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Carestream Health, Inc.
ATTN: Patent Legal Staff
150 Verona Street
Rochester, NY 14608

| EXAMINER |
|---|
| LEE, REBECCA Y |

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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*Ex parte* DAVID R. WHITCOMB, WILLIAM D. RAMSDEN, and DOREEN C. LYNCH[1]

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Appeal 2015-000959
Application 14/013,135
Technology Center 1700

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Before CHUNG K. PAK, JENNIFER R. GUPTA, and LILAN REN, *Administrative Patent Judges*.

REN, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants timely appeal under 35 U.S.C. § 134(a) from a rejection[2] of claims 1–9. (App. Br. 2.)[3] We have jurisdiction. 35 U.S.C. § 6(b).

We affirm-in-part.

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[1] The real party in interest is identified as Carestream Health, Inc. (Appeal Brief, filed May 21, 2014 ("App. Br."), 1.)
[2] Final Office Action mailed January 29, 2014 ("Final Office Action," cited as "Final Act.").
[3] No Reply Brief has been filed.

OPINION

A. Introduction[4]

The subject matter on appeal relates to using "a mixture of metals or metal ions" to "control the aspect ratios of silver nanowires" made from compounds such as silver nitrates. (Spec. 4, ll. 16–18.) According to the '135 Specification, "[n]anowires made in the presence of such as mixture of metals or metal ions may be thicker than other nanowires and may be useful in devices requiring high electrical current densities." (*Id.* at 4, ll. 18–20.)

Representative claim 1 recites:

> 1. A method of producing metal nanowires with reduced nanoparticle coproduction comprising:
> providing a composition comprising:
> a first molar quantity of at least one first reducible metal ion,
> a second molar quantity of at least one second metal or metal ion, said at least one second metal or metal ion comprising germanium or an ion of germanium, and
> a third molar quantity of at least one third metal or metal ion, said at least one third metal or metal ion comprising tin or an ion of tin; and
> reducing the at least one first reducible metal ion to at least one first metal nanowire,
> wherein the ratio of (1) the sum of the second molar quantity and the third molar quantity to (2) the first molar quantity is from about 0.0001 to about 0.1.

(Claims Appendix, App. Br. 18.)

The Examiner maintains the following grounds of rejection:[5]

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[4] Application 14/013,135, *Nanowire Preparation Methods, Compositions, and Particles*, filed August 23, 2013. We refer to the "'135 Specification," which we cite as "Spec."

[5] Examiner's Answer mailed July 11, 2014 ("Ans.").

A: Claims 1–8 stand rejected under 35 U.S.C. § 103(a) in view of Wang,[6] Agrawal,[7] and Brandes.[8]

B: Claim 9 stands rejected under 35 U.S.C. § 101 for statutory double patenting over claim 1 of U.S. Patent No. 8,613,888.[9]

B. Discussion

Findings of fact throughout this Opinion are supported by a preponderance of the evidence of record.

*Rejection A: Claim 1*[10]

The Examiner finds, and Appellants do not dispute, that Wang discloses a method to produce silver nanowires based on a reduction reaction of silver nitrate. (Final Act. 2 (citing various portions of Wang including examples 6–9 disclosed in Wang); App. Br. 3.) Although the Examiner acknowledges that Wang does not disclose a second molar quantity of a second metal or metal ion comprising germanium or an ion of germanium and a third molar quantity of at least one third metal or metal ion comprising

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[6] Yuliang Wang & Janet Cravens Dickerson, *Methods for the Production of Silver Nanowires*, U.S. Patent Application Publication No. 2009/0196788 A1, published August 6, 2009 ("Wang").

[7] Anoop Agrawal & John P. Cronin, *Metal Coatings, Conductive Nanoparticles and Applications of the Same*, U.S. Patent Application Publication No. 2010/0002282 A1, published January 7, 2010 ("Agrawal").

[8] Mariola Brandes et al., *Method for Electroless Metal Plating*, U.S. Patent Application Publication No. 2004/0086646 A1, published May 6, 2004 ("Brandes").

[9] David R. Whitcomb et al., *Nanowire Preparation Methods, Compositions, and Articles*, U.S. Patent No. 8,613,888 B2, issued December 24, 2013 ("'888 Patent").

[10] Claims 2–8 stand or fall with claim 1. (App. Br. 2.)

tin or anion of tin as recited in claim 1, the Examiner finds, and Appellants do not dispute, that Agrawal teaches using "[s]tarting chlorides" such as "$GeCl_2$" to "form [] nanowires" which may include "alloys of silver." (Final Act. 2 (citing Agrawal ¶ 30); App. Br. 4.) Appellants also do not dispute the Examiner's finding that Brandes discloses preparing a "solution of colloidal silver . . . by mixing a solution containing silver ions and a solution containing stannous (Sn(II)) ions" to reduce the "silver compound." (Brandes ¶ 33; *see* Final Act. 3; App. Br. 2–7.) Based on the combined teachings of all references (namely, Wang, Agrawal, and Brandes) including their disclosures of the concentration of each reactant which may affect the efficiency and other attributes of the reduction reaction, the Examiner finds that a skilled artisan would have had the routine skill to discover an optimum value of the recited molar quantities. (Final Act. 3–4.)

Appellants argue that the Examiner reversibly erred in establishing a prima facie case of obviousness because Agrawal is "directed to producing silver alloy nanowires" whereas Wang is directed to producing silver nanowires. (App. Br. 4.) According to Appellants, "because silver alloy nanowires are not silver nanowires" and the "silver-germanium alloy nanowires of the Examiner's proposed process would . . . have lower conductivity than silver metal," Wang and Agrawal are not combinable as the combined product would be unsatisfactory to the intended purpose of producing silver nanowires. (*Id.* at 5 (citing Declaration I ¶ 32).)[11]

Contrary to Appellants' argument, Agrawal in fact discloses that "[c]onductive nanofibers made out of silver have been suggested for use as

[11] Declaration of Dr. David R. Whitcomb submitted January 14, 2013 ("Declaration I").

transparent conductors and electrical connectors." (Agrawal ¶ 18.) Example 7 in Agrawal discloses the preparation of a "silver nanowire." (*Id.* ¶ 35.) Agrawal discloses certain enhancements to the conductive silver nanowire including increased corrosion resistance. (*Id.* ¶¶ 17, 18.) To improve such conductive silver nanowire, Agrawal exemplifies adding Pd and Ni and starting chlorides, such as $GeCl_2$, to form silver alloy nanowires having increased corrosion resistance and hardness. (*Id.* ¶¶ 17, 18, 30, 35.) On this record, Appellants do not point us to evidence showing that the mechanical improvement resulting from adding $GeCl_2$ results in said "lower conductivity" unsatisfactory for Wang's intended purpose.

All of the features of the secondary reference need not be bodily incorporated into the primary reference and the skilled artisan is not compelled to blindly follow the teaching of one prior art reference over the other without the exercise of independent judgment. *See Lear Siegler, Inc. v. Aeroquip Corp.*, 733 F.2d 881, 889 (Fed. Cir. 1984). Because Wang and Agrawal both teach ways to make silver nanowires and/or to improve the mechanical properties of silver nanowires (and Appellants do not address the teachings of Brandes), Appellants have not shown reversible error in the Examiner's prima facie case of obviousness. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007) ("[T]he analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.").

The declaration by co-inventor Dr. Whitcomb states: "If the rejection is literally correct in saying that it would have been obvious to make silver nanowires with improved hardness, as taught by Agrawal et al. (section

0030), it is my reasoned opinion that there would be no reasonable chance of success, because Agrawal et al. (section 0030) does not teach methods of hardening silver nanowires." (Declaration I ¶ 30 (emphases omitted).) Dr. Whitcomb, however, does not present factual evidence (e.g., data, scientific reasoning, etc.) to show that it is beyond a skilled artisan's skill to apply the combined teachings of Wang, Agrawal, and Brandes to arrive at the method recited in claim 1. *See KSR* 550 U.S. at 417 ("[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 unless its actual application is beyond his or her skill."); *see also In re Buchner*, 929 F.2d 660, 661 (Fed. Cir. 1991) ("[A]n expert's opinion on the ultimate legal issue must be supported by something more than a conclusory statement."). Nor does Dr. Whitcomb take into account Agrawal's purpose of improving conductive silver nanowires as indicated *supra*.

Dr. Whitcomb's conclusion that "modifying the method of Wang et al. to produce silver-germanium nanowires instead of silver nanowires would result in lowered conductivity of the nanowires" and thus "not [] suitable for the intended use of the silver nanowires of Wang et al." does not specify, or cite to evidence in the record, the "intended use" of Wang. (*See* Declaration I ¶¶ 33, 34.)[12] Without explaining what the "intended use" of Wang might be and without explaining why Agarwal's disclosure regarding enhancement of "[c]onductive nanofibers made out of silver [which] have been suggested for use as transparent conductors and electrical connectors"

[12] There are two paragraphs 33 as well as two paragraphs 34 in Declaration I.

(Agrawal ¶ 18) would be inapplicable to Wang's method of producing silver nanowires, no reversible error has been shown in the Examiner's prima facie case of obviousness. *See Velander v. Garner*, 348 F.3d 1359, 1371 (Fed. Cir. 2003) ("In giving more weight to prior publications than to subsequent conclusory statements by experts, the Board acted well within [its] discretion."); *see also In re Am. Acad. of Sci. Tech. Ctr.*, 367 F.3d 1359, 1368 (Fed. Cir. 2004) ("[T]he Board is entitled to weigh the declarations and conclude that the lack of factual corroboration warrants discounting the opinions expressed in the declarations.") (citations omitted).

We are also not persuaded because Appellants' arguments and the statements in Declaration I are directed to limitations not recited in claim 1. (App. Br. 7–8.) Claim 1, an open-ended claim for the production of "metal nanowires," is not limited to silver nanowires and does not exclude silver alloy nanowires. The recited "metal nanowires" are produced by "reducing the at least one first reducible metal ion" which does not exclude silver alloys. The '135 Specification in fact provides that the recited "first reducible metal ion comprises at least one of: at least one coinage metal ion, at least one ion of an element from IUPAC Group 11, or at least one ion of silver." (Spec. 2, ll. 20–23.) Claim 1 also does not recite properties of the metal nanowire such as conductivity or others that would exclude the metal nanowire suggested by the applied prior art. Appellants' "arguments fail from the outset because . . . they are not based on limitations appearing in the claims." *See In re Self*, 671 F.2d 1344, 1348 (CCPA 1982).

We are not persuaded that there lacks motivation to combine Wang and Agrawal as asserted by Appellants at App. Br. 6. Wang discloses a method to produce silver nanowires based on a reduction reaction of silver

nitrate. (Wang ¶¶ 272–339.) Agrawal discloses that "[c]onductive nanofibers made out of silver have also been suggested for use as transparent conductors and electrical connectors" and that "[c]oating with gold, and alloying with other elements have been suggested to reduce corrosion." (Agrawal ¶ 18.) Other than repeating the argument that Agrawal does not teach "methods for making silver nanowires," Appellants do not show reversible error in the Examiner's findings or articulated reasoning. For example, Appellants do not refute the Examiner's finding that the silver nanowires taught in Wang does not exclude silver alloy nanowires. (*See* App. Br. 6; Ans. 5.) Appellants do not refute the Examiner's finding that Agrawal teaches using $GeCl_2$ to "alter the physical, mechanical and chemical properties of the nanowires." (Agarwal ¶ 30; *see* App. Br. 6; *see also* Ans. 5.) Appellants do not refute the Examiner's reasoning that a skilled artisan would have found claim 1 obvious as it is no "more than the predictable use of prior art elements according to their established functions" based on the combined prior art teachings. *See KSR* at 417 ("If a person of ordinary skill can implement a predictable variation [of a known work], § 103 likely bars its patentability."); (App. Br. 6; *see also* Ans. 5). We are therefore not persuaded that the Examiner committed reversible error here.

Given that no reversible error has been identified in the Examiner's prima facie case of obviousness, we now turn to Appellants' unexpected results argument. "[T]he burden of showing unexpected results rests on he who asserts them." *In re Klosak*, 455 F.2d 1077, 1080 (CCPA 1972). Appellants presents declaration evidence[13] showing that "the use of a mixed

[13] Declaration of Dr. David R. Whitcomb submitted January 31, 2013 ("Declaration II").

tin-germanium catalyst system resulted in a larger yield of silver to nanowires versus nanoparticles compared to use of either of the single catalyst individually." (App. Br. 12.)

"If an applicant demonstrates that an embodiment has an unexpected result and provides an adequate basis to support the conclusion that other embodiments falling within the claim will behave in the same manner, this will generally establish that the evidence is commensurate with [the] scope of the claims." *In re Kao*, 639 F.3d 1057, 1068 (Fed. Cir. 2011) (citation omitted). "[C]ommensurate in scope" means that the evidence provides a reasonable basis for concluding that the untested embodiments encompassed by the claims would behave in the same manner as the tested embodiment(s). *See In re Lindner*, 457 F.2d 506, 508 (CCPA 1972).

In this case, Appellants and declarant Dr. Whitcomb rely on "Examples 3–5" in the '135 Specification to establish unexpected results. (App. Br. 9; Declaration II ¶¶ 10–27.) In Example 3, $GeCl_2$ alone was used to catalyze a reduction reaction of silver nitrate, and the "overall catalyst to silver mole ratio was [] 0.006." (App. Br. 10; *see* Declaration II ¶¶ 12–15.) In Example 4, $SnCl_2$ alone was used to catalyze the reduction reaction, and the "overall catalyst to silver mole ratio was [] 0.006." (App. Br. 10; *see* Declaration II ¶¶ 16–21.) In Example 5, on the other hand, both $GeCl_2$ and $SnCl_2$ were used to catalyze the reduction reaction, and the "overall catalyst to silver mole ratio was [] 0.007." (App. Br. 11.)

Although the mole ratio in Example 5 is 0.007 which differs from the ratio of 0.006 in Examples 3 and 4, Appellants consider it "essentially the same as the ratios used in Examples 3 and 4" – although Appellants do not explain why the difference of 0.001 should be overlooked particularly in

light of the range "from about 0.0001 to about 0.1" recited in claim 1. (App. Br. 11; *see* Declaration II ¶¶ 16–26.) Based on optical micrographs of the end products from these examples, Appellants assert that "the use of a mixed tin-germanium catalyst system resulted in a larger yield of silver to nanowires versus nanoparticles compared to use of either of the single catalysts individually." (App. Br. at 12 (citing Declaration II 27–28).)

To the extent that Appellants argue unexpected results based on Example 5 using a combined Ge/Sn to silver ratio of 0.007 as compared to a different ratio of 0.006 in Examples 3 and 4, Appellants have not shown that the ratio of 0.007 is applicable to the entire range of "about 0.0001 to about 0.1" ratio recited in claim 1. Appellants do not explain why a single data point of 0.007 may be applicable to show unexpected results for the entire recited range having a lower limit of "about 0.0001" and an upper limit of "about 0.1" both of which differ from 0.007 by orders of magnitude. Moreover, Appellants have not shown that these examples – all directed to the reduction of silver nitrate ($AgNO_3$) – are applicable to show unexpected results for the entire group of "first reducible metal ion" recited in claim 1 which may include "coinage metal ion," "an element from IUPAC Group 11," and "one ion of silver." (*See* Spec. 2, ll. 20–23.)

Absent evidence showing a reasonable basis for concluding that the untested embodiments encompassed by the claims would behave in the same manner as the tested embodiments, we are not persuaded that the Examiner committed reversible error in finding that the evidence is not commensurate in scope with claim 1. *See, e.g.*, *In re Harris*, 409 F.3d 1339, 1344 (Fed. Cir. 2005) ("Even assuming that the results were unexpected, Harris needed to show results covering the scope of the claimed range. Alternatively

Harris needed to narrow the claims."); *see also In re Greenfield*, 571 F.2d 1185, 1189 (CCPA 1978) ("Establishing that one (or a small number of) species gives unexpected results is inadequate proof, for 'it is the view of this court that objective evidence of non-obviousness must be commensurate in scope with the claims which the evidence is offered to support.'") (quoting *In re Tiffin*, 448 F.2d 791, 792 (CCPA 1971)).

*Rejection B: Claim 9*

Claim 9 depends from claim 1 and additionally recites "wherein the at least one first metal nanowire comprises one or more silver nanowires." The Examiner rejects claim 9 based on claim 1 of the '888 Patent for statutory double patenting under 35 U.S.C. § 101.

A comparison between claim 9 on appeal and claim 1 of the '888 Patent is provided in Table I below.

| Claim 9 on appeal | Claim 1 of the '888 Patent |
|---|---|
| 1. A method of producing metal nanowires with reduced nanoparticle coproduction comprising: | 1. A method of producing silver nanowires with reduced nanoparticle coproduction comprising: |
| providing a composition comprising: | providing a composition comprising: |
| a first molar quantity of at least one first reducible metal ion, | a first molar quantity of silver ion, |
| a second molar quantity of at least one second metal or metal ion, said at least one second metal or metal ion comprising germanium or an ion of germanium, and | a second molar quantity of at least one second metal or metal ion, said at least one second metal or metal ion comprising germanium or an ion of germanium, and |
| a third molar quantity of at least one third metal or metal ion, said at least | a third molar quantity of at least one third metal or metal ion, said at least |

| | |
|---|---|
| one third metal or metal ion comprising tin or an ion of tin; and | one third metal or metal ion comprising tin or an ion of tin; and |
| reducing the at least one first reducible metal ion to at least one first metal nanowire,<br><br>9. wherein the at least one first metal nanowire comprises one or more silver nanowires. | reducing the silver ion to silver nanowire, |
| wherein the ratio of (1) the sum of the second molar quantity and the third molar quantity to (2) the first molar quantity is from about 0.0001 to about 0.1. | wherein the ratio of (1) the sum of the second molar quantity and the third molar quantity to (2) the first molar quantity is from about 0.0001 to about 0.1. |

Table I. Comparison of claim 9 on appeal and claim 1 of the '888 patent

Section 101 prohibits two patents from issuing from the same invention. *In re Vogel*, 422 F.2d 438, 441 (CCPA 1970). The *Vogel* court held: "A good test, and probably the only objective test, for 'same invention,' is whether one of the claims could be literally infringed without literally infringing the other. If it could be, the claims do not define identically the same invention." MPEP 804 further states that "[a] reliable test for double patenting under 35 U.S.C. 101 is whether . . . there [is] an embodiment of the invention that falls within the scope of one claim, but not the other? If there is such an embodiment, then identical subject matter is not defined by both claims and statutory double patenting would not exist."

In this case, Appellants argue that claim 1 of the '888 Patent is narrower in scope than that of the open-ended claim 9 because claim 9 "may include, in addition to silver nanowires, other metal nanowires that are not

silver nanowires." (App. Br. 16.)[14] We agree and reverse the statutory type double patenting rejection of claim 9.

C. Order

It is ORDERED that the obviousness rejections of claims 1–8 are affirmed.

It is ORDERED that the statutory double patenting rejection of claim 9 is reversed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a). *See* 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED-IN-PART

[14] Appellants submit that a terminal disclaimer has been filed in this case. (App. Br. 16.)