

The opinion in support of the decision being entered today was **not** written for publication and is **not** binding precedent of the Board.

Paper No. 22

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte STEFAN UHLENBROCK

Appeal No. 2003-1162
Application No. 09/468,292

ON BRIEF

Before GARRIS, TIMM, and MOORE, *Administrative Patent Judges*.
TIMM, *Administrative Patent Judge*.

DECISION ON APPEAL

Claims 1-28 and 33-72 are currently pending in the Application. Of these, the Examiner rejects claims 1-9, 20-24, 33-39, and 44-72, whereas the other claims are indicated as allowed or allowable if written in independent form (Answer, p. 2). We have jurisdiction over the appeal pursuant to 35 U.S.C. § 134.

INTRODUCTION

Appellant's claims are directed to a method for providing volatile precursor molecules to a chemical vapor deposition (CVD) process (specification, p. 1, ll. 4-6). In the CVD process, the provided precursors are vapor phase reactants that react to form a thin film on a substrate (specification, p. 1, ll. 9-13). Solid precursors must be vaporized before delivery to the CVD chamber for reaction. One conventional method of vaporizing involves dissolving a solid precursor in a solvent and placing the solution in a bubbler device (specification, p. 3, ll. 7-9). The solution is heated in a reservoir (specification, p. 3, ll. 9-10). A carrier gas is directed over or bubbled through the solution so that the carrier gas picks up the vaporized precursor molecules and transports them to the CVD process chamber (specification, p. 3, ll. 10-13).

The main difference between Appellant's process and that of the prior art resides in the identity of the solvent: Appellant's solvent is an ionic liquid, i.e., a liquid comprising ions (specification, p. 4, ll. 18-23). According to Appellant, "an ionic liquid means a salt compound having the following characteristics: (1) a melting point of less than about 250°C, (2) substantially no measurable vapor pressure (i.e., less than about 1 Torr and preferably less than 0.01 Torr), (3) a liquid range of about at least 100°C, and, preferably about at least 200°C, and (4) functions as a solvent for a wide range of desirable CVD precursor elements and compounds." (specification, p. 13, ll. 22-28).

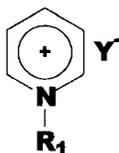
Claims 1, 2, 46, 59, and 61 are further illustrative of the method on appeal:¹

1. A method for vaporizing reactants for vapor deposition of a thin film on a substrate, comprising:

providing an ionic liquid;
dissolving a precursor in the ionic liquid; and
passing a stream of gas through the ionic liquid.

2. The method of claim 1, further comprising heating the ionic liquid to a temperature equal to about a volatilization point of the precursor.

46. The method of claim 1, wherein the ionic liquid is of the formula:



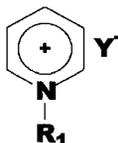
wherein R_1 is alkyl and Y^- comprises halides, sulfates, nitrates, acetates, nitrites, tetrafluoroborates, tetrachloroborates, hexafluorophosphates, $[SbF_6]^-$, chloroaluminates, bromoaluminates, chlorocuprates, heteropolyanionics, trifluoromethanesulfonates, or mixtures thereof.

59. A method for vaporizing reactants for vapor deposition of a thin film on a substrate, comprising:

providing an ionic liquid;
substantially dissolving at least one precursor in the ionic liquid; and
passing a stream of gas through the ionic liquid.

¹Emphasis added in claims 46, 59, and 61.

61. The method of claim 1, wherein the ionic liquid is of the formula:



wherein R₁ is alkyl and Y⁻ *consists essentially of* a halide, sulfate, nitrate, acetate, nitrite, tetrafluoroborate, tetrachloroborate, hexafluorophosphate, [SbF₆]⁻, chloroaluminate, bromoaluminate, chlorocuprate, heteropolyanion, trifluoromethanesulfonate, or mixture thereof.

The Examiner maintains rejections under 35 U.S.C. § 112, ¶¶ 1 and 2, as well as under 35 U.S.C. § 103(a). As evidence of obviousness, the Examiner relies upon the following prior art references:

Frigo et al. (Frigo) 5,232,869 Aug. 3, 1993

Hartmann et al. (Hartmann) 6,019,840 Feb. 1, 2000
(filed Jun. 27, 1997)

Biefeld et al. (Biefeld) 6,071,109 Jun. 6, 2000
(filed Feb. 24, 1999)

Michael Freemantle, *Designer Solvents*, C&EN, Mar. 30, 1998, at 32-37 (Freemantle).

The Examiner also relies upon Appellant's Admitted Prior Art, specification, p. 3, ll. 7-10 (AAPA).

A number of rejections were withdrawn after the filing of the appeal (Answer, pp. 3-4), but the Appellant and Examiner have wisely retained the numbering of the issues presented in the Brief and Amended Brief.² We will do likewise and we further break down some of the issues into subparts according to Appellant's grouping of the claims. The rejections according to our breakdown are as follows:

Issue (1): Claims 1, 3-9, 23, 24, 46-49, 57, 59-64 and 72 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Frigo in view of Freemantle.

We break this issue into two parts in accordance with Appellant's grouping of the claims (Amended Brief, p. 4):

Issue (1a): Claims 1, 3-9, 23, 24, 46-49, 57, 61-64, and 72

Issue (1b): Claims 59 and 60

Issue (2): Claims 2, 20-22, 33, and 58 stand rejected under 35 U.S.C. § 103(a) over Frigo and Freemantle and further in view of AAPA. For this issue, the claims stand or fall together (Amended Brief, p. 4).

Issue (6) Claims 34-36, 38, 39, 44, and 45 stand rejected under 35 U.S.C. § 103(a) over Frigo and Freemantle and further in view of Biefeld or Hartmann. For this issue, the claims stand or fall together (Amended Brief, p. 5).

²The Amended Brief replaces the originally filed Brief and we, therefore, address the issues as presented in the Amended Brief and the Reply Brief.

- Issue (7) Claim 37 stands rejected under 35 U.S.C. § 103(a) over Frigo, Freemantle and Biefeld or Hartmann and further in view of AAPA.
- Issue (11) Claims 46-57 stand rejected under 35 U.S.C. § 112, ¶ 1 as lacking compliance with the written description requirement. For this issue, the claims stand or fall together (Amended Brief, p. 5).
- Issue (12) Claims 59 and 60 stand rejected under 35 U.S.C. § 112, ¶ 1 as lacking compliance with the written description requirement. For this issue, the claims stand or fall together (Amended Brief, p. 5).
- Issue (13) Claims 59-72 stand rejected under 35 U.S.C. § 112, ¶ 2 as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. We break this issue into two groups in accordance with Appellant's grouping of the claims (Amended Brief, p. 5):
- Issue (13a): Claims 59 and 60
- Issue (13b): Claims 61-72

With respect to Issues (1a), (1b), (2), (6), (7), (12), (13a) and (13b), we affirm substantially for the reasons presented by the Examiner. We reverse with respect to Issue (11). Our reasons follow.

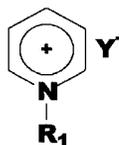
OPINION

We take up the issues of indefiniteness first. To comply with § 112, ¶ 2, the claims must “particularly point[] out and distinctly claim[] the subject matter the applicant regards as his invention.” 35 U.S.C. § 112, ¶ 2 (2001). The standard is one of reasonableness: The claims must set out and circumscribe a particular area with a reasonable degree of precision and particularity. *In re Moore*, 439 F.2d 1232, 1235, 169 USPQ 236, 238 (CCPA 1971).

Issue (13b)

We start with Issue (13b), i.e., the rejection of claims 61-72 under 35 U.S.C. § 112, ¶ 2. For this rejection, the claims stand or fall together (Amended Brief, p. 5). We select claim 61 to represent the issues on appeal.

Claim 61 is dependent on claim 1 and further limits the identity of the ionic liquid used in the method for vaporizing reactants. The ionic liquid must be of the formula:



wherein Y⁻ consists essentially of a halide, sulfate, nitrate, ... or mixtures thereof.

Claim 61 defines a genus or subgenus by enumeration of species. Such a definition of a genus or subgenus has long been accepted in patent claims. *See Ex parte Markush*, 1925 CD 126 (Com. Pat. 1924). Both the Examiner and Appellant use the terminology “Markush group” to refer to the genera and subgenera of the claims which are defined by enumeration of species. *See*

In re Harnisch, 631 F.2d 716, 719-20, 206 USPQ 300, (CCPA 1980)(“Markush was the name of an applicant for patent (Eugene A. Markush) who happened to use in a claim a type of definition of a genus or subgenus by enumeration of species, which he did not devise and which had been used before in patent claims.”); *see also Abbott Labs. v. Baxter Pharmaceutical Products Inc.*, 334 F.3d 1274, 1280-81, 67 USPQ2d 1191, 1196 (Fed. Cir. 2003)(A Markush group is a listing of specified alternatives of a group in a patent claim, typically expressed in the form “a member selected from the group consisting of A, B, and C,” but which also can be expressed, for instance, as “wherein R is A, B, C, or D”).

The rejection is made on the basis that “the improper Markush group language ‘consists essentially of’ renders the scope of the claims indefinite.” (Answer, p. 19). According to the Examiner, the language “consists essentially of” leaves the claim open to elements (substituents) other than those explicitly recited in the Markush groups (Answer, pp. 19-20). The Examiner finds that Appellant “has not provided any indication of what these other elements (i.e., the elements not explicitly listed but encompassed by the language ‘consists essentially of’) may be.” (Answer, p. 20). Because of this, the Examiner concludes that “one skilled in the art would not recognize what elements are encompassed by the claims, and thus the scope of the claims is indefinite.” (Answer, p. 20).

In response, Appellant’s sole argument is that “[t]he phrase ‘consisting essentially of’ is acceptable, and commonly used, terminology for a Markush group.” (Amended Brief, p. 17). As evidence, Appellant states that a search of the USPTO database for the phrase “group consisting

essentially of” in the claims field for patents issued from 1996-current produced over 700 hits (*Id.*). Appellant attaches three patents using “consisting essentially of” in the context of a Markush group as Exhibits D, E, and F (*Id.*).

The question here is not whether the phrase “consisting essentially of” is acceptable and commonly used terminology for a Markush group. The question is whether the claims under review set out and circumscribe a particular area with a reasonable degree of precision and particularity as required by 35 U.S.C. § 112, ¶ 2. *Moore*, 439 F.2d at 1235, 169 USPQ at 238. We are cognizant of the fact that the Examiner labeled the language “consisting essentially of” in the rejected claims as “improper Markush group language.” Such a label does not lend clarity to the issue of indefiniteness. It is not the form of the language itself which is important to the question of indefiniteness: In all cases what is required is a determination of whether “one skilled in the art would understand the bounds of the claim when read in light of the specification.” *Miles Lab., Inc. v. Shandon, Inc.*, 997 F.2d 870, 875, 27 USPQ2d 1123, 1126 (Fed. Cir. 1993). In different contexts, the same words may result in different outcomes with respect to indefiniteness. In the case at hand, the Examiner did not rest his case on a mere deviation from the language normally used to set forth Markush groups; the thrust of the rejection was that one of ordinary skill in the art would not recognize what substituents are encompassed by the claims. The Examiner’s analysis is consistent with the law on indefiniteness.

The Examiner has correctly interpreted the claim language as being open to substituents other than those explicitly recited in the Markush groups (Answer, pp. 19-20). “By using the

term ‘consisting essentially of,’ the drafter signals that the invention necessarily includes the listed ingredients and is open to unlisted ingredients that do not materially affect the basic and novel properties of the invention.” *PPG Industries v. Guardian Industries Corp.*, 156 F.3d 1351, 1354, 48 USPQ2d 1351, 1353 (Fed. Cir. 1998). In claim 61, the language “consisting essentially of” precedes a list of substituents using alternative language, i.e., “halide, sulfate, ... or mixtures thereof.” The claim, therefore, requires the presence of an ionic liquid with one of the listed substituents or a mixture thereof. But the claim is also open to the additional presence of ionic liquids with other substituents as long as the substituent does not materially affect the basic and novel properties of the ionic liquid in the method of vaporizing reactants.

In order to understand what additional ionic liquids are encompassed by claim 61, one must understand which additional Y⁻ substituents will “materially affect the basic and novel properties” of the ionic liquid. The Examiner finds that there is no guidance in the specification as to what other substituents are encompassed (Answer, p. 20). We agree. The specification merely uses the same words as the claims without further explanation (specification, p. 5, ll. 1-9 and p. 14, ll. 1-8). Moreover, the anion portion (represented as Y⁻ in claim 61) is indicated as having a determining effect on the chemical properties of the ionic liquid and some anions, such as chloroaluminate, may react undesirably with certain precursor molecules (specification, p. 9, ll. 22-28). The facts of record, therefore, indicate that the identity of the anion has an important effect on the properties of the ionic liquid and that the effect may be detrimental. Which additional anions will “materially affect the basic and novel properties” of the ionic liquid is

unclear, particularly since one of the anions specifically listed in claim 61, chloroaluminate, is said to react undesirably with certain precursor molecules.

For the above reasons, we conclude that the Examiner has established that claims 61-72 are indefinite in violation of 35 U.S.C. § 112, ¶ 2.

Issue (13a)

We next turn to Issue (13a), i.e., the rejection of claims 59 and 60 under 35 U.S.C. § 112, ¶ 2 on the basis that “substantially dissolving” in the phrase “substantially dissolving at least one precursor in the ionic liquid” renders those claims indefinite.

Appellant argues that the “substantially dissolving” limitation distinguishes the claimed process from that of Frigo in view of Freemantle. A closer look at the issues behind this argument provides a background for understanding the issue of indefiniteness. Frigo describes a process in which a precursor is dissolved in solvent, but the amount of solvent is limited. The amount of solvent added is such that the bottom of the bubbler inlet tube is covered, but not so much as to dissolve all of the precursor (Frigo, col. 3, l. 61 to col. 4, l. 4). Some of the precursor remains as a solid phase (*Id.*). Appellant argues that Frigo teaches away from “substantially dissolving a precursor” because Frigo discloses a preference for leaving 50% or more of the precursor undissolved (Amended Brief, p. 8). According to Appellant, “substantially dissolving” means dissolving more than 50 wt% of the precursor (Amended Brief, p. 16). The key point is that “substantially dissolving” is intended to provide a limit on the amount of undissolved solid which can be present after the addition of the solvent.

The Examiner's conclusion of indefiniteness is based on the finding that the specification does not provide a standard for ascertaining the degree to which the precursor must dissolve in order to be "substantially dissolved" (Answer, p. 19). We agree. With regard to a term of degree such as "substantially," the specification must provide some standard for measuring the degree. *Seattle Box Co. v. Industrial Crating & Packing, Inc.*, 731 F.2d 818, 826, 221 USPQ 568, 574 (Fed. Cir. 1984). Here, there is no standard, only silence.

Appellant argues that, based on the teachings in the specification at page 10, lines 5-7, page 17, lines 24-25, and page 12, lines 18 and 27, a skilled artisan could readily ascertain if a substantial amount of the precursor has been dissolved, especially in view of the guidance in the specification at page 17, lines 24-25, that "[a]s much of each precursor as possible is dissolved in the solvent." (Amended Brief, p. 17 referring to p. 15).

In truth, the passages cited by Appellant do not provide any guidance as to how much of the precursor must dissolve to be "substantially dissolved." The statement on page 10, lines 5-7 that the ionic liquids "are able to dissolve relatively large quantities of a wide variety of precursors" only indicates that ionic liquids are good solvents for many precursors, it gives no guidance as to what amounts of solids may remain after addition of the solvent nor does it indicate that the precursors should be "substantially dissolved," completely dissolved, or discuss any other level of dissolving. The statement on page 17, lines 24-25 that "[a]s much of each precursor as possible is dissolved in the solvent" merely indicates that the solution should be at, or close to, saturation: it does not provide a standard for determining what level of dissolving is

“substantial” or what levels of solid are acceptable within the confines of “substantially dissolving.” The designation of “first solution 140” and “second solution 250” on page 12, lines 18 and 27, likewise, provides no guidance with respect to any dissolved and solid precursor levels. There is no discussion of solid levels at all, much less any discussion of what liquid:solid ratios equate to substantial dissolution.

The focus throughout the specification is on the solvating ability of the ionic liquid, not on the amount of precursor dissolved relative to the amount of solid precursor remaining after the addition of ionic liquid. The evidence supports the finding of the Examiner that the specification does not provide the level of guidance required for one of ordinary skill in the art to understand whether they are “substantially dissolving at least one precursor” in accordance with the claimed method (Answer, p. 19).

The Examiner has established a *prima facie* case of indefiniteness with respect to the subject matter of claims 59 and 60 which has not been sufficiently rebutted by Appellant.

Issue (12)

Next we consider Issue (12), i.e., the rejection of claims 59 and 60 under the written description requirement of 35 U.S.C. § 112, ¶ 1. According to the Examiner, there is no written descriptive support for “substantially dissolving at least one precursor in the ionic liquid” as recited in claims 59 and 60.

We agree with the Examiner that the concept embodied by “substantially dissolving,” i.e., the concept of controlling the amount of ionic liquid so that a substantial amount of the precursor

is dissolved, is a concept outside the scope of what is discussed in the specification (Answer, pp. 17-19). The specification fails to discuss any level of liquid relative to solid which would constitute “substantial dissolving.” In fact, the specification is completely silent with respect to the presence of solid after the addition of the solvent. The Examiner has met the initial burden of presenting evidence or reasons why persons skilled in the art would not recognize in the disclosure a description of the invention defined by the claims. *In re Gosteli*, 872 F.2d 1008, 1012, 10 USPQ2d 1614, 1618 (Fed. Cir. 1989). Although the original written description does not have to describe exactly the subject matter claimed, the description must clearly allow persons of ordinary skill in the art to recognize that Appellant invented what is claimed. *Id.*

Appellant argues that, although the word “substantially” does not appear in the relevant portions of the specification, it is clear that a skilled artisan reading the specification would appreciate that the claimed process *could* include dissolving a considerable amount of precursor in the ionic liquid, i.e., an amount Appellant equates with a substantial amount (Amended Brief, p. 15). “That a person skilled in the art might realize from reading the disclosure that such a step is *possible* is not a sufficient indication to that person that the step is part of appellants’ invention.” *In re Barker*, 559 F.2d 588, 593, 194 USPQ 470, 474 (CCPA 1977), *cert. denied*, 434 U.S. 1064 (1978)(quoting *In re Winkhaus*, 527 F.2d 637, 640, 188 USPQ 129, 131 (CCPA 1975)).

We conclude that the Examiner has established a *prima facie* case of lack of written description which has not been sufficiently rebutted by Appellant.

Issue (11)

We next consider issue (11), the rejection of claims 46-57 under the written description requirement of 35 U.S.C. § 112, ¶ 1. The rejection is on the basis that these claims use “comprises” while the specification uses the more restrictive language “consists essentially of” when introducing a group of alternative substituents of a generic chemical formula (Answer, p. 17). The Examiner states that there is no indication that Appellant had possession of the groups encompassed by “comprises” but not encompassed by “consisting essentially of” (*Id.*). This reasoning seems to be grounded in the broad proposition that “consisting essentially of” occupies a middle ground between “comprises” and “consisting of” in terms of openness. *PPG Industries*, 156 F.3d at 1354, 48 USPQ2d at 1353.

The Examiner’s reasoning does not apply to claim 53. Claim 53 does not use the word “comprises” in a way that “opens” the recited group to other substituents as argued by the Examiner. Claim 53 is dependent on claim 13 which limits R₁, R₂, and R₃ to alkyls. Claim 53 further limits the alkyls to those of a particular range of carbon chain length. The Examiner has not established a lack of written description with respect to claim 53.

Claims 46-52 and 54-57 stand on a different footing. These claims introduce a list of substituents with the word “comprises.” For instance, claim 46 limits the ionic liquid to one of a generic formula in which “Y⁻ comprises halides, sulfates, or mixtures thereof.” The specification, as pointed out by the Examiner introduces those same groups using the transitional phrase “consisting essentially of.” It is to these claims that the Examiner’s reasoning applies.

The Examiner has the initial burden of presenting evidence of reasons why persons skilled in the art would not recognize in the disclosure a description of the invention defined by the claims. *In re Wertheim*, 541 F.2d 257, 263, 191 USPQ 90, 97 (CCPA 1976). The Examiner here has attempted to meet that burden by pointing out that the claims might encompass more than what is disclosed in the specification. In this case, this potential difference is not enough to meet the Examiner's burden.

First, as a matter of claim interpretation, the claims require the presence of at least one of the enumerated substituents in the ionic liquid. The transitional phrase "comprises" merely allows for the inclusion of other ionic liquids in addition thereto. In the context of claims 46-52 and 54-57 which use "comprises" to introduce a list of alternative substituents for Y⁻ and R groups on a generic formula, each list requires the presence of one of the recited members, although additional ionic liquids may be included. This interpretation is consistent with the holding of our reviewing court that "[c]omprising' is a term of art used in claim language which means that ***the named elements are essential***, but other elements may be added and still form a construct within the scope of the claim." *Genentech Inc. v. Chiron Corp.*, 112 F.3d 495, 501, 42 USPQ2d 1608, 1613 (Fed. Cir. 1997)(emphasis added); *see also Kustom Signals Inc. v. Applied Concepts Inc.*, 264 F.3d 1326, 1332, 60 USPQ2d 1135, 1139 (Fed. Cir. 2001)("The open-ended transition 'comprising' does not free the claim from its own limitations."); *Moleculon Research Corp. v. CBS, Inc.*, 793 F.2d 1261, 1271, 229 USPQ 805, 812 (Fed. Cir. 1986)("comprising"

opens a method claim to the inclusion of additional steps, but does not affect the scope of the structure recited within the steps).

It is true that the claims might allow for the addition of ionic liquids with substituents not covered by the “consisting essentially of” language of the specification. But the fact that the claims are “open” to the inclusion of additional ionic liquids is a concept within the scope of the written description and that is sufficient for written descriptive support. *See In re Anderson*, 471 F.2d 1237, 1244, 176 USPQ 331, 336 (CCPA 1973). The ionic liquids of the claims are recited in the specification as examples of useful ionic liquids. The specification does not particularly limit the ionic liquids to those within the exemplified generic formulas: The specification is directed to the use of ionic liquids in general and then states that “for example” the ionic liquid may be one from the generic formulas set forth. We agree with Appellant that the specification sufficiently indicates that the inventor contemplated the use of ionic liquids in addition to those exemplified (Reply Brief, p. 3).

We conclude that the Examiner has failed to establish a lack of written description under 35 U.S.C. § 112, ¶ 1 with regard to the subject matter of claims 46-57.

Issue (1a)

We next consider Issue (1a), i.e., the rejection of claims 1, 3-9, 23, 24, 46-49, 57, 59-64 and 72 under 35 U.S.C. § 103(a) as being unpatentable over Frigo in view of Freemantle. We select claim 1 to represent the issues on appeal with respect to this rejection.

There is no question here that, as found by the Examiner, Frigo describes the process of claim 1 except that Frigo does not specify the use of an ionic liquid as the solvent for dissolving the precursor (Frigo, col. 3, ll. 46-51 and ll. 59-61; Answer, p. 7; Amended Brief, pp. 5-7). Nor is there any question that, as further found by the Examiner, Freemantle describes the use of ionic liquids as solvents (Answer, p. 7; Amended Brief, pp. 5-7). Rather, Appellant argues that there is no motivation to combine the teachings of the two references (Amended Brief, pp. 5-7; Reply Brief, pp. 1-2). In the alternative, Appellant argues that, even assuming there is a suggestion supporting the combination, it simply amounts to a suggestion to try various liquids with low or no vapor pressure: There is nothing in the references that would have prompted one to specifically select ionic liquids (Amended Brief, pp. 6-7; Reply Brief, p. 2).

A claim is unpatentable as obvious “if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art.” 35 U.S.C. § 103(a) (2001). In making a determination of obviousness, one must look at what the combined teachings of the references would have suggested to those of ordinary skill in the art. *In re Keller*, 642 F.2d 413, 425, 208 USPQ 871, 881 (CCPA 1981). A suggestion supporting obviousness may come: (1) expressly from the references themselves; (2) it may come from knowledge held by those of ordinary skill in the art that certain references, or disclosures in the references, are known to be of special interest or importance in the particular field; or (3) it may come from the nature of a problem to be solved, leading inventors to look to references relating

to possible solutions to that problem. *Pro-Mold & Tool Co. v. Great Lakes Plastics, Inc.*, 73 F.3d 1568, 1573, 37 USPQ2d 1626, 1630 (Fed. Cir. 1996).

Here, the Examiner has identified the portions of Frigo and Freemantle which provide a suggestion to choose an ionic liquid for the liquid required by Frigo (Answer, pp. 7-8). Frigo requires “a liquid of relatively low volatility” to be used as a solvent for a metal precursor (Frigo, col. 3, ll. 59-61). Freemantle indicates that ionic liquids are very powerful solvents, have low volatility, and have the other characteristics Frigo specifies as important (Answer, pp. 7-8). The Examiner has specifically identified the principles present in the references which provide the suggestion to combine. *See In re Rouffet*, 149 F.3d 1350, 47 USPQ2d 1453 (Fed. Cir. 1998)(The principle, known to one of ordinary skill, that suggests the claimed combination must be specifically identified).

Appellant attempts to call into question the Examiner’s finding of a suggestion by engaging in an overly literal reading of Frigo. According to Appellant, the focus in Frigo is on the volatility of the liquid relative to the precursor, not on the absolute vapor pressure of the liquid (Amended Brief, pp. 5-6). According to Appellant, a skilled artisan reading Frigo would not have been motivated to seek a liquid having a vapor pressure as low as possible, much less having an extremely low or substantially no vapor pressure, such as the present recited ionic liquids (Amended Brief, p. 6).

We, like the Examiner, disagree with Appellant’s interpretation of what Frigo would have suggested to one of ordinary skill in the art. The Examiner provides a well reasoned response to

Appellant's argument (Answer, p. 21-22). We incorporate the Examiner's response herein and add the following for emphasis.

Frigo suggests more than what Appellant characterizes the reference as teaching: The point of selecting a "liquid of relatively low volatility" is to avoid its vaporization. Frigo states that "[t]he liquid of relatively low volatility does not vaporize to any considerable extent and thus does not form a major constituent of the carrier gas leaving the bubbler." (Frigo, col. 4, ll. 59-62). Implicit in this statement is the idea that vaporized liquid is an undesirable constituent of the carrier gas. The less of the liquid solvent that vaporizes, the less contamination of the carrier gas there will be.

There is a suggestion to fill the need implicitly expressed in Frigo. Freemantle indicates that an important advantage of ionic fluids is that they have "no measurable vapor pressure." (Freemantle, p. 32, col. 1, ll. 11-13). In other words, none, or almost none, of the ionic liquid will vaporize. One of ordinary skill in the art would have recognized the value of the vapor pressure characteristic of ionic liquids in the process of Frigo in preventing undesirable vaporization. Thus, the teachings in the prior art, as filtered through the knowledge of one skilled in the art, as well as the nature of the problem to be solved, provide a suggestion to use ionic liquids to dissolve precursors in precursor vaporization methods. *See Brown & Williamson Tobacco Corp. v. Philip Morris Inc.*, 229 F.3d 1120, 1125, 56 USPQ2d 1456, 1459 (Fed. Cir. 2000)(The suggestion need not be express, but may come the prior art, as filtered through the knowledge of one skilled in the art); *In re GPAC Inc.*, 57 F.3d 1573, 1582, 35 USPQ2d 1116,

1123 (Fed. Cir. 1995)(An implied suggestion is enough); *In re Preda*, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968)(“[I]n considering the disclosure of a reference, it is proper to take into account not only the specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom.”).

One of ordinary skill in the art would have also expected a beneficial result. Frigo draws a connection between volatility, vaporization, and undesirable contamination of the carrier gas. Freemantle establishes that those of ordinary skill in the art recognized that ionic liquids have no measurable volatility. Because vaporization levels would be minuscule, one of ordinary skill in the art would have expected a reduction in undesirable contamination of the carrier gas when employing ionic liquid in the process of Frigo. Expected beneficial results are evidence of obviousness of a claimed invention, just as unexpected beneficial results are evidence of unobviousness. *In re Skoll*, 523 F.2d 1392, 1397, 187 USPQ 481, 484 (CCPA 1975).

Appellant also argues that, even if there is a suggestion, it is merely a suggestion to try various liquids with low or no vapor pressure (Amended Brief, p. 7). An invention is “obvious to try” where the prior art provides either no indication of which parameters would be critical or no direction as to which of many possible choices is likely to be successful. *Merck & Co. v. Biocraft Labs., Inc.*, 874 F.2d 804, 807, 10 USPQ2d 1843, 1845 (Fed. Cir.), *cert. denied*, 493 U.S. 975 (1989)(*quoting In re O'Farrell*, 853 F.2d 894, 903, 7 USPQ2d 1673, 1681 (Fed. Cir. 1988)). Here, as found by the Examiner, Frigo identifies the critical parameters for the “liquid of relatively low volatility” and Freemantle describes liquids having characteristics meeting those

parameters (Answer, pp. 7-8). The level of guidance provided by the references is similar to the level of guidance provided in the specification. In fact, Appellant's specification refers to Freemantle for guidance (specification, p. 9, l. 13 to p. 10, l. 7; *see also* Freemantle, particularly, p. 33, col. 1, ll. 17-22). Given the strong dissolving ability of ionic liquids (even rocks dissolve: Freemantle, p. 33, col. 2, ll. 29-31 and col. 3, ll. 1-3) and the ability to vary solubility extensively (Freemantle, p. 33, col. 1, ll. 17-22), there would have been a reasonable expectation that ionic liquids would work in the process of Frigo and that is enough to establish obviousness. *In re O'Farrell*, 853 F.2d 894, 904, 7 USPQ2d 1673, 1681 (Fed. Cir. 1988). Moreover, based on the fact that the guidance in the specification is similar to that in the prior art, were we to find that the prior art provides no reasonable expectation of success, we would be constrained to further conclude that undue experimentation would be required to practice the full scope of Appellant's invention contrary to the enablement requirement of 35 U.S.C. § 112, ¶ 1. Here, there is either obviousness or lack of enablement and Appellant points no clear flaw in the reasoning of the Examiner with respect to obviousness.

We conclude that the Examiner has established a *prima facie* case of obviousness with respect to the subject matter of claim 1 and those claims that stand or fall therewith which has not been sufficiently rebutted by Appellant.

Issue (1b)

We next consider Issue (1b), i.e., the rejection of claims 59 and 60 under 35 U.S.C. § 103(a) as unpatentable over Frigo in view of Freemantle. Our focus will be on claim 59.

Claim 59 requires a step of substantially dissolving at least one precursor in the ionic liquid. Appellant seeks to distinguish the claims from the process of Frigo in view of Freemantle on the basis that Frigo requires only a portion of the precursor dissolve, the rest remaining as a solid phase (Amended Brief, pp. 8-9; see also Frigo, col. 4, ll. 2-4). In Appellant's view, "substantially dissolving" means "dissolving" more than 50% by weight of the precursor (Amended Brief, pp. 15-16) and Frigo teaches away from such levels because Frigo states that "[g]ood results are obtained if no more than 50% by weight of the metal precursor initially dissolves in the liquid present." (Amended Brief, pp. 8-9; see also Frigo, col. 4, ll. 5-7).

In response, the Examiner maintains the rejection of claims 59 and 60 under 35 U.S.C. 103(a) on the basis that "substantially dissolved" means "dissolved to a considerable extent" and that Frigo dissolves to such an extent (Answer, pp. 11-12 and 25).

In order to properly consider the rejection for obviousness, we must first interpret the claims. *Panduit Corp. v. Dennison Mfg. Co.*, 810 F.2d 1561, 1 USPQ2d 1593 (Fed. Cir.), *cert. denied*, 481 U.S. 1052 (1987). "When examining claims for patentability, claims are interpreted as broadly as is reasonable and consistent with the specification." *In re Thrift*, 298 F.3d 1357, 1364, 63 USPQ2d 2002, 2006 (Fed. Cir. 2002). Claim 59 merely uses the phrase "substantially dissolving" and nothing in the specification indicates that a "substantial" level is any particular percentage. It is therefore, inappropriate to limit the claims to Appellant's desired definition, i.e., more than 50% by weight. Instead, we adopt, as did the Examiner, the ordinary and accustomed

meaning which, as evidenced by Appellant's Exhibit A, is "considerable ... in amount." *See Id.*; *In re Paulsen*, 30 F.3d 1475, 1480, 31 USPQ2d 1671, 1674 (Fed. Cir. 1994).

Frigo does not teach away from substantially dissolving the precursor as argued by Appellant (Amended Brief, pp. 7-8). While Frigo requires that the precursor remain in part as a solid, Frigo does not specifically exclude dissolving considerable amounts of the precursor nor does Frigo indicate that the process will not work at such levels. Frigo only indicates that good results are obtained when no more than 50% by weight of the precursor initially dissolve. This is merely a preferred embodiment. It is well settled that a prior art reference is relevant for all that it teaches to those of ordinary skill in the art. *In re Fritch*, 972 F.2d 1260, 23 USPQ2d 1780, 1782 (Fed. Cir. 1992). *See also Merck & Co v. Biocraft Laboratories*, 874 F.2d 804, 807, 10 USPQ2d 1843, 1847 (Fed. Cir. 1989) (A reference may be relied upon for all that it would have reasonably suggested to one having ordinary skill in the art, including non-preferred embodiments). Nor does the claim exclude initial levels of less than but approaching 50% by weight dissolved as such levels are "considerable in amount" within the meaning of the claim.

We conclude that the Examiner has established a *prima facie* case of obviousness with respect to the subject matter of claims 59 and 60 which has not been sufficiently rebutted by Appellant.

Issue (2)

We next consider Issue (2), i.e., the rejection of claims 2, 20-22, 33, and 38 under 35 U.S.C. § 103(a) over Frigo and Freemantle and further in view of AAPA. For this rejection, the

claims stand or fall together (Amended Brief, p. 4). We select claim 2 to represent the issues on appeal with regard to this rejection.

Claim 2 requires that the ionic liquid be heated to a temperature equal to about a volatilization point of the precursor. The Examiner acknowledges that Frigo does not disclose heating and cites the AAPA as showing that such heating was known in the art (Answer, pp. 12-13). The Examiner concludes that such heating would have been obvious to one of ordinary skill in the art to vaporize the precursors more easily (Answer, p. 16).

Appellant argues that Frigo teaches away from heating the liquid because Frigo performs the process at ambient temperature and heating would have exacerbated the solvent volatility problems that concerned Frigo (Amended Brief, pp. 8-9). Appellant further argues that the use of the term “typically” before ambient temperature in Frigo denotes a strong preference for ambient temperature which teaches away from heating (Amend Brief, p. 9) and that heating goes against the accepted wisdom in the art (Amended Brief, p. 9).

“In general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant.” *In re Gurley*, 27 F.3d 551, 553, 31 USPQ2d 1130, 1131 (Fed. Cir. 1994). In other words, the reference must lead one of ordinary skill in the art to the conclusion that the process will not work. *See Baxter Int'l, Inc. v. McGaw, Inc.*, 149 F.3d 1321, 1328, 47 USPQ2d 1225, 1230 (Fed. Cir. 1998).

The disclosure of Frigo would not have lead one of ordinary skill in the art to the conclusion that heating will not work. Frigo discloses conducting the process “typically” at ambient temperature (Frigo, col. 4, ll. 50-52). This does not preclude heating. In fact, Frigo indicates that other temperatures may be selected: Frigo specifically states that the “liquid of relatively low volatility ... is a liquid ... having a vapor pressure lower than that of the metal precursor at *the temperature of operation*, typically ambient.” (Frigo, col. 4, ll. 30-35).

Heating, as acknowledged in Appellant’s specification, was conventional in the art (specification, p. 3, ll. 7-16). The point of the process is to vaporize the precursor so it enters the carrier gas (Frigo, col. 4, ll. 55-59; specification, p. 2, ll. 13-15 discusses vaporization in an analogous process). Just as one must heat water to entrain enough water vapor in air to steam vegetables, one must heat some precursors to entrain an adequate amount of the precursor in the carrier gas for the CVD process. Appellant’s specification describes the prior art processes as involving heating to vaporize the precursor (specification, p. 3, ll. 7-16) and one of ordinary skill in the art would have recognized that such heating would be useful in the process of Frigo for those precursors with inadequate vapor pressure at ambient temperature.

We conclude that the Examiner has established a *prima facie* case of obviousness with respect to the subject matter of claim 2, and claims 20-22, 33, and 58 that stand or fall therewith, which has not been sufficiently rebutted by Appellant.

Issue (6)

We next consider Issue (6), i.e., the rejection of claims 34-36, 38, 39, 44, and 45 under 35 U.S.C. § 103(a) over Frigo and Freemantle and further in view of Biefeld or Hartmann. The claims stand or fall together (Amended Brief, p. 5). We select claim 34 to represent the issues on appeal.

The Examiner addresses all the limitations of claim 34 and finds a reason, suggestion or motivation in light of the prior art (Answer, pp. 14-16). Appellant does not advance any additional arguments over and above those already addressed above. As we have already addressed those arguments, no further explanation is required here. We conclude that the Examiner has established a *prima facie* case of obviousness with respect to the subject matter of claim 34 which has not been sufficiently rebutted by Appellant.

Issue (7)

Under Issue (7), claim 37 stands rejected under 35 U.S.C. § 103(a) over Frigo, Freemantle and Biefeld or Hartmann and further in view of AAPA.

The Examiner's reasoning is the same as that presented for Issues (2) and (6) and Appellant advances no additional arguments. We, therefore, conclude that the Examiner has established a *prima facie* case of obviousness with respect to claim 37 which has not been sufficiently rebutted by Appellant.

CONCLUSION

To summarize, the decision of the Examiner to reject claims 59 and 60 under 35 U.S.C. § 112, ¶ 1, claims 59-72 under 35 U.S.C. § 112, ¶ 2, and claims 1-9, 20-24, 33-39, 44-49, 57-64, and 72 under 35 U.S.C. § 103(a) is affirmed. The decision of the Examiner to reject claims 46-57 under 35 U.S.C. § 112, ¶ 1 is, however, reversed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

BRADLEY R. GARRIS)	
Administrative Patent Judge)	
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CATHERINE TIMM)	APPEALS
Administrative Patent Judge)	AND
)	INTERFERENCES
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