioceramics teaches well-known methods for preparing open-cell macroporous structures from CaP biomaterials and that the '251 patent, Example 8, describes similar well-known techniques. Pet. Reply 9–10 (citing Ex. 1133, 226:7–233:18). Dr. Karin Hing, a research scientist for ApaTech and currently Senior Lecturer in Biomaterials at Queen Mary University of London, provides unrebutted testimony that "[t]he desirability of incorporating interconnected macropores in calcium phosphate bone graft substitute materials was well known in the 1990's."

Ex. 1136 ¶ 8. Dr. Hing's further opinion, that "the benefits of interconnected macroporosity and prior methods for incorporating macroporosity were known well before the filing of [the '251] patent" (*id.* ¶ 23), is supported by extensive corroborative evidence. *Id.* ¶¶ 9–20.

3. Secondary considerations

Patent Owner argues that objective indicia, including long-felt but unmet need, the failure of Petitioner to arrive at the claimed invention until many years later, the length of intervening time between the prior art and the claimed invention, unexpected results, wide acclaim in the industry, and commercial success (PO Resp. 40–54), "contravenes and eliminates any hindsight argument that the claimed invention of claim 6 was obvious." PO Resp. 8. In support, Patent Owner relies on, *inter alia*, the Declaration of Dr. Ong.

Patent Owner cites evidence of the success of Patent Owner's bone graft material, sold under the trade name Skelite, and Petitioner's bone graft material, sold under the trade name Actifuse, in support of Patent Owner's argument. *Id.* at 42–45. Patent Owner states that Skelite is a "calcium-phosphate bone material that contains silicon substitution" and "result[s] in resorption by osteoclasts and deposition of new bone by osteoblasts according to the natural course of bone remodeling, on the basis of its interconnected micro-and macroporosity." *Id.* at 43 (citing Ex. 1001, 23:13–18; Ex. 2030, 2; Ex. 2026 ¶ 83). Patent Owner states that Actifuse is a "silicon substituted calcium-phosphate bone material having properties that . . . result in resorption by osteoclasts and deposition of new bone by osteoblasts according to the natural course of bone remodeling on the basis

of its interconnected micro-and macroporosity." *Id*. at 44 (citing Ex. 2026 ¶ 85; Ex. 2032, 1).

It is not sufficient, however, for Patent Owner to establish that a product is within the scope of a claim. Patent Owner must establish a causal relationship, a "nexus," between the asserted secondary consideration (e.g., long-felt need or commercial success of a product) and the unique characteristics of the claimed invention. *Merck & Co., Inc. v. Teva Pharm. USA, Inc.*, 395 F.3d 1364, 1376 (Fed. Cir. 2005). Objective evidence of non-obviousness must be tied to the novel elements of the claim at issue, otherwise the evidence will not suffice to establish the required nexus to the claimed invention. *In re Kao*, 639 F.3d 1057, 1068 (Fed. Cir. 2011).

a. Long-Felt but Unmet Need

Patent Owner contends that the claimed invention met a long-felt but unsolved need. PO Resp. 45. Patent Owner contends that, prior to the '251 patent priority date, only autologous bone could provide biocompatibility and bioresorption to match that of natural bone rebuilding, but autologous bone had the disadvantage of requiring at least two surgical interventions (one to harvest and one to implant). *Id*. at 45–46 (citing Ex. 2026 ¶¶ 86–87; Ex. 2034, 1)). Patent Owner further argues that Petitioner has acknowledged the long-felt need and prior failure of others. *Id*. at 46 (citing Ex. 2001, 2).

Patent Owner does not explain how a nexus exists between the asserted long-felt need for a synthetic bone graft material to replace autologous bone and the features of claim 6. In particular, Patent Owner does not tie the effectiveness of Skelite and/or Actifuse to any asserted novelty of the claimed macroporous structure. For example, Dr. Ong admitted he did not perform a comparative analysis of Actifuse or Skelite

with autologous bone grafts or other macroporous HA bone replacement biomaterials that were available on the market or reported in the prior art. Pet. Reply 13 (citing Ex. 1133, 248:22–250:17, 253:7–258:21; Ex. 2031, 5; Ex. 2026 ¶ 83). Consequently, we are not persuaded by Patent Owner's contentions in relation to long-felt but unmet need.

b. Failure of ApaTech to arrive at the invention until many years later

Patent Owner argues that Petitioner ApaTech's "prolonged path to discovery" regarding Actifuse reflects the non-obviousness of claim 6. PO Resp. 46; *see also id.* at 27–33 (discussing ApaTech's "development history" of silicon-substituted CaP formed into a macroporous structure). Patent Owner asserts it was not until October 1998 – more than two years after the '251 patent's August 1996 priority date – that Petitioner's team filed a patent application directed to a process of forming CaP biomaterials into a macroporous structure. *Id.* at 46–47 (citing Ex. 2024, 2:61, 5:10; 2035, 3). Patent Owner argues that Petitioner's own actions during the relevant time period undermine Petitioner's current assertion that claim 6 would have been obvious over Ruys '93a and Bioceramics. *Id.* at 47.

To the extent Patent Owner relies on the Declaration of Dr. Ong to establish ApaTech's development timeline, Dr. Ong admitted he did not know when the ApaTech researchers first formed the idea of "introducing macroporosity into their calcium phosphate material." Pet. Reply 12 (citing Ex. 1133, 213:10–14). Dr. Ong also admitted the ApaTech patent (Ex. 2024) on which he relied in his Declaration (i) recognizes that the concept of interconnected macropores was known, and (ii) is directed to a process for making a "specific macroporous structure." Pet. Reply 12 (citing Ex. 1133, 217:14–218:2, 219:7–11). As noted earlier, Dr. Hing testified that the

benefits of interconnected macroporosity and methods for incorporating macroporosity were known well before the August 1996 priority filing date of the '251 patent. Ex. 1136 ¶¶ 8–20. Dr. Hing further testified that the ApaTech patent referenced in Dr. Ong's Declaration (Ex. 2024) is directed to a foamed ceramic technique intended to be "used commercially, for reproducibly introducing macroporosity into any bioceramic material." *Id.* ¶¶ 21–22. In short, Patent Owner conflates Petitioner's efforts to develop a particular technique for reliably forming a CaP biomaterial into a macroporous structure, with the more general claim 6 limitation of a compound "formed as a macroporous structure." Therefore, the evidence of record does not support Patent Owner's argument that Petitioner's asserted failure to arrive at its bone replacement product was due to the non-obviousness of forming a microporous CaP biomaterial into a macroporous structure.

c. Unexpected results, industry acclaim, and commercial success

Patent Owner contends that the claimed silicon-substituted microporous CaP compound formed into a macroporous structure "was, very surprisingly, able to greatly exceed the performance of porous HAP as evidenced by studies conducted using both Skelite and Actifuse, and according to studies conducted on Actifuse, was able to meet or exceed the performance of the gold-standard autologous bone." PO Resp. 47–48 (citing Ex. 2026 ¶ 88). For example, Patent Owner contends that the osteoclast resorption rate of Skelite greatly exceeded that of HA. *Id*. at 48 (citing Ex. 2036, 1; Ex. 2026 ¶ 90). Patent Owner further contends that Actifuse "was biomechanically, radiographically, and histologically equivalent to autograft in the ovine model." *Id*. (citing Ex. 2034, 308–09; Ex.2035, 5–6; Ex. 2026 ¶

88). Patent Owner also contends that Actifuse "promote[d] rapid bone formation and an elevated volume of bone ingrowth compared with traditional calcium phosphates of similar structure." *Id*. at 48–49 (citing Ex. 2037, 3–4; Ex. 2026 ¶ 89).

Patent Owner fails to explain how the asserted unexpected results are attributable to the features recited in claim 6. More particularly, Patent Owner does not provide comparative tests or analysis of the claimed invention relative to prior art silicon-substituted CaP biomaterials, such as those disclosed in Ruys '93a, to establish that formation of the silicon-substituted biomaterial into a macroporous structure is the reason for the asserted unexpected results. Petitioner contends that Patent Owner could have compared Skelite or Actifuse "to numerous bone substitute products on the market in the mid-1990s, such as Endobon and Pro Osteon" as opposed to the "autologous bone and generic hydroxyapatite material [Patent Owner] does compare." Pet. Reply 13 (citing Ex. 1133, 248:22–250:17, 253:7–258:1; Ex. 2031, 5; Ex. 2026 ¶ 83). Having considered the evidence presented, we are not persuaded that Patent Owner has shown a sufficient nexus between the asserted unexpected results of Skelite or Actifuse and any novel aspect of forming those silicon-substituted CaP biomaterials into a macroporous structure.

We reach the same conclusion with respect to Patent Owner's assertions of industry acclaim and commercial success. The evidence cited by Patent Owner suggests the benefits from Skelite and Actifuse are attributable to silicon substitution, previously disclosed in Ruys '93a, and the use of the claimed macroporous "scaffolds" to promote bone growth. PO Resp. 50–51 (citing Ex. 2039, 3 ("we have uncovered the role of trace

elements that are found in normal bone . . . [and] if you incorporate these elements in synthetic bone graft scaffolds, you actually get a unique biological effect")); Ex. 2040, 4 ("[T]he company has successfully received FDA approval for clinical use of Skelite™ scaffolds."); 2041;[24] Ex. 2043, 1–2; Ex. 2044.[25] The cited evidence, however, must be read in the context of the Bioceramics disclosure of an idealized cancellous bone graft substitute having an interconnected macroporous structure (Ex. 1021, 110–11) and Dr. Hing's unrebutted testimony regarding the known benefits of interconnected macroporosity and prior art methods for incorporating macroporosity (Ex. 1136 ¶¶ 9–20), which was confirmed by Dr. Ong (Ex. 1133, 226:7–233:18). On balance, we are not persuaded that Patent Owner's industry acclaim evidence is sufficient to outweigh Petitioner's strong evidence of the obviousness of claim 6.

Patent Owner argues that in 2009, after only four years on the market, annual sales of Actifuse were $90 million, and in March 2010, Baxter

[24] "Current products range from powders and granules, which are designed to fill small, irregular bone voids at common fracture sites, to large porous synthetic scaffolds that can repair problems such as badly damaged limbs or collapsing spines . . . . Because it can be manufactured at low cost in various function-specific configurations, Skelite satisfies critical needs in a variety of medical and biotechnology applications." Ex. 2041, 7.

[25] "ApaTech has introduced a novel silicate substituted calcium phosphate bone graft material, Actifuse™ globally. The company believes that Actifuse is the first of a new class of synthetic bone graft material that combines osseo-conductive and osseo-stimulatory activities. Actifuse has been shown to accelerate the rate and quality of bone formation and is available as a range of granule and microgranule formulations . . . combining the biological benefits of Actifuse scaffold with placement and mouldability benefits." Ex. 2044, 1.

International acquired ApaTech for $330 million specifically to acquire Actifuse. PO Resp. 53 (citing Ex. 2049, 1; Ex. 2001, 6). Gross sales figures, in the absence of evidence as to market share or what sales would normally be expected in the market, do not support an inference that the sales represent a substantial share of any definable market. *Cable Elec. Prod., Inc. v. Genmark, Inc.*, 770 F.2d 1015, 1027 (Fed. Cir. 1985) (reversed on other grounds); *see also* Pet. Reply 14 (stating that "because the sales figures for Actifuse fail to provide any analysis of relative market share, they are fatally defective") (citing *In re Applied Materials, Inc.*, 692 F.3d 1289, 1300 (Fed. Cir. 2012)). Based on the record before us, we find Patent Owner's evidence of nexus in relation to commercial success to be tenuous, and we do not accord the cited evidence of commercial success significant weight.

4. Conclusion

In sum, the evidence establishes that one of ordinary skill in the art of bone implant materials, prior to the '251 patent priority date, would have had sound reasons to form the silicon-substituted CaP compound of Ruys'93a into a "macroporous structure" having "an open cell construction with interconnected voids having a pore size of approximately 50 to 1000 microns," with every expectation of success.

Ruys '93a, moreover, does not teach away from forming a silicon-substituted CaP compound into a macroporous structure of interconnected voids, as asserted by Patent Owner. PO Resp. 33–35. It is true that Ruys '93a does not acknowledge or address macroporosity, and Ruys '93a does focus on the potential biological impact of silicon doping rather than "porosity control." *Id.* (citing Ex. 1011, 3; Ex. 2026 ¶¶ 77–79). By the

same token, Ruys '93a concludes that the reported silicon doping experiments "have established the suitability of silicon-doped HAP for clinical trials," a clear indication of the potential use of silicon-doped CaP compounds for the types of well-known biomaterial applications disclosed in Bioceramics. Pet. Reply 10–11 (citing, *inter alia*, Ex. 1134 ¶¶ 78–85).

Therefore, we conclude that Petitioner has established the obviousness of claim 6 over the combination of Ruys '93a and Bioceramics by a preponderance of the evidence.

F. Motions to Exclude Evidence

The party moving to exclude evidence bears the burden of proof to establish that it is entitled to the relief requested, namely that the material sought to be excluded is inadmissible under the Federal Rules of Evidence. *See* 37 C.F.R. §§ 42.20(c), 42.62(a).

Petitioner seeks to exclude Exhibits 2003 and 2039–2041, on which Patent Owner relies in support of asserted secondary considerations of nonobviousness of claim 6. Pet. Mot. Excl. Petitioner objects to the timeline of Exhibit 2003 for lack of authentication and foundation. *Id.* at 2–3. Exhibit 2003 is a demonstrative timeline of ApaTech patent filings from 1996 to 2008. Petitioner objects to Exhibits 2039–2041 for lack of authentication and hearsay, because each exhibit is a website printout regarding Patent Owner's Skelite product. *Id.* at 4–5. We need not reach the merits of Petitioner's Motion to Exclude, because even upon full consideration of this evidence, we determine that Petitioner has shown the obviousness of claim 6 by a preponderance of the evidence. Accordingly, Petitioner's motion to exclude is *dismissed as moot*.

Patent Owner seeks to exclude paragraphs 20, 23–27, 35, 96–102, and 125 of Exhibit 1134 (reply testimony of Dr. Mikos) under Fed. R. Evid. 401, 402, and/or 403. PO Mot. Excl., 1–5. Patent Owner further seeks to exclude paragraphs 28, 35, 108–140 of Exhibit 1134 under Fed. R. Evid. 702 and paragraphs 21, 62–67 under 37 C.F.R. § 42.23. *Id.* at 5–10. We do not rely on any of the identified paragraphs in Exhibit 1134 as evidence in support of our Decision. Therefore, sections I–III of Patent Owner's motion to exclude are *dismissed as moot*.

In section IV of its motion, Patent Owner seeks to exclude certain deposition testimony of Dr. Ong and related reply testimony of Dr. Mikos, bearing on the issue of whether Ruys '93a inherently discloses a "microporous structure." *Id.* at 10–14. The particular testimony in question appears at page 161 of Dr. Ong's deposition transcript (Ex. 1133) and is referenced in paragraphs 41, 46, and 48 of the Reply Declaration of Dr. Mikos (Ex. 1134). *Id.* at 10. Patent Owner argues the asserted admission of inherency is not consistent with Dr. Ong's earlier deposition testimony, is the result of opposing counsel harassing the witness, and amounts to cumulative testimony. As indicated previously, we do not rely on the identified testimony of Dr. Ong as an admission that Ruys '93a "necessarily" discloses a microporous structure. Having been alerted to the dispute by Patent Owner, through its motion and again during the oral hearing, we have taken great care to weigh all of Dr. Ong's testimony on the issue in context and in view of the additional evidence adduced by both parties in this dispute. Therefore, we are not persuaded of any undue prejudice, confusion, or misleading result derived from our consideration of the testimony. We do not find reason to exclude the testimony in question.

For the reasons given above, section IV of Patent Owner's motion to exclude is *denied*.

G. Motion for Observation

Patent Owner's observations are directed to the cross-examination testimony of Dr. Mikos (Ex. 2055), who was deposed after Petitioner filed its Reply. We have considered Patent Owner's observations, and Petitioner's response, regarding the dispute over whether Ruys '93a discloses a "microporous structure" (PO Obs. 1–3), ApaTech's development history (*id.* at 4), and the assertion of "misleading" positions by Petitioner and Dr. Mikos (*id.* at 4–5). We have accorded the testimony the appropriate weight, but Patent Owner's observations do not change our findings or conclusions.

III. CONCLUSION

We determine Petitioner has established by a preponderance of the evidence that claims 1 and 8–13 of the '251 patent are unpatentable as anticipated by Ruys '93a under 35 U.S.C. § 102(b). We also determine Petitioner has established by a preponderance of the evidence that claim 6 is unpatentable as obvious over Ruys'93a and Bioceramics under 35 U.S.C. § 103(a).

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1, 6, and 8–13 of the '251 patent have been shown by a preponderance of the evidence to be unpatentable;

FURTHER ORDERED that Petitioner's Motion to Exclude is *dismissed as moot*; and

FURTHER ORDERED that sections I–III of Patent Owner's Motion to Exclude are *dismissed as moot*; and

FURTHER ORDERED that section IV of Patent Owner's Motion to Exclude is *denied*.

This is a final written decision. Parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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