

United States District Court,
D. Delaware.

ATOFINA,
Plaintiff.

v.

GREAT LAKES CHEMICAL CORPORATION,
Defendant.

No. Civ.02-1250-SLR

March 16, 2005.

Paul E. Crawford, of Connolly Bove Lodge & Hutz, Wilmington, DE. Thomas G. Rowan, Daniel L. Malone, Eric C. Stops, Gasper S. LaRosa, of Jones Day, New York, New York, for Plaintiff.

Frederick L. Cottrell, III, of Richards Layton & Finger, Wilmington, DE. Richard D. Harris, James K. Cleland, of Greenberg & Traurig, Chicago, IL, for Defendant.

REDACTED OPINION

ROBINSON, Chief J.

I. INTRODUCTION

On July 1, 2002 plaintiff Atofina filed suit against defendant Great Lakes Chemical Corporation, alleging infringement of U.S. Patent No. 5,900,514 ("the '514 patent"). The '514 patent claims a process of manufacturing a refrigerant called difluoromethane. The court conducted a bench trial in January 2004 on the issues of infringement, validity, and enforceability. FN1 The following constitutes the court's findings of fact and conclusions of law pursuant to Fed.R.Civ.P. 52(a).

FN1. The parties entered a stipulation regarding damages. Consequently, the amount of money damages was not tried.

II. FINDINGS OF FACT

A. Parties and Background

1. Plaintiff Atofina is a company organized under the laws of France, having a place of business at 4-8 Cours Michelet, 92 800 Puteaux, R.C.S. Nanterre B 319 632 790, France. (D.I.84, ex. 1)
2. Defendant Great Lakes Chemical Corporation is a Delaware corporation with its principal place of business in West Lafayette, Indiana. (Id.; D.I. 33)
3. For many years chlorofluorocarbons ("CFCs") FN2 were commonly used as refrigerants. (D.I. 103 at 82) However, in the 1980s it was discovered that the chlorine portion of CFCs was harmful to the ozone layer. (Id. at 83) As a result, many countries joined the Montreal Protocol on Substances that Deplete the Ozone Layer ("the Montreal Protocol"), an agreement which phased out the use of ozone depleting substances such

as CFCs. (Id .)

FN2. CFCs are molecules which consist of chlorine, fluorine and carbon. (D.I. 103 at 82-83; D.I. 104 at 401).

4. In light of the Montreal Protocol and the impending phase out of CFCs, refrigerant manufacturers began to look for alternatives to CFCs. (Id.) Difluoromethane provided just such an alternative. (Id.) Difluoromethane is a refrigerant containing one carbon atom attached to two hydrogen atoms and two fluorine atoms ("CH₂F₂"). (Id. at 82-83) The absence of chlorine from difluoromethane's chemical structure means it does not pose the same threat to the ozone layer as CFCs. (Id. at 83)

B. Prior Art

5. The parent of the '514 patent was a French patent application filed by plaintiff on June 27, 1995. The application for the '514 patent was filed in the United States on June 14, 1996, claiming priority from the previously filed French counterpart application. (D.I. 107 at 981)

6. JP 51-82206 is a Japanese patent application filed on January 16, 1975, and published on July 19, 1976. JP 51-82206 discloses a process for maintaining the activity of a catalyst in a gas-phase catalytic fluorination reaction with hydrogen fluoride. (D.I. 108 at 1266, 1271-72; DX 593) FN3 One of the seven preferred starting materials in JP 51-82206 is methylene chloride, the same starting material specified in the '514 patent. (DX 593 at 5) JP 51-82206 discloses a temperature range of 100 to 500 (deg.), with 150 to 350 (deg.) preferred (id. at 1, 4, 6), operates in a pressure range of 0.1 to 10 atm (id. at 6), and uses a chromium oxide catalyst (id. at 4, see also id. at 1-3). JP 51-82206 specifies that the chromium catalyst can either be "pure" chromium oxide or mainly chromium oxide. (D.I. 108 at 1272) According to JP 51-82206, oxygen is fed with the reactants in a ratio of 0.001% to 1% of the starting organic material to lengthen catalyst life. (D.I. 109 at 1341, 1343; DX 593 at 1, 4-5) The contact times employed in the examples of JP 51-82206 are 3.0 and 4.1 seconds. (D.I. 108 at 1276-77; DX 593 at 6-8)

FN3. "DX ___" refers to exhibits submitted by the defendant at trial. For example, DX 509 would be defense exhibit number 509.

7. The Derwent FN4 abstract for JP 51-82206 states in full the following:

FN4. Derwent is "the world's leading patent and scientific information provider." "Thomson Derwent: About Us", at [http:// thomsonderwent.com/aboutus/](http://thomsonderwent.com/aboutus/) (February 14, 2005). Derwent "make[s] global patent information easily accessible by writing concise abstracts that clearly highlight the nature of the invention, then publish[es] these in a single, English-language database that can be searched precisely for specific technologies." Id.

The [preparation] of freons by fluorinating a halogenated 1-3C hydrocarbon [containing] a chlorine or bromine atom (e.g., CCl₄, CHCl₃, CH₂Cl₂, CCl₃F, etc.) with hydrogen fluoride in the presence of a fluorinating catalyst mainly comprising trivalent chromium oxide, is carried out at 100-500 degrees C under a pressure of 0.1-10 atmos[pheres] (absolute press[ure]), while adding 0.001-1.0 mole-% oxygen (based on the halogenated hydrocarbon) to the starting gaseous materials. The fluorination can be conducted continuously for several hundreds of hours without bringing about substantial decrease in catalytic activity. (DX 579 at AT000184) The abstract does not indicate that the full JP 51-82206 application contemplates a chromium catalyst comprising "pure" chromium. (Id. at AT000184; DX 850; D.I. 108 at 1299) The abstract also does not include any of the examples of the full JP 51-82206 document and, therefore, does not

disclose the contact times which are derived from those examples. (DX 579 at AT000184; DX 593 at AT005278; DX 850; D.I. 108 at 1296-97)

8. U.S. Patent No. 3,644,545 ("*Buckman*") discloses the gas-phase catalytic fluorination of a halocarbon (e.g., methylene chloride) with hydrogen fluoride in the presence of an alkali metal fluoride such as potassium fluoride at 150 to 350 (deg.)C. (DX 575, col. 1 at ll. 54-59, col. 2 at ll. 50-52) The preferred catalyst is chromium, particularly chromium oxide. (DX 575, col. 2 at ll. 50-52) The alkali metal fluoride can either be mixed into the catalyst bed, or incorporated with the catalyst particles. (DX 575, col. 2 at l. 55, col. 2 at ll. 61-64; D.I. 108 at 1149-51) *Buckman* discloses a contact time of 10 seconds. (DX 575, col. 3 at ll. 67-68)

9. U.S. Patent No. 3,325,612 ("*Anello*") discloses the gas-phase catalytic fluorination of halogenated hydrocarbons having one to three carbon atoms, including methylene chloride, using a bulk or supported chromium catalyst. (DX 628, col. 1 at ll. 36-47, col. 1 at ll. 54-59, col. 2 at ll. 36-43) In the preferred form of the supported catalyst, the chromium oxide comprises 2 to 45% by weight of the catalyst. (DX 628, col. 2 at 47-52)

10. EP 629440 A1 ("*Tsuji*") describes a fluorination catalyst for a gas-phase catalytic fluorination of halogenated hydrocarbons to produce hydrofluorocarbons, particularly difluoromethane, at a temperature of 200 to 400 (deg.)C. (DX 626, col. 2 at ll. 5-12, col. 6 at ll. 13-16) *Tsuji* discloses the use of a supported chromium-based catalyst having 10.5 wt% chromium. (D.I. 108 at 1285; D.I. 109 at 1372)

11. EP 554 165 A1 ("*Galland*") discloses a gas-phase catalytic fluorination of chlorotrifluoroethane (C₂H₂ClF₃) with hydrogen fluoride to obtain tetrafluoroethane (C₂H₂F₄) at a temperature of 300 to 450 (deg.)C, preferably between 330 and 400 (deg.)C, in the presence of a bulk supported chromium catalyst. (DX 627 at 4-5) The reaction is carried out in the presence of 0.1 to 5 mole% oxygen based upon the starting material to improve the lifetime of the catalyst, with a contact time of between 0.1 to 60 seconds, preferably from 3 to 30 seconds. (D.I. 108 at 1288) The chromium catalyst may contain solely chromium or other components, and the chromium content of the disclosed supported chromium catalyst is less than 20%, and preferably between 4 and 10%. (*Id.* 108 at 1287-88, 1384)

C. The '514 Patent

12. In 1994, plaintiff directed Dr. Benoit Requime along with Dr. Eric Lacriox and Dr. Andre Lantz to begin the development of a new process for the manufacture of difluoromethane. (*Id.* at 81-83)

13. Drs. Requime, Lacriox, and Lantz are the only named inventors on the '514 patent. (*Id.* at 78-81, DX 509) All three named inventors assigned their interest in the '514 patent to Elf Atochem. (D.I. 103 at 78-79, 135; PX 2) FN5 Elf Atochem subsequently became Atofina, the plaintiff in this case. (D.I. 103 at 79-80, 172-173) Plaintiff owns the '514 patent.

FN5. "PX ___" refers to exhibits submitted by the plaintiff at trial. For example, PX 1 would be plaintiff's exhibit number 1.

14. The '514 patent covers the catalytic gas-phase fluorination of methylene chloride with hydrogen fluoride in the presence of oxygen and a bulk or supported chromium catalyst to make difluoromethane. (*Id.* at 84; D.I. 104 at 400-01; D.I. 105 at 425, 427-28; DX 509; PX 1) In the processes claimed in the '514 patent, the chlorines in methylene chloride ("CH₂ Cl₂") are replaced with fluorines from anhydrous hydrofluoric acid ("HF") to yield difluoromethane ("CH₂F₂"). (D.I. 104 at 406-07; DX 509; PX 1) The '514 patent also requires that oxygen and methylene chloride are fed to a reactor in a ratio of 0.1 to 5.0 moles of oxygen per 100 moles of methylene chloride. (D.I. 103 at 85; D.I. 105 at 425; DX 509; PX 1) The processes claimed in the '514 patent are carried out at a temperature between 330 and 450 (deg.)C. (D.I. 103 at 84-85; D.I. 105 at

15. Plaintiff alleges that defendant has infringed claims 1, 2, 5, 6, 7, 9, and 10 of the '514 patent. (D.I. 103 at 32)

16. Independent claim 1 provides:

Process for the manufacture of difluoromethane consisting essentially of gas-phase catalytic fluorination of methylene chloride with anhydrous hydrofluoric acids in the presence of 0.1 to 5 moles of oxygen per 100 moles of methylene chloride, at a temperature of between 330 and 450 (deg.)C[] and with a bulk or supported chromium catalyst.

('514 patent, col. 7 at ll. 20-25)

17. Claim 2 states:

Process according to claim 1, wherein the O_2/CH_2Cl_2 molar ratio is between 0.5% and 3%.

('514 patent, col. 7 at ll. 26-27)

18. Claim 5 covers:

Process according to claim 1 wherein a supported chromium catalyst is employed, the weight content of chromium being less than 20%.

('514 patent, col. 8 at ll. 3-5)

19. Claim 6 provides:

Process according to claim 1 wherein the gas[-]phase mixture of methylene chloride, anhydrous hydrogen fluoride and oxygen is in contact with the catalyst for a time between 0.01 and 10 seconds.

('514 patent, col. 8 at ll. 5-9)

20. Claim 7 covers:

Process according to claim 1 wherein the process is carried out at a pressure of between 1 and 20 bars absolute.

('514 patent, col. 8 at ll. 10-11)

21. Independent claim 9 provides:

Process for the manufacture of difluoromethane consisting of gas-phase catalytic fluorination of methylene chloride with anhydrous hydrofluoric acids in the presence of 0.1 to 5 moles of oxygen per 100 moles of methylene chloride, at a temperature of between 330 and 450 (deg.)C[] and with a bulk or supported chromium catalyst.

('514 patent, col. 8 at ll. 14-19)

22. Independent claim 10 states:

Process for the manufacture of difluoromethane consisting essentially of gas-phase catalytic fluorination of methylene chloride with anhydrous hydrofluoric acids in the presence of 0.1 to 5 moles of oxygen per 100 moles of methylene chloride, at a temperature of between 330 and 450 (deg.)C and with a bulk or supported chromium catalyst, the gas[-]phase mixture of methylene chloride, anhydrous hydrogen fluoride and oxygen is in contact with the catalyst for a time between 0.01 and 10 seconds.

('514 patent, col. 7 at ll. 20-28)

23. The '514 specification teaches that the prior art dealt with certain problems arising from the manufacture of difluoromethane by using a composite catalyst that contains two active catalysts: nickel and chromium. According to the specification:

To overcome this disadvantage it has been proposed [in the prior art] to employ some chromium-based mixed catalysts which make it possible to restrict the Deacon reaction.FN6 Thus, patent EP 546 883 shows that, in the case of bulk catalyst [sic], the addition of a metal such as nickel allows the oxidation of HCl to be partially inhibited. A similar phenomenon is observed on Ni-Cr/AlF mixed catalysts....

FN6. The Deacon reaction is a significant problem in the manufacture of difluoromethane. The reaction creates unwanted side products and causes the degradation of catalysts. (D.I. 105 at 434-35) Consequently, the Deacon reaction is something that difluoromethane manufacturers want to avoid. (Id. at 434)

('514 patent, col. 2 at ll. 17-24) (footnote added)

24. The '514 specification states that the prior art used additives to address certain problems:

Recently, after having shown that in the case of the reaction of fluorination of methylene chloride in the presence of oxygen the chromium catalysts were not very selective (formation of F22 and of halogenated ethane derivatives), patent JP 5-339179 has also claimed the use of catalysts devoid of chromium, which are specific to the synthesis of F32. These catalysts, such as $\text{CoCl}_2/\text{AlF}_3$ or $\text{NiCl}_2/\text{AlF}_3$, are highly selective and their stability is increased by additives chosen from the rare earths (La, Ce) or alkaline-earth elements (Mg, Ca, Se).

('514 patent, col. 2 at ll. 31-40)

25. According to the '514 specification, the claimed catalyst has comparatively better stability and selectivity compared to the mixed metal catalyst prior art:

In trials of fluorination of methylene chloride, with a shorter contact time, aimed at increasing the space time yield of F32, we have been surprised to find that, in contrast to what the abovementioned patents lead one to expect, usual fluorination catalysts such as Ni/AlF_3 or $\text{Ni-Cr}/\text{AlF}_3$ are not stable, even in the presence of oxygen.

On the other hand, it has now been found that there is a temperature range in which a catalyst based on pure chromium (without the addition of another metal oxide) can produce, in the presence of oxygen, with an excellent stability, [difluoromethane] by gas-phase fluorination of methylene chloride, without any significant loss of selectivity.

('514 patent, col. 2 at ll. 48-59)

26. The '514 specification states that the superior performance of the claimed pure chromium catalyst made use of additives unnecessary and pointed to this feature as an advantage of the '514 process:

It is therefore unnecessary to employ special additives in order to increase its selectivity; the elimination of the additives employed in the mixed catalysts enables the manufacture of the catalyst to be simplified and thereby its cost to be reduced.

('514 patent, col. 3 at ll. 10-14)

27. The '514 specification states that "Comparative Examples 2 and 3 show that it is necessary to have a catalyst containing solely chromium" ('514 patent, col. 7 at ll. 7-8)

28. In response to a rejection by the United States Patent and Trademark Office ("USPTO") dated December 30, 1997, the '514 applicants attempted to distinguish their claims from the prior art by reiterating that the '514 application process uses a catalyst for which "[i]t is therefore unnecessary to employ special additives to increase its selectivity; the elimination of additives employed in the mixed catalysts enables the manufacture of the catalyst to be simplified and thereby its cost to be reduced." (DX 579 at AT000172)

29. The '514 applicants also argued that the USPTO's December 30th rejection "ignore[d] the criticality of utilizing a chromium catalyst alone, as opposed to other types of chromium-based catalysts such as that taught in comparative examples 2 and 3." (Id. at AT000179; D.I. 108 at 1148)

30. The applicants further sought to distinguish *Buckman* based on the claimed "bulk or supported chromium catalyst" limitation. *Buckman* calls for the gas-phase catalytic fluorination of a halocarbon, such as methylene chloride, with hydrogen fluoride in the presence of an alkali metal fluoride, specifying that the alkali metal fluoride can be either mixed into the catalyst bed or incorporated with the catalyst. (D.I. 108 at 1149-51; DX 579 at AT000179) The '514 applicants argued that "[t]he present claims exclude the utilization of an alkali metal fluoride noted in column 1, line 59 of *Buckman*[" (DX 579 at AT000179)

31. In the prosecution history of the '514 patent, the applicants also attempted to distinguish the *Tsuiji* prior art reference by stating:

Applicants point out that the claims recited the phrase 'consisting essentially of' which would exclude the utilization of a combination catalyst, such as that taught by *Tsuiji* [sic].... Rather applicants' disclosure in comparative examples 2 and 3 indicate the criticality of using chromium catalysts alone rather than in combination with other metal components.

(D.I. 108 at 1152-53; DX 579 at AT000180)

32. On February 25, 1998 the USPTO again rejected the '514 patent claims as being unpatentable, this time issuing a final rejection. (DX 573 at AT003130-AT003136)

33. The '514 applicants filed a further Amendment and Communication dated February 25, 1998. (DX 573 at AT000204) In this Amendment, the applicants again defined their claimed bulk or supported catalyst, "as defined on page 5, lines 13-14 [of the '514 patent], pure chromium means without the addition of another metal oxide[.]" (DX 579 at AT000207)

34. In that same Amendment, the '514 applicants distinguished the prior art. The '514 applicants argued that "the elimination of additives employed in the mixed catalysts enables the manufacture of the catalyst to be simplified and thereby its cost to be reduced." (DX 579 at AT00208) The '514 applicants emphasized "the criticality of utilizing a chromium catalyst alone, as opposed to other types of chromium-based catalysts such as that taught in comparative examples 2 and 3." (DX 579 at AT00216; D.I. 108 at 1148) The '514 applicants reiterated that "the claims recite[] the phrase 'consisting essentially of' which would exclude the utilization of a combination catalyst, such as that taught by *Tsuiji* [sic].... Rather applicants' disclosure in

comparative examples 2 and 3 indicate the criticality of using chromium catalysts alone rather than in combination with other metal components." (DX 579 at AT000217; D.I. 108 at 1152) Finally, the '514 applicants argued that "[c]ontrary to what might be expected from the prior art, the present invention makes it possible to employ a catalyst based solely on chromium to carry out this fluorination reaction." (DX 579 at AT00208)

35. The '514 applicants again distinguished *Buckman*, arguing "[t]he present claims exclude the utilization of an alkali metal fluoride noted in column 1, line 59 of *Buckman*[" (Id. at AT000216)

36. During prosecution of the '514 patent, the applicants characterized the examples of JP 51-82206 as "refer[ring] only to the fluorination of perhalogenated saturated materials (CCl₄ and C₂Cl₃F₃). It is known, however, that the reactivity of perhalogenated molecules is very different from that of the hydrogenated materials." (Id. at AT00175, AT00212) (emphasis in original) The applicants also stated, "[a] person skilled in the art, who is looking for a means of fluorinating a specific H containing halocarbon (CH₂ Cl₂) with a good selectivity, is therefore not prompted to consider the teachings of *Buckman* and JP 51-82206." (Id. at AT000178, AT000215) (emphasis in original) In the full translation of JP 51-82206, methylene chloride, a starting material for the '514 patent process and an H containing halocarbon, is listed as a preferred starting material, one of three other preferred starting materials (out of seven total) which are not perhalogenated. (DX 593 at 5)

37. The '514 applicants further told the USPTO that JP 51-82206 discloses a catalyst containing "chiefly chromium oxide," but did not mention that JP 51-82206 also discloses a catalyst of pure chromium. (D.I. 109 at 1539-41; DX 597 at AT000175, AT000212) The full English translation of JP 51-82206 discloses the use of a "pure chromium" catalyst. (DX 593 at 4; D.I. 108 at 1299)

38. In arguing for allowance of claims 6, 8, and 10 containing contact time limitations, the '514 applicants stated, "[t]hese specific process conditions effect a contact time of 10 seconds or less.... The short contact time is not taught in the applied references. Contact time[s] indicated in the references are substantially in excess of this." (DX 579 at AT000171; DX 848; D.I. 108 at 1306) The "applied references" were *Buckman*, the JP 51-82206 abstract, and U.S. Patent No. 5,523,500 ("*Cheminal*"). *Buckman* discloses a residence or contact time of 10 seconds for manufacturing difluoromethane in a gas-phase catalytic fluorination process. (D.I. 108 at 1306-07; DX 575, ex. 1) JP 51-82206 has contact times of 3.1 and 4.0 seconds, calculated from reaction data provided in the experimental examples. (D.I. 108 at 1307; DX 593 at 6-8) *Cheminal* discloses a range of contact times of 3 to 100 seconds, and preferably less than 30 seconds. (Id. at 1307; DX 609)

39. On two separate occasions the '514 patent applicants argued, "these [prior art] references, taken all together, do not prompt one skilled in the art to chose a restricted temperature range of 330-450 (deg.)C as claimed in our process. They rather teach away from this range toward lower temperatures." (DX 579 at AT000178, 214-215) The applicable references were *Buckman*, the JP 51-82206 abstract, and *Cheminal*. *Buckman* discloses a temperature range of 150 to 350 (deg.)C for a gas-phase catalytic fluorination reaction of methylene chloride with hydrogen fluoride to produce difluoromethane. (DX 575; D.I. 108 at 1310) JP 51-82206 discloses a temperature range of 100 to 500 (deg.)C for a gas-phase catalytic fluorination reaction with hydrogen fluoride in the presence of oxygen with a preferred range of 150 to 350 (deg.)C. (DX 593 at 1, 4, 6; D.I. 108 at 1310) *Cheminal* discloses a temperature range for a gas-phase catalytic fluorination reaction of 300 to 500 (deg.)C. (DX 609; D.I. 108 at 1310)

D. The European Application

40. The European counterpart to the '514 patent was copending with the '514 application during the entirety of the '514 prosecution, and was eventually allowed as a European patent approximately six years later in 2002. (DX 605)

41. On October 11, 1996, the European Patent Office ("EPO") issued a search report relative to the EPO counterpart application. (Id. at AT005337) The EPO search report cited a Derwent abstract of JP 51-82206. (Id.; D.I. 107 at 1071-75)

42. On May 12, 1999, the EPO rejected all of the claims of the EPO counterpart application FN7 in light of JP 51-82206 for lack of novelty. (DX 594; D.I. 107 at 1082-84). Additionally, the EPO demanded a full translation of JP 51-82206. (D.I. 107 at 1086-89)

FN7. The claims of the EPO counterpart application mirrored those of the issued '514 patent.

43. After receiving the full translation, the EPO maintained its rejection, again citing a lack of novelty in view of JP 51-82206. (Id. at 1093-94; DX 605) The EPO noted that methylene chloride is listed as one of seven preferred starting materials in JP 51-82206 and one of skill in the art would obtain difluoromethane from methylene chloride in light of the full disclosure of JP 51-82206. (DX 605 at AT005348-50)

44. Plaintiff amended its claims on June 2, 2000, requiring a molar ratio of hydrogen fluoride to methylene chloride between 1.5 and 10, preferably between 2 and 5. (Id. at 5338-41; D.I. 107 at 1098-99) Plaintiff also amended the EPO specification itself by adding examples to demonstrate a surprising effect of the newly claimed molar ratio. (DX 605 at AT005330-31; D.I. 107 at 1099-1100, 1105-07) Ultimately, the EPO allowed the application in view of the amendments to both the claims and the specification.

E. Defendant's Process

45. Defendant manufactures difluoromethane by a gas-phase fluorination of methylene chloride with hydrogen fluoride, utilizing a catalyst which contains chromium. (D.I. 104 at 308-09; D.I. 106 at 719-20) Agent X FN8 significantly enhances the selectivity of defendant's fluorination reactions, as well as the catalyst life. (D .I. 104 at 301, 354-56) Defendant feeds oxygen at a level of about 1.1 to 1.2 moles of oxygen per 100 moles of methylene chloride. (Id. at 310; D.I. 105 at 425-26, 455) The reactants in defendant's process are in contact with the catalyst for a time of approximately 10 seconds. (D.I. 105 at 460) Defendant's reaction is carried out at a pressure of between 5.5 and 7.6 bars absolute. (Id. at 461-62) Defendant's process was originally carried out at a temperature of approximately 310 (deg.)C. (D.I. 104 at 326-27) In October 1999 defendant upgraded its reactor temperature control system, enabling it to manufacture difluoromethane at upwards of 343 (deg.)C. (D.I. 106 at 749-53, 836-38) Once defendant's system was upgraded the reaction was capable of being conducted at 335 (deg.)C. (D.I. 104 at 326; D.I. 106 at 753-55, 800) The temperature of defendant's fluorination reaction came within the claimed temperature range of the '514 patent sometime between June 18 and July 27, 2001. (D.I. 103 at 374)

FN8. By stipulation of the parties, the designation "Agent X" is used throughout to refer to a component of defendant's proprietary catalyst formulation that is subject to a Protective Order. Likewise, "Compound X" and "Compound Y" are used to refer to certain compounds containing Agent X.

46. On one occasion defendant depleted its supply of Agent X and was forced to prepare a batch of Agent X-free catalyst for use in its fluorination reaction to produce a hydrofluorocarbon similar to difluoromethane. (Id. at 358; D.I. 106 at 737-038) Catalyst life was shortened and reaction yield was reduced four-fold. (D.I. 104 at 358; D.I. 106 at 744-45)

47. Defendant has compared the performance of its catalyst to various pure chromium catalysts that have been offered to it by commercial catalyst manufacturers. (D.I. 106 at 721-23) In March 1999, defendant tested its Agent-X containing catalyst against a pure chromium catalyst in the manufacture of difluoromethane and found that its catalyst provided substantially better selectivity, greater consistency, and

fewer undesired byproducts. (D.I. 106 at 723-27, 787; DX 538) In February 2001, defendant compared its catalyst against pure chromium catalysts from another vendor and determined that the vendor catalyst performance did not even justify full-scale testing of the vendor catalyst. (D.I. 106 at 728-29) In November 2002 and September 2003, two further vendor comparisons were performed, comparing defendant's catalyst to another vendor's pure chromium catalyst. The pure chromium catalyst exhibited a lower catalyst life than that of defendant's catalyst. (D.I. 106 at 729-30)

48. In the absence of chromium, defendant's fluorination process would not work. (D.I. 105 at 452-53, 560-61 D.I. 108 at 1206; D.I. 109 at 1518-19)

F. Willful Infringement

49. Dr. Mark Robin worked for defendant as a research chemist from 1988 until 2000. (D.I. 104 at 220-25) Between 1994 and 2000, Dr. Robin spent nearly all of his time identifying commercial applications for flame retardant products unrelated to difluoromethane. (Id. at 221) In March of 2000, Dr. Robin was asked to review relevant patent literature in connection with defendant's development of a liquid-phase process for the manufacture of difluoromethane. (Id. at 221) The '514 patent was one of many patents that came up in Dr. Robin's patent search; however, it was not identified as an issue for a liquid-phase process for difluoromethane. (Id. at 328, 332-33)

50. In May or June of 2001, a representative of plaintiff informed defendant's general manager of fluorine at an industry conference that, if defendant was producing difluoromethane, defendant had to be infringing at least one of plaintiff's patents. (Id. at 327; D.I. 105 at 612-13)

51. Days after plaintiff's accusation, defendant launched a focused search of plaintiff's patent portfolio. (D.I. 105 at 613-14) Dr. Stephan Brandstadter was given the responsibility of locating plaintiff's patents related to the manufacture of difluoromethane. (D.I. 103 at 195-98) Dr. Brandstadter identified several of plaintiff's patents relating to the manufacture of difluoromethane, including the '514 patent. (D.I. 104 at 371; D.I. 105 at 615-16) Dr. Gregory Leman, defendant's business director for specialty fluorine products, ordered an internal investigation into the '514 patent. (D.I. 104 at 371; D.I. 105 at 596; D.I. 106 at 661)

52. By June 19, 2001, defendant had identified the JP 51-82206 prior art and noted that it was merely practicing that prior art. (D.I. 105 at 623)

53. On July 11, 2001, defendant's outside patent counsel completed a New Project Trigger Form in response to defendant's request that a careful examination be performed towards ensuring that defendant did not infringe the '514 patent. (D.I. 104 at 341-42)

54. By July 18, 2001, Dr. Brandstadter and defendant's internal fluorine team concluded defendant did not infringe the '514 patent. (D.I. 103 at 206-07)

55. Within 90 days of defendant's contacting its outside patent counsel, the outside patent counsel informed defendant that its process for manufacturing difluoromethane could not infringe the '514 patent. (D.I. 105 at 616; D.I. 106 at 758-59)

56. On October 19, 2001, Robert Hyta of defendant's outside counsel wrote an email to Dr. Leman ("the Hyta email"). (D.I. 104 at 375) In the Hyta email, Mr. Hyta asked Dr. Leman to verify that the email set forth a correct description of defendant's process, including its catalyst. (Id. at 375) The Hyta email stated that the supporting catalyst was made from a mixture of chromium oxide (CrO_3) and Compound Y. (Id. at 375) Dr. Leman, testifying as defendant's Rule 30(b)(6) designee, indicated that Mr. Hyta's statement that defendant's catalyst was made from chromium oxide and Compound Y was wrong. (Id. at 376) According to Dr. Leman, defendant's catalyst was actually made from chromium oxide and Compound X. (Id.)

57. In April 2002, plaintiff sent a letter to defendant identifying five patents which plaintiff believed defendant infringed. Defendant responded to plaintiff within days, attempting to demonstrate defendant's non-infringement. (D.I. 106 at 759-60) Defendant also sought a written opinion of outside counsel as to whether its process for manufacturing difluoromethane infringed any of the five patents identified by plaintiff. (D.I. 105 at 616-17)

58. On June 18, 2002, defendant received a formal opinion report from its patent counsel indicating that it did not infringe the '514 patent. (D.I. 106 at 765-67)

G. Inequitable Conduct

59. Drs. Benoit Requieme, Amberieux LaCroix, and Andre Lantz are research scientists for plaintiff and the named inventors of the '514 patent. (D.I. 103 at 77)

60. Drs. Requieme and LaCroix both had knowledge of, possessed, and read a copy of an English language translation of JP 51-82206 during their work on the difluoromethane project and before filing the '514 patent application. (D.I. 103 at 101-102, 147; D.I. 107 at 917-18) The translation of JP 51-82206 had been in the patent archives of plaintiff's research center since 1988. (D.I. 103 at 147-48; D.I. 107 at 916) Pursuant to his normal practice, Dr. Requieme would have provided a copy of the full English translation of JP 51-82206 to plaintiff's in-house patent attorney, Mr. Leboulanger, in preparation for filing the underlying French priority application. (D.I. 103 at 158-59) Partway through the prosecution of the '514 patent, in September of 1997, Pierre Granet took over responsibility for prosecution of the '514 patent. (D.I. 107 at 1051-52, 1058) Mr. Granet admitted that he had the full English translation of JP 51-82206 in his files, which were transferred to Mr. Granet from Mr. Leboulanger. (Id. at 1063, 1065)

61. The '514 patent was prosecuted before the USPTO by plaintiff's U.S. patent counsel, Frederick Calvetti. (Id. at 981) None of the named inventors of the '514 patent sent a translation of JP 51-82206 to Mr. Calvetti or made any communications to Mr. Calvetti during prosecution of the '514 patent. (Id. at 926, 930-31) Instead, during the prosecution of the '514 patent, Mr. Calvetti communicated with Mr. Leboulanger. (Id. at 997) Mr. Calvetti never received a copy of the full English translation of JP 51-82206, nor was the translation ever submitted to the USPTO by plaintiff. (Id. at 1027-28) Had Mr. Calvetti been provided with a copy of the English language translation of JP 51-82206, he would have provided that document to the USPTO. (Id. at 1027-28) Mr. Calvetti filed Information Disclosure Statements (IDS) with the USPTO which included a copy of JP 51-82206 in Japanese and a Derwent abstract of JP 51-82206. (Id. at 1031, 1042)

III. CONCLUSIONS OF LAW

A. Claim Construction

1. The parties only dispute the construction of one limitation in the '514 patent: bulk and supported chromium catalyst. (D.I. 112 at 14; D.I. 114 at 13) Plaintiff construes the limitation to cover a catalyst that uses chromium as the only catalytically active metal, but which may also contain non-catalytically active components or additives. (D.I. 73 at 2) Under plaintiff's construction, a "bulk or supported chromium catalyst" would not function in the absence of chromium. (D.I. 105 at 430-32; D.I. 112 at 15) In other words, although a "bulk or supported chromium catalyst" could contain additives, none of these additives could catalyze the reaction by themselves. (Id.) Plaintiff cites evidence that defendant's catalyst would not function in the absence of chromium. (Id.) Plaintiff also cites evidence that Agent X by itself would not catalyze the reaction for making difluoromethane. (Id.) Defendant construes "bulk and supported chromium catalyst" to cover a substance that lowers the activation energy of a chemical reaction, without itself being consumed, which only contains chromium without the addition of other metal components such as metal oxides or alkali metal fluorides or non-inert additives. (D.I. 73 at 2) In support of its construction, defendant

cites several references from the '514 specification and from the '514 prosecution history where plaintiff stated that its invention does not include metal oxides or alkali metal flourides. (D.I. 115 at 9-10, 12-14)

2. Claim construction is question of law. *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 979 (Fed.Cir.1995) (*en banc*).

3. In interpreting the claims, a court should begin with the intrinsic evidence of record (i.e., the patent itself, including the claims, the specification, and the prosecution history). *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed.Cir.1996). "Such intrinsic evidence is the most significant source of the legally operative meaning of disputed claim language." *Id.*

4. First, a court should look to words of the claims themselves to define the scope of the patented invention. *Id.* There is a heavy presumption that the claim terms carry their ordinary and customary meanings as would be understood by one of ordinary skill in the art. *Markman*, 52 F.3d at 986. In other words, the court must determine how a person of experience in the field of the invention, upon reading the patent documents, would understand the words used to define the invention. *Toro Co. v. White Consol. Indus., Inc.*, 199 F.3d 1295, 1299 (Fed.Cir.1999). Dictionaries and scientific treatises may help to supply the pertinent context and usage for claim construction. *Tex. Digital Sys., Inc. v. Telegenix, Inc.*, 308 F.3d 1193, 1201, 1202 (Fed.Cir.2002).

5. Second, because a patentee may choose to be his own lexicographer and use a term in a manner either more or less expansive than its general usage in the relevant art, the court also should review the specification to determine whether an inventor has used any term in a manner other than its ordinary meaning. *Vitronics*, 90 F.3d at 1582. The specification may act as a dictionary when it either expressly defines terms used in the claims or when it defines terms by implication. *Id.*

6. Third, a court may consider the prosecution history of a patent, if in evidence. *Id.* "The prosecution history limits the interpretation of claim terms so as to exclude any interpretation that was disclaimed during prosecution." *Id.* (quoting *Southwall Tech., Inc. v. Cardinal IG Co.*, 54 F.3d 1570, 1576 (Fed.Cir.1995)). That is, a court must look to the prosecution history to determine if the patentee has limited the scope of the claims by disclaiming a particular interpretation during prosecution. *Biodex Corp. v. Loredan Biomed, Inc.*, 946 F.2d 850, 862 (Fed.Cir.1991).

7. Additionally, if the meaning of a term is not clear from the intrinsic evidence, then a court may consult extrinsic evidence, such as expert testimony, in construing claim terms as they would be understood in the relevant art. *Markman*, 52 F.3d at 980-81.

8. When construing the claims, courts must take great care to avoid importing unnecessary limitations into the claims from the specification. *Amgen Inc. v. Hoechst Marion Roussel, Inc.*, 314 F.3d 1313, 1325 (Fed.Cir.2003). "If we once begin to include elements not mentioned in the claim in order to limit such claim ... we should never know where to stop." *Johnson Worldwide Assocs., Inc. v. Zebco Corp.*, 175 F.3d 985, 990 (Fed.Cir.1999) (quoting *McCarty v. Lehigh Val. R.R.*, 160 U.S. 110, 116 (1895)). Nevertheless, a court should look to the specification to determine whether it refers to a limitation only as a part of less than all possible embodiments or whether it suggests that the very character of the invention requires that the limitation be a part of every embodiment. It is impermissible to read the one and only disclosed embodiment into a claim without other indicia that the patentee so intended to limit the invention. *Teleflex, Inc. v. Ficosa N. Am. Corp.*, 299 F.3d 1313, 1327 (Fed.Cir.2002). On the other hand, where the specification makes clear at various points that the claimed invention is narrower than the claim language might imply, it is entirely permissible and proper to limit the claims. *SciMed Life Sys., Inc. v. Advanced Cardiovascular Sys., Inc.*, 242 F.3d 1337, 1345 (Fed.Cir.2001).

9. The court construes "chromium catalyst" FN9 to mean a substance that alters the velocity of a chemical

reaction without itself being consumed, where the only catalytically active material is chromium without the addition of metal oxides, alkali metal fluorides, or non-inert additives. A substance is catalytically active if it contributes to the catalysis of a reaction. Being catalytically active does not require a substance to catalyze a reaction on its own.FN10

FN9. The language of independent claims 1, 9 and 10 of the '514 patent include as a limitation a "bulk or supported chromium catalyst." ('514 patent, col. 7 at l. 25, col. 8 at ll. 19, 25) Furthermore, the parties purport to construe this "bulk or supported chromium catalyst" limitation. (D.I. 112 at 8-9; D.I. 114 at 14) However, the parties did not provide arguments related to construction of "bulk or supported." Furthermore, the court did not find an ordinary meaning of "bulk or supported" in the context of catalysts. As far as the court can tell, a supported chromium catalyst is "a composition in which the chromium catalyst is prepared by depositing it on a support-on the surface of the support[,]and the catalyst is chromium." (D.I. 103 at 92) "A bulk chromium catalyst is one in which the catalyst is also a chromium catalyst, but this time it is prepared without a support." (Id. at 93) The parties' claim construction and infringement arguments center on construction of "chromium catalyst" and have nothing to do with whether defendant's catalyst was bulk or supported. Consequently, the court will disregard this portion of the limitation and focus its analysis on construction of "chromium catalyst."

FN10. Plaintiff defines "chromium catalyst" as a catalyst where chromium is the only catalytically active metal in the claimed fluorination reaction. (D.I. 112 at 9) Plaintiff further claims that catalytically active means capable of carrying out the claimed fluorination reaction. (D.I. 105 at 430-432; D.I. 113 at 8) Thus, under plaintiff's construction, a chromium catalyst would not function without the presence of chromium and could not be carried out by another element. Plaintiff's construction would arguably cover defendant's catalyst since: (1) defendant's catalyst would not function in the absence of chromium; and (2) although Agent X plays some role in defendant's catalyst, Agent X could not carry out the catalysis on its own. (D.I. 105 at 452-53, 560-61; D.I. 108 at 1206; D.I. 109 at 1518-19) While the court agrees with plaintiff's construction of "chromium catalyst" as a catalyst in which chromium is the only catalytically active material, it rejects plaintiff's attempt to expand "catalytically active" to cover substances capable of carrying out the fluorination reaction by themselves.

Plaintiff begins its construction argument with what it claims is the ordinary meaning of chromium catalyst. However, plaintiff's sole evidence regarding the ordinary meaning of chromium catalyst comes in the form of Dr. Dolbier's testimony:

Q: Could you explain what the term chromium catalyst would mean, the ordinary meaning of that term would be to a person of ordinary skill in the art in your opinion?

A: What this means is that the active catalyst in this reaction is chromium and only chromium.

(D.I. 105 at 430-31) This testimony does not indicate that "catalytically active" means capable of catalyzing a reaction on its own.

Plaintiff cites several statements in the specification and prosecution history which it claims establish that the '514 patent defined chromium catalyst to mean that only chromium is capable of catalyzing the claimed fluorination process. (D.I. 113 at 9-12) First, the '514 specification identifies the prior art "chromium-based mixed catalysts" such as "Ni-Cr/AlF₃ mixed catalysts." ('514 patent, col. 2 at ll. 17-41) Plaintiff claims that this establishes that the prior art had "two active catalysts (as opposed to the claimed 'chromium catalyst')." (D.I. 112 at 10) However, this statement says nothing about whether each of the metals in the mixed metal catalyst was capable of carrying out the reaction. At most, this statement in the specification shows that the prior art had two separate metals which contributed to the catalysis. Plaintiff also points to a specification reference which states that "usual fluorination catalysts such as ... Ni-Cr/AlF₃ are not stable" ('514

patent, col. 2 at ll. 51-53) Once again, this reference says nothing about both nickel and chromium being capable of carrying out the catalyzed reaction on their own. It merely shows that the prior art contained both nickel and chromium and that both of these metals contributed to the catalysis. In the prosecution history, the '514 applicants stated, "[c]omparative examples 2 and 3 show that the use of supported catalysts (Ni/AlF₃ and Ni-Cr/AlF₃) does not make it possible to obtain the lifetime obtained on [sic] catalysts according to the invention." (PX 4 at AT000173) Like the specification references, this statement also does not indicate that the prior art contained two metals, each of which was capable of carrying out the reaction. Finally, in support of its claim construction argument, plaintiff points to arguments made before the USPTO distinguishing *Cheminal* from the '514 patent. The applicants for the '514 patent distinguished *Cheminal* by saying it "completely [taught] away from the applicants' claimed process, because it suggests to use a Cr-Ni based catalyst, where as [sic] the present catalyst is only chromium based." (PX 4 at AT000178) However, *Cheminal* does not indicate whether nickel is capable of catalyzing the reaction by itself. (D.I.609)

None of the references or communications cited by plaintiff explicitly states that each metal in the prior art mixed metal catalysts could carry out the catalysis. Furthermore, plaintiff does not cite any evidence, other than the unsupported testimony of Dr. Dolbier (see D.I. 105 at 435-36), that these prior art references described catalysts in which each metal was capable of catalyzing the claimed reaction. Thus, plaintiff has failed to establish that the intrinsic evidence of record supports its definition of catalytically active (or chromium catalyst). Given that *Cheminal* does not disclose that both nickel and chromium are capable of catalyzing the reaction by themselves, plaintiff's construction of chromium catalyst could also encompass prior art. As a result, the court rejects plaintiff's construction of "bulk or supported chromium catalyst", and holds that catalytically active merely means contributing to the catalyzation of a reaction.

10. The court begins by noting that the plain ordinary meaning of a catalyst is a "substance[] that accelerate[s] the rate of chemical reactions without [] being consumed during the reactions...." FN11 Van Nostrand's Scientific Encyclopedia 560 (8th ed.1995). See also McGraw-Hill Concise Encyclopedia of Science & Technology 329 (3d ed.1992) (defining "catalysis" as "[t]he phenomenon in which a relatively small amount of foreign material called a catalyst augments the rate of a chemical reaction without itself being consumed."); McGraw-Hill Dictionary of Scientific and Technical Terms 307 (4th ed.1989) (defining a catalyst as a "[s]ubstance that alters the velocity of a chemical reaction and may be recovered essentially unaltered in form and amount at the end of the reaction."). A "chromium catalyst" would be a catalyst in which the only catalytically active material is chromium. Thus, a "chromium catalyst" would be a substance that alters the velocity of a chemical reaction without itself being consumed, where the only catalytically active material is chromium.

FN11. Plaintiff and defendant both agree with this plain ordinary meaning of catalyst. Dr. Dolbier, an expert for plaintiff, testified that "[a] catalyst is a material which when added to a reaction ... will enhance the rate of the reaction by providing an alternative lower barrier pathway or mechanism for the reaction." (D.I. 105 at 428) Defendant states in its post trial brief that "[t]o one of ordinary skill in the art, the ordinary meaning of the term 'catalyst' means 'a species that lowers the activation energy of a chemical reaction without itself being consumed.'" (D.I. 114 at 14)

11. However, the applicants for the '514 patent made several disclaimers of claim scope in the specification and the prosecution history of the '514 patent. First, the '514 specification states that "it has now been found that there is a temperature range in which a catalyst based on pure chromium (without the addition of another metal oxide) can produce, in the presence of oxygen ... [difluoromethane] by gas-phase fluorination" ('514 patent, col. 2 at ll. 54-58) The '514 applicants also stated to the USPTO that "as defined on page 5, lines 13-14 [of the '514 patent], pure chromium means without the addition of another metal oxide." (DX 579 at AT00207) The '514 applicants indicated to the USPTO that "[t]he present claims exclude the utilization of an alkali metal fluoride noted in column 1, line 59 of Buckman [.]" (D.I. 579 at AT000179, AT000216) The applicants for the '514 patent state in the specification and in the prosecution history that,

"[i]t is therefore unnecessary to employ special additives to increase its selectivity; the elimination of additives employed in the mixed catalysts enables the manufacture of the catalyst to be simplified and thereby its cost to be reduced." FN12 ('514 patent, col. 3, ll. 10-14; DX 579 at AT000172, AT000208) These statements constitute a clear disavowal of metal oxides, metal fluorides, and non-inert additives from the '514 patent's "bulk or supported chromium catalyst." As a result, the ordinary meaning of chromium catalyst must be construed to cover a substance that alters the velocity of a chemical reaction without itself being consumed, where the only catalytically active material is chromium without the addition of metal oxides, alkali metal fluorides, or non-inert additives.

FN12. Plaintiff argues in its post trial motion that this quote's description of additives as "unnecessary" simply means that additives are not needed, but does not mean they are prohibited. (D.I. 112 at 11) In this quote the '514 applicants were distinguishing the '514 patent from the prior art and pointing out a benefit of the invention, namely, that it was cheaper and easier to make. While "unnecessary" can be contorted to mean not prohibited, it is clear in the context of this quote that the '514 applicants did not intend their invention to include special additives.

B. Literal Infringement FN13

FN13. Plaintiff does not make any arguments regarding the doctrine of equivalents. Therefore, the court will not consider whether defendant infringes under this doctrine.

12. Plaintiff claims that defendant's difluoromethane process meets all the limitations, most notably the bulk or supported chromium catalyst limitation, of claims 1, 2, 5, 6, 7, 9, and 10 of the '514 patent. Defendant argues that the Agent X in its catalyst is either an excluded metal component or is a catalytically active additive and, therefore, does not satisfy the bulk or supported chromium catalyst limitation. (D.I. 114 at 21)

13. A patent is infringed when a person "without authority makes, uses or sells any patented invention, within the United States ... during the term of the patent." 35 U.S.C. s. 271(a).

14. A court should employ a two-step analysis in making an infringement determination. *Markman*, 52 F.3d at 976. First, the court must construe the asserted claims to ascertain their meaning and scope. *Id.* Claim construction is a question of law subject to de novo review. *See Cybor Corp. v. FAS Techs.*, 138 F.3d 1448, 1454 (Fed.Cir.1998). Second, the trier of fact must compare the properly construed claims with the accused infringing product. *Markman*, 52 F.3d at 976. This step is a question of fact. *See Bai v. L & L Wings, Inc.*, 160 F.3d 1350, 1353 (Fed.Cir.1998). Literal infringement occurs where each limitation of at least one claim of the patent is found exactly in the alleged infringer's product. *Panduit Corp. v. Dennison Mfg. Co.*, 836 F.2d 1329, 1330 n. 1 (Fed.Cir.1987).

15. The patent owner has the burden of proving infringement and must meet its burden by a preponderance of the evidence. *SmithKline Diagnostics, Inc. v. Helena Lab. Corp.*, 859 F.2d 878, 889 (Fed.Cir.1988) (citations omitted).

16. The court finds that defendant's catalyst does not meet the "bulk or supported catalyst" limitation of the asserted claims in the '514 patent. Defendant's catalyst contains Agent X. (DX 125; DX 126) Furthermore, defendant produced evidence that the Agent X in its catalyst is catalytically active. Defendant found substantially decreased catalyst performance when it attempted to run a fluorination process with a catalyst lacking Agent X. (D.I. 104 at 358, D.I. 106 at 737-38, 744-45) Furthermore, when defendant tested its catalyst against a variety of commercial third-party "pure" chromium catalysts, its Agent X-chromium catalyst substantially outperformed each pure chromium catalyst tested. (D.I. 106 at 721-23) Dr. Jeffrey Webb, an expert for defendant, testified that he tested defendant's catalyst and verified that Agent X was

present in defendant's catalyst and was catalytically active. (D.I. 108 at 1173-88; DX 841, 811, 812, 813, 814, 815, 816, 129) Finally, Dr. Webb and Dr. William Gumprecht testified that several articles and printed publications indicate that Agent X plays a catalytically active role in defendant's catalyst. (D.I. 108 at 1210-11, 1255, 1257-58; PX 564, 565, 566, 567) In sum, Agent X, together with chromium, serves as a catalyst in defendant's fluorination process.FN14 Thus, defendant does not have a fluorination process in which chromium is the only catalytically active material; defendant's process does not satisfy the "bulk or supported chromium catalyst" limitation.FN15

FN14. Even if Agent X were not a catalyst, at the very least it is a non-inert additive. The '514 applicants disclaimed use of non-inert additives. ('514 patent, col. 3, ll. 10-14; DX 579 at AT000172, AT000208) Consequently, even if Agent X does not rise to the level of being classified as a catalyst, its presence still puts defendant's process outside the scope of the '514 patent.

FN15. Plaintiff's arguments that defendant literally infringes the '514 patent are unavailing. (D.I. 112 at 15-21) First, plaintiff points to the testimony of Drs. Dolbier and Webb as evidence that chromium is the only catalytically active metal in defendant's catalyst. However, this argument relies on plaintiff's construction of chromium catalyst and catalytically active. Since the court has not adopted plaintiff's construction, this argument is moot. Next, plaintiff refers to several internal communications of defendant which failed to mention Agent X as a component of defendant's catalyst. (D.I. 103 at 183-84, 187-88, 201; D.I. 104 at 328, 333; D.I. 106 at 786, 804-07, 811-12; D.I. 108 at 1214-18) The fact that defendant did not acknowledge in these documents the significance of the role Agent X played in its catalytic reaction does not detract from the credible evidence of record demonstrating that measurable amounts of Agent X are present in the catalyst and that Agent X does play an active role in the catalytic reaction. Finally, plaintiff argues that defendant's catalyst is not outside the scope of the '514 patent because it only possesses de minimus levels of Agent X. The amount of material used has no relevance in determining whether a material is a catalyst. Van Nostrand's Scientific Encyclopedia 560 (8th ed.1995) (noting that early scientists found that "minute amounts of foreign substances[, catalysts,] were able to greatly affect the course of chemical reactions...."). Furthermore, the Syntex report found Agent X oxide to be the third most abundant component in defendant's catalyst. (PX 126) As a result, the court rejects plaintiff's arguments regarding literal infringement.

17. Furthermore, the '514 applicants clearly disclaimed metal oxides other than chromium oxide from the scope of the '514 patent. ('514 patent, col. 2 at ll. 54-58; DX 579 at AT000207) Both the Johnson Matthey report and the Syntex report demonstrated that defendant's catalysts contained several metal oxides including Agent X oxide. (PX 125 at 4; PX 126 at 3) As a result, defendant's catalyst once again falls outside the scope of the "bulk or supported chromium catalyst."

18. Because defendant's catalyst does not infringe the '514 patent, the court will not address plaintiff's claims of willful infringement.

C. Invalidity

1. Anticipation

19. Defendant argues that claims 1, 2, 6, 7, 9, and 10 of the '514 patent lack novelty in light of the fully translated version of JP 51-82206 which was not submitted to the USPTO. (D.I. 114 at 25)

20. Under 35 U.S.C. s. 102(b), "[a] person shall be entitled to a patent unless the invention was patented or described in a printed publication in this or a foreign country ... more than one year prior to the date of the application for patent in the United States ." The Federal Circuit has stated that "[t]here must be no

difference between the claimed invention and the referenced disclosure, as viewed by a person of ordinary skill in the field of the invention." *Scripps*, 927 F.2d at 1576. In determining whether a patented invention is explicitly anticipated, the claims are read in the context of the patent specification in which they arise and in which the invention is described. *Glaverbel Societe Anonyme v. Northlake Mktg. & Supply, Inc.*, 45 F.3d 1550, 1554 (Fed.Cir.1995). The prosecution history and the prior art may be consulted if needed to impart clarity or to avoid ambiguity in ascertaining whether the invention is novel or was previously known in the art. *Id.* The prior art need not be *ipsissimis verbis* (i.e., use identical words as those recited in the claims) to be anticipating. *Structural Rubber Prods. Co. v. Park Rubber Co.*, 749 F.2d 707, 716 (Fed.Cir.1984).

21. A prior art reference also may anticipate without explicitly disclosing a feature of the claimed invention if that missing characteristic is inherently present in the single anticipating reference. *Continental Can Co. v. Monsanto Co.*, 948 F.2d 1264, 1268 (Fed.Cir.1991). The Federal Circuit has explained that an inherent limitation is one that is necessarily present and not one that may be established by probabilities or possibilities. *Id.* That is, "[t]he mere fact that a certain thing may result from a given set of circumstances is not sufficient." *Id.* The Federal Circuit also has observed that "[i]nherency operates to anticipate entire inventions as well as single limitations within an invention." *Schering Corp. v. Geneva Pharms. Inc.*, 339 F.3d 1373, 1380 (Fed.Cir.2003). Moreover, recognition of an inherent limitation by a person of ordinary skill in the art before the critical date is not required to establish inherent anticipation. *Id.* at 1377.

22. An anticipation inquiry involves two steps. First, the court must construe the claims of the patent in suit as a matter of law. *Key Pharms. v. Hercon Labs Corp.*, 161 F.3d 709, 714 (Fed.Cir.1998). Second, the finder of fact must compare the construed claims against the prior art. *Id.* A finding of anticipation will invalidate the patent. *Applied Med. Res. Corp. v. U.S. Surgical Corp.*, 147 F.3d 1374, 1378 (Fed.Cir.1998).

23. Claim 1 discloses the following limitations: (1) gas-phase fluorination; (2) of methylene chloride; (3) with anhydrous hydrofluoric acid; (4) in the presence of 0.1 to 5 moles of oxygen per 100 moles of methylene chloride; (5) at a temperature of between 330 and 450 (deg.)C; and (6) with a bulk or supported chromium catalyst.FN16 ('514 patent, col. 7 at l. 21-col. 8 at ll. 28) JP 51-82206 discloses: (1) gas-phase catalytic fluorination (DX 593 at 1, 2, 4); (2) of halogenated hydrocarbons, specifically methylene chloride (*id.* at 1-5); (3) with anhydrous hydrofluoric acids (*id.* at 1, 3); (4) with oxygen, which is fed into the reaction at a ratio of 0.001 to 1 molar percent of the starting halogenated hydrocarbon (i.e., methylene chloride) (*id.* at 1, 4-5); (5) at a temperature of between 100 and 500 (deg.)C (*id.* at 1, 4, 6); and (6) with a pure chromium catalyst (*id.* at 4; see also *id.* at 1-3). JP 51-82206 explicitly discloses the first two limitations of claim 1 of the '514 patent (i.e., gas-phase catalytic fluorination and methylene chloride). At least a portion of the '514 patent's limitation of 0.1 to 5 moles of oxygen per 100 moles of methylene chloride is within JP 51-82206's range of 0.001 to 1 molar percent of oxygen based on methylene chloride.FN17 "When, as by a recitation of ranges or otherwise, a claim covers several compositions, the claim is 'anticipated' if one of them is in the prior art." *Titanium Metals Corp. v. Banner*, 778 F.2d 775, 782 (Fed.Cir.1985) (emphasis in original). Thus, JP 51-82206 discloses this limitation of claim 1 of the '514 patent. Similarly, the '514 patent's limitation of 330 to 450 (deg.)C is entirely within JP 51-82206's temperature range of 100 and 500 (deg.)C. Consequently, this limitation of claim 1 is also disclosed by JP 51-82206. The court's construction of "bulk or supported chromium catalyst" is a substance that alters the velocity of a chemical reaction without itself being consumed, where the only catalytically active material is chromium without the addition of metal oxides, alkali metal fluorides, or non-inert additives. Since JP 51-82206's catalyst is pure chromium, chromium must be the only catalytically active material in the catalyst and the catalyst must be a bulk or supported chromium catalyst for purposes of the '514 patent. JP 51-82206 does not mention the addition of metal oxides, alkali metal fluorides, or non-inert additives. JP 51-82206 discloses all the limitations of claim 1 of the '514 patent.

FN16. Plaintiff argues that difluoromethane is a limitation of claim 1 of the '514 patent. The statement "[p]rocess for the manufacture of difluoromethane" is the only mention of difluoromethane in claim 1. However, this statement is in the preamble of claim 1. The Federal Circuit has held that

[n]o litmus test defines when a preamble limits claim scope. Whether to treat a preamble as a limitation is a determination "resolved only on review of the entirety of the patent to gain an understanding of what the inventors actually invented and intended to encompass by the claim."

In general, a preamble limits the claimed invention if it recites essential structure or steps, or if it is "necessary to give life, meaning, and vitality" to the claim. Clear reliance on the preamble during prosecution to distinguish the claimed invention from the prior art may indicate that the preamble is a claim limitation because the preamble is used to define the claimed invention.

In re Cruciferous Sprout Litig., 301 F.3d 1343, 1347 (Fed.Cir.2002) (citations omitted). The preamble of claim 1 does not recite essential structure or steps. Furthermore, claim 1's preamble does not give life, meaning, or vitality to the claim. Rather, the preamble of claim 1 provides a descriptive name to the set of limitations in the body of the claim. Plaintiff also fails to identify any language in the prosecution history where the applicants for the '514 patent relied on the preamble to distinguish the claimed invention from the prior art. Consequently, this court concludes that the preamble of claim 1 does not create a limitation for claim 1.

However, even if the preamble of claim 1 did create a limitation, the fact that JP 51-82206 does not explicitly mention difluoromethane does not mean the process described in JP 51-82206 does not produce difluoromethane. JP 51-82206 identified methylene chloride, the starting material in the '514 patent, as one of its starting materials. JP 51-82206 then performed the same steps as the '514 patent, under the same conditions as the '514 patent. Because JP 51-82206 uses the same starting material, steps, and conditions as the '514 patent, it must also produce at least some difluoromethane. Furthermore, plaintiff's argument that there is no conversion of methylene chloride to difluoromethane at certain conditions described in JP 51-82206, does not change the court's finding that JP 51-82206 produces at least some difluoromethane. The '514 patent says nothing about the efficiency or consistency of difluoromethane production. That JP 51-82206 produces any difluoromethane under the limitations of claim 1, is sufficient to invalidate claim 1. FN17. 0.001 to 1.0 molar percent of oxygen based on the starting halogenated hydrocarbon (i.e., methylene chloride) is the equivalent of 0.001 to 1 mole of oxygen per 100 moles of methylene chloride. (D.I. 113 at 33)

24. Claim 2 depends from claim 1 of the '514 patent and, therefore, includes all the limitations of claim 1 plus the additional limitation that the oxygen to methylene chloride molar ratio is between 0.5% and 3%. ('514 patent, col. 7 at ll. 26-27) JP 51-82206 discloses all the limitations of claim 1. At least a portion of claim 2's additional limitation is also within JP 51-82206's range of 0.001 to 1.0 molar percent of oxygen based on methylene chloride. JP 51-82206's disclosure of part of the range covered in claim 2 means that JP 51-82206 disclosed this limitation. Titanium Metals, 778 F.2d at 782. JP 51-82206 discloses all the limitations of claim 2, and anticipates this claim.

25. Claim 6 also depends from claim 1 of the '514 patent and, therefore, includes all the limitations of claim 1 plus the additional limitation that the mixture of methylene chloride, anhydrous hydrogen fluoride and oxygen is in contact with the catalyst for a time between 0.01 and 10 seconds. ('514 patent, col. 8 at ll. 8-9) Although JP 51-82206 does not explicitly mention contact times, these contact times can be calculated based on the information provided in the examples of JP 51-82206.FN18 (D.I. 108 at 1276-77)) According to Dr. Gumprecht, examples 1 and 2 of JP 51-82206 have contact times of 3.0 and 4.1 seconds, which are within the range covered by claim 6. (Id.) JP 51-82206 discloses all the limitations of claim 6 and, therefore, anticipates this claim.

FN18. Defendant cites the following testimony in support of its argument that contact times may be calculated from the information provided in the examples of JP 51-82206:

Q: Let's go to Claim 6. Did you find either inherently or expressly language corresponding to that claim element

A: Yes.

Q: What about -

A: That's inherently because we have to calculate it from the examples.

Q: You mean the actual seconds of contact time you have to arrive at differently than actually seeing the number on the page?

A: The numbers are not specifically there, but the parameters are there for making the calculation.

(D.I. 108 at 1276-77) Plaintiff argues that the contact time cannot be calculated from the information disclosed in the JP 51-82206 examples. (D.I. 113 at 35) However, the testimony cited by plaintiff does not establish this argument. First, plaintiff cites the following from the cross-examination of Dr. William Gumprecht:

Q: My question is this: Where in [JP 51-82206] is there a disclosure of a gas-phase mixture of methylene chloride, anhydrous hydrogen fluoride and oxygen in contact with the catalyst for a time between .01 and 10 seconds?

A: There is no disclosure of the fluorination of methylene chloride, it's listed as a preferred raw material, and therefore it's part of the disclosure of the reference.

(D.I. 108 at 1331) However, the rest of Dr. Gumprecht's response to this question indicates that contact times could be determined based on the information provided in the examples. According to Dr. Gumprecht: [The] feed rates for raw materials and catalyst volume, temperature combined, it doesn't really make a difference [for] one of ordinary skill in the art.... You can determine [contact time] for any organic feed rate if you know the number of moles per hour of the organic and then moles of [hydrofluoric acid].

(D.I. 108 at 1331-1332) The remaining testimony cited by plaintiff indicates, not that contact times cannot be calculated based on the information provided, but that it is inappropriate to use the contact times from these examples because the examples do not produce difluoromethane; a reaction producing difluoromethane would require different conditions (e.g., temperature, reactants) from those presented in the examples. (D.I. 109 at 1481-82, 1530) Thus, plaintiff does not provide any testimony or evidence that contact time cannot be calculated from the examples. Plaintiff's argument that the contact times calculated from the examples of JP 51-82206 should not be considered because different reaction parameters would be required to produce difluoromethane, is without merit for two reasons. First, plaintiff does not dispute that none of the parameters it claims would have to change in order to produce difluoromethane (e.g., temperature, reactants) have anything to do with calculating contact time. As Dr. Gumprecht indicated, contact time can be calculated from the number of moles per hour of the organic (e.g., methylene chloride) and the moles of hydrofluoric acid used. Second, JP 51-82206 discloses a wide range of starting materials, temperatures, and oxygen to starting material ratios. If methylene chloride were substituted into the examples of JP 51-82206, the reaction parameters could change in such a way that difluoromethane could be produced and still be within JP 51-82206's disclosure. Regardless of plaintiff's argument regarding the applicability of JP 51-82206's examples to the '514 patent, the fact still remains plaintiff has not refuted that JP 51-82206 discloses contact times of between 0.1 and 10 seconds.

26. Claim 7 also depends from claim 1 of the '514 patent and, therefore, includes all the limitations of claim 1 plus the additional limitation that the process of claim 1 must be carried out at a pressure between 1 and 20 bars absolute. ('514 patent, col. 8 at ll. 8-9) JP 51-82206 discloses a fluorination reaction carried out at a pressure of 0.1 to 10 atm absolute pressure. (DX 593 at 6) This corresponds to a reaction pressure range of

0.8 to 4.0 bars absolute. (D.I. 114 at 28) JP 51-82206 discloses all the limitations of claim 7 and anticipates this claim.

27. Claim 9 has the same limitations as claim 1. FN19 ('514 patent, col. 8 at ll. 14-19) JP 51-82206 anticipates claim 9.

FN19. The only difference between claim 1 and claim 9 is in the transitional term used. Claim 1 uses the transitional term "consisting essentially of", while claim 9 uses the transitional term "consisting of". ('514 patent, col. 7 at ll. 21-22, col. 8 at ll. 14-15)

28. Claim 10 has the same limitations as claim 1 with the additional limitation that the mixture of methylene chloride, anhydrous hydrogen fluoride and oxygen is in contact with the catalyst for a time between 0.01 and 10 seconds. ('514 patent, col. 8 at ll. 26-28) The contact times employed in the examples of JP 51-82206 are 3.0 and 4.1 seconds. (D.I. 108 at 1276-77; DX 593 at 6-8) JP 51-82206 discloses all the limitations of claim 10.

29. Plaintiff argues that JP 51-82206 does not enable claims 1, 2, 6, 7, 9, or 10 of the '514 patent. (D.I. 112 at 30) Plaintiff's argument is that JP 51-2206 "does not direct one towards the narrow process parameters of the '514 patent claims, and a person of ordinary skill in the art would not obtain those parameters without undue experimentation." (Id. at 31) According to plaintiff, "the narrow process parameters of the '514 patent were necessary to overcome a reaction known as the Deacon Reaction." (Id.)

30. The '514 specification mentions the Deacon reaction six separate times. ('514 patent, col. 2 at ll. 9, 13, 19, 61, 67, col. 5 at l. 55) The first three references are in the "Background of the Invention" section and describe how the prior art dealt with the Deacon reaction. The next two references indicate that the claimed '514 patent processes did not produce the Deacon reaction. The final reference to the Deacon reaction is in the discussion of Example 1, and indicates that the Deacon reaction did not occur. None of the claims in the '514 patent mention the Deacon reaction. ('514 patent, col. 7 at l. 21-col. 8 at l. 28) Furthermore, plaintiff has not presented any claim construction argument that the Deacon reaction should be incorporated into any claim language. Consequently, information related to avoiding the Deacon reaction is completely irrelevant to determining whether the claims of the '514 patent are anticipated.

31. Furthermore, JP 51 82206's failure to direct one towards the narrow process parameters of the '514 patent claims is also irrelevant to an anticipation inquiry. In *Titanium Metals Corp. v. Banner*, the applicants for a patent claimed "[a] titanium base alloy consisting essentially by weight of about 0.6% to 0.9% nickel, 0.2% to 0.4% molybdenum, up to 0.2% maximum iron, balance titanium...." 778 F.2d 775, 776 (Fed.Cir.1985). A Russian prior art reference disclosed a titanium base alloy that had 0.25% molybdenum, 0.75% nickel and the balance titanium. Id. at 776. The applicants attempted to distinguish their invention from the Russian prior art on the basis that they had discovered "range limits of the [nickel] and [molybdenum] content, outside of which [corrosion] resistance diminishes...." Id. at 781. In other words, the applicants' contribution to the art was disclosure of specific ranges, outside of which negative results occurred. The Federal Circuit rejected this argument and found the patent application to be anticipated by the Russian prior art reference. Like *Titanium Metals*, the plaintiff attempts to argue that its patent is novel on the basis that it discovered specific parameters to avoid an undesirable result. (D.I. 112 at 31) Just as in *Titanium Metals*, this argument fails.

2. Obviousness

32. Defendant argues that claim 5 of the '514 patent is invalid for obviousness in view of JP 51-82206 and any of the *Galland*, *Tsuji*, or *Anello* references. (D.I. 114 at 29-30)

33. In pertinent part, 35 U.S.C. s. 103 provides that

a patent may not be obtained ... if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

34. The question of obviousness turns on four factual inquiries: (1) the scope and content of the prior art; (2) the level of ordinary skill in the art; (3) the differences between the claimed invention and the prior art; and (4) any objective indicators of nonobviousness, more commonly termed secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966); *B.F. Goodrich Co. v. Aircraft Braking Sys. Corp.*, 72 F.3d 1577, 1582 (Fed.Cir.1996). The existence of each limitation of a claim in the prior art does not, by itself, demonstrate obviousness. Instead, there must be a "reason, suggestion, or motivation in the prior art that would lead one of ordinary skill in the art to combine the references, and that would also suggest a reasonable likelihood of success." *Smiths Indus. Med. Sys., Inc. v. Vital Signs, Inc.*, 183 F.3d 1347, 1353 (Fed.Cir.1999). "Such a suggestion or motivation may come from the references themselves, from knowledge by those skilled in the art that certain references are of special interest in a field, or even from the nature of the problem to be solved." *Id.* at 1356.

35. To rebut a prima facie case of obviousness, objective evidence of nonobviousness may be used. *Tec Air, Inc. v. Denso Mfg. Mich, Inc.*, 192 F.3d 1353, 1360 (Fed.Cir.1999). This objective evidence includes: (1) a long-felt and unmet need in the art for the invention; (2) failure of others to achieve the results of the invention; (3) commercial success of the invention; (4) copying of the invention by others in the field; (5) whether the invention was contrary to accepted wisdom of the prior art; (6) expression of disbelief or skepticism by those skilled in the art upon learning of the invention; (7) unexpected results; (8) praise of the invention by those in the field; and (9) independent invention by others. *Graham*, 383 U.S. at 17-19. "The objective evidence of nonobviousness ... should when present always be considered as an integral part of the analysis." *Demaco Corp. v. F. Von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 1393 (Fed.Cir.1988) (quoting *W.L. Gore & Assoc. Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1555 (Fed.Cir.1983)).

36. A person of ordinary skill in the art of the '514 patent would have a Bachelor's Degree and either a Master's Degree or Ph.D. in chemistry or chemical engineering, as well as at least five years of practical experience in gas-phase catalytic fluorination. (D.I. 108 at 1133-34, 1249)

37. Claim 5 has all the limitations of claim 1 with the additional limitation that the supported chromium catalyst has a weight content of chromium being less than 20%. JP 51-82206 presents all the limitations of claim 1. "While JP 51-82206 permits the use of a supported catalyst, it does not expressly suggest the use of a chromium weight percent below 20%." (D.I. 114 at 30) Defendant argues that each of *Galland*, *Tsuji*, and *Anello* disclose a chromium catalyst which has a chromium weight percent below 20%. (D.I. 114 at 30-31) However, defendant fails to present any evidence of a motivation to combine JP 51-82206 with any of the *Galland*, *Tsuji*, or *Anello* references.FN20 Without this motivation to combine, defendant's obviousness argument fails.

FN20. Defendant states that "the prior art is replete with chromium catalysts in analogous gas-phase catalytic fluorination reactions having a weight of chromium less than 20%." (D.I. 114 at 33) While this may be true, defendant does not suggest that chromium catalysts having a weight of chromium less than 20% were so widespread that such a feature would be implicitly suggested by JP 51-82206. *See, e.g., SIBIA Neurosciences, Inc. v. Cadus Pharm. Corp.*, 225 F.3d 1349, 1356 (Fed.Cir.2000). Defendant also states that *Tsuji*, *Galland*, and *Anello* disclose the use of a supported catalyst responding to the limitation of claim 5, in fluorination reactions that are closely related to those described in JP 51-82206. Thus, the nature of the problem-developing an effective fluorination process to produce difluoromethane-would suggest to a person considering JP-82206 to also look to the *Tsuji*, *Galland*, or *Anello* references.

(D.I. 114 at 33) Although *Tsuji*, *Galland*, and *Anello* do disclose a catalyst having less than 20% of its weight coming from chromium and this catalyst is used in fluorination reactions, this only proves that *Tsuji*, *Galland*, and *Anello* were in the same field of invention as JP 51-82206 and the '514 patent. Obviousness requires more than showing that prior art was in the same field of invention. In re Bigio, 381 F.3d 1320, 1325 (Fed.Cir.2004). Nothing about the nature of the problem of developing an effective fluorination process to produce difluoromethane would suggest looking to these three references. Defendant also argues that reduction of chromium content would reduce the cost of a catalyst, thereby creating a motivation to combine JP 51-82206 with *Tsuji*, *Galland*, and *Anello*. However, difluoromethane manufacturers' desire to limit costs does not necessarily mean that they would look to these three prior art references to reduce the cost. There are undoubtedly several ways to reduce catalyst costs. Defendant fails to point to any prior art reference suggesting that chromium reduction is a way to make the JP 51-82206 catalyst more profitable. Defendant also points to the '514 inventors' practice of studying existing processes before developing their own process as motivation to combine JP 51-82206 with *Tsuji*, *Galland*, and *Anello*. (D.I. 114 at 33) This evidence does not create a motivation to combine the specific references cited by plaintiff. Finally, defendant argues that Dr. Dolbier was not one of skill in the relevant art and, therefore, did not have a valid opinion on the obviousness of the '514 patent. Regardless of Dr. Dolbier's skill level, defendant still has not identified a motivation to combine the references. As a result, defendant's obviousness argument is rejected.

3. Enablement

38. Defendant argues that the '514 patent fails to enable preparation of the claimed bulk catalyst. (D.I. 114 at 35) According to defendant, "[w]ithout specifying the process by which a chromium catalyst is prepared, the performance of the catalyst is highly unpredictable." (Id.) Defendant claims that one of ordinary skill in the art would have to begin by selecting from numerous starting compounds and countless variations on catalyst preparation technique in hopes of "stumbling" upon a catalyst providing the results of the '514 patent. (Id.)

39. The statutory basis for the enablement requirement is found in 35 U.S.C. s. 112, paragraph 1, which provides in relevant part:

The specification shall contain a written description of the invention and of the manner and process of making and using it, in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same.

40. The Federal Circuit has explained that "patent protection is granted in return for an enabling disclosure of an invention, not for vague intimations of general ideas that may or may not be workable.... Tossing out the mere germ of an idea does not constitute enabling disclosure." *Genentech, Inc. v. Novo Nordisk A/S*, 108 F.3d 1361, 1366 (Fed.Cir.1997).

41. To satisfy the enablement requirement, a specification must teach those skilled in the art how to make and to use the full scope of the claimed invention without undue experimentation. *Genentech*, 108 F.3d at 1365. "While every aspect of a generic claim certainly need not have been carried out by the inventor, or exemplified in the specification, reasonable detail must be provided in order to enable members of the public to understand and carry out the invention." *Id.* at 1366. The specification need not teach what is well known in the art. *Hybritech v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 1384 (Fed.Cir.1986).

42. Enablement is determined as of the filing date of the patent application. In re Brana, 51 F.3d, 1560, 1567 n. 19 (Fed.Cir.1995).

43. Some experimentation may be necessary in order to practice a claimed invention; the amount of experimentation, however, "must not be unduly extensive." *Id.* at 1576.

44. As summarized by the Federal Circuit:

The test [for whether undue experimentation would have been required] is not merely quantitative, since a considerable amount of experimentation is permissible, if it is merely routine, or if the specification in question provides a reasonable amount of guidance with respect to the direction in which the experimentation should proceed to enable the determination of how to practice a desired embodiment of the invention claimed.

PPG Indus. Inc. v. Guardian Indus. Corp., 75 F.3d 1558, 1564 (Fed.Cir.1996) (quoting *Ex parte Jackson*, 217 U.S.P.Q. 804, 807 (1982)).

45. A court may consider several factors in determining whether undue experimentation is required to practice a claimed invention, including: (1) the quantity of experimentation necessary; (2) the amount of direction or guidance disclosed in the patent; (3) the presence or absence of working examples in the patent; (4) the nature of the invention; (5) the state of the prior art; (6) the relative skill of those in the art; (7) the predictability of the art; and (8) the breadth of the claims. In re Wands, 858 F.2d 731, 737 (Fed.Cir.1988). These factors are sometimes referred to as the "*Wands* factors." A court need not consider every one of the *Wands* factors in its analysis. Rather, a court is only required to consider those factors relevant to the facts of the case. See *Amgen, Inc. v. Chugai Pharm. Co., Ltd.*, 927 F.2d 1200, 1213 (Fed.Cir.1991).

46. The enablement requirement is a question of law based on underlying factual inquiries. *Wands*, 858 F.2d at 737.

47. Defendant has not provided clear and convincing evidence that the '514 patent does not enable a person of ordinary skill to practice the claimed inventions. Dr. Gumprecht testified that chromium catalysts are unpredictable depending on the catalyst's preparation, and that patents dealing with chromium catalysts typically describe the catalyst in great detail in the specification and the examples. (D.I. 108 at 1291-93, 1318) Defendant also presented U.S. Patent No. 3,258,500 which, according to Dr. Gumprecht, "states that the selection of [a] catalyst is very important in the results [obtained] in fluorinating various chlorocarbons." (D.I. 108 at 1293; DX 614) However, plaintiff countered this testimony and evidence with Dr. Dolbier's testimony that a person of ordinary skill in the art would know how to make the '514 catalyst and also would know where to purchase such a catalyst. (D.I. 109 at 1517-18) Furthermore, defendant provides no evidence concerning the amount of experimentation necessary to practice the claimed invention. Given the conflicting testimony and lack of information regarding the amount of experimentation required, the court finds that defendant did not provide clear and convincing evidence that the '514 patent does not enable a person of ordinary skill to practice the claimed invention.FN21

FN21. "[A] specification need not disclose what is well known in the art.... [This] means that the omission of minor details does not cause a specification to fail to meet the enablement requirement.... It is the specification, not the knowledge of one skilled in the art, that must supply the novel aspects of an invention in order to constitute adequate enablement." *Genentech, Inc. v. Novo Nordisk A/S*, 108 F.3d 1361, 1366 (Fed.Cir.1997). The '514 patent claims a novel process for manufacturing difluoromethane. It does not claim that the bulk or supported catalyst used by the invention is novel. Nor does the '514 patent claim a novel process for creating the bulk or supported catalyst. This already existed in the prior art cited by defendant. As a result, the '514 patent need not provide a detailed description of the bulk or supported catalyst or how to make the catalyst used by the '514 claims.

4. Best Mode

48. Defendant argues that plaintiff failed to disclose its best mode of practicing the '514 patent because plaintiff knew that crushing its catalyst prior to use in the reaction enhanced the catalyst's performance and, yet, plaintiff never disclosed use of a crushed catalyst in the '514 patent's specification. (D.I. 114 at 36)

49. The best mode requirement of 35 U.S.C. s. 112, para. 1. states:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

35 U.S.C. s. 112 (2002) (emphasis added).

50. "The purpose of the best mode requirement is to ensure that the public, in exchange for the rights given the inventor under the patent laws, obtains from the inventor a full disclosure of the preferred embodiment of the invention." *Dana Corp. v. IPC Ltd. P'ship*, 860 F.2d 415, 418 (Fed.Cir.1988). Consequently, the best mode requirement of s. 112 "requires an inventor to disclose the best mode contemplated by him, as of the time he executes the application, of carrying out the invention." *Bayer AG & Bayer Corp. v. Schein Pharms., Inc.*, 301 F.3d 1306, 1314 (Fed.Cir.2002) (citation omitted). "The existence of a best mode is a purely subjective matter depending upon what the inventor actually believed at the time the application was filed." *Id.* Because of this subjectivity, s. 112 demands actual disclosure, regardless of whether practicing that mode would be within the knowledge of one of ordinary skill in the art. *Id.* Nevertheless, the extent of this actual disclosure is limited to the invention as defined by the claims. *Id.* at 1315.

51. In determining whether an inventor has disclosed the best mode, the Federal Circuit has adopted a two-step inquiry. First, the invention must be defined by construing the claims. *Id.* at 1320 (citing *Northern Telecom Ltd. v. Samsung Elec. Co.*, 215 F.3d 1281, 1286-87 (Fed.Cir.2000)). The Federal Circuit has noted that "[d]efinition of the invention 'is a legal exercise, wherein the ordinary principles of claim construction apply.'" *Id.* It has also commented that such definition "is a crucial predicate to the factual portions of the best mode inquiry because it ensures that the finder of fact looks only for preferences pertaining to carrying out the claimed invention." *Id.*

52. Once the claim analysis is complete, the finder of fact may proceed to the second step and apply the classic two-prong test. That is, the fact-finder must determine whether, at the time of filing the application, the inventor possessed a best mode for practicing the claimed invention. *Id.* at 1320. If the inventor subjectively contemplated a best mode, then the fact-finder must evaluate whether the inventor's disclosure is objectively adequate to enable one of ordinary skill in the art to practice the best mode of the claimed invention. *Id.*

53. The Federal Circuit further has delineated that "if the best mode for carrying out the claimed invention involves novel subject matter, then an inventor must disclose a method for obtaining that subject matter even if it is unclaimed." *Id.* at 1322 (quoting *Eli Lilly & Co. v. Barr Labs., Inc.*, 251 F.3d 955, 965 (Fed.Cir.2001)). In other words, when the subject matter is unclaimed, but both novel and essential for carrying out the best mode of the claimed invention, disclosure is required. *Id.* With regard to unclaimed subject matter unrelated to the properties of the claimed invention, the Federal Circuit has acknowledged that an inventor need not disclose a mode for obtaining it. *Id.* (citing *Eli Lilly*, 251 F.3d at 963)

54. As evidence of plaintiff's failure to disclose the best mode, defendant pointed to an English translation of plaintiff's research documentation which, defendant claimed, indicated that the bulk chromium catalyst was crushed prior to use in the reaction. (DX 710 at AT003347; D.I. 103 at 143-44; D.I. 108 at 1294-95) However, plaintiff contested this translation, claiming that a more accurate translation would have used the word "chop" instead of "crush." (D.I. 103 at 144) Furthermore, plaintiff pointed to an appendix in the same research document which indicated that the catalyst was cut into four pieces. (DX 710 at AT003413; D.I. 103 at 144-45) Based on this conflicting evidence, defendant has not produced clear and convincing evidence that plaintiff failed to disclose its best mode with respect to preparing the '514 catalyst.

D. Inequitable Conduct

55. Defendant alleges that "[t]he '514 patent is unenforceable because the applicants intentionally withheld the full English language translation of the JP 51-82206 prior art during prosecution of the application before the USPTO, while making repeated misrepresentations to the USPTO in attempting to distinguish the '514 patent claims over the prior art." (D.I. 114 at 37)

56. Applicants for patents and their legal representatives have a duty of candor, good faith, and honesty in their dealings with the PTO. *Molins PLC v. Textron, Inc.*, 48 F.3d 1172, 1178 (Fed.Cir.1995); 37 C.F.R. s. 1.56(a). This duty is predicated on the fact that "a patent is an exception to the general rule against monopolies and to the right of access to a free and open market." *Precision Instrument Mfg. Co. v. Auto. Maint. Mach. Co.*, 324 U.S. 806, 816 (1945). The duty of candor, good faith, and honesty includes the duty to submit truthful information and the duty to disclose to the USPTO information known to patent applicants or their attorneys which is material to the examination of a patent application. *Elk Corp. of Dallas v. GAF Bldg. Materials Corp.*, 168 F.3d 28, 30 (Fed.Cir.1999). A breach of this duty constitutes inequitable conduct. *Molins*, 48 F.3d at 1178.

57. If it is established that a patent applicant engaged in inequitable conduct with respect to one claim, then the entire patent application is rendered unenforceable. *Kingsdown Med. Consultants v. Hollister Inc.*, 863 F.2d 867, 877 (Fed.Cir.1988). Additionally, "[a] breach of the duty of candor early in the prosecution may render unenforceable all claims which eventually issue from the same or a related application." *Fox Indus., Inc. v. Structural Pres. Sys., Inc.*, 922 F.2d 801, 803-04 (Fed.Cir.1991).

58. A finding of inequitable conduct is "an equitable determination" and, therefore, "is committed to the discretion of the trial court." *Monon Corp. v. Stoughton Trailers, Inc.*, 239 F.3d 1253, 1261 (Fed.Cir.2001).

59. In order to establish unenforceability based on inequitable conduct, a defendant must establish by clear and convincing evidence that: (1) the omitted or false information was material to patentability of the invention; (2) the applicant had knowledge of the existence and materiality of the information; and (3) the applicant intended to deceive the USPTO. *Molins*, 48 F.3d at 1178.

60. A determination of inequitable conduct entails a two step analysis. First, the court must determine whether the withheld information meets a threshold level of materiality. A reference is considered material if there is a substantial likelihood that a reasonable examiner would consider it important in deciding whether to allow the application to issue as a patent. *Allied Colloids, Inc. v. American Cyanamid Co.*, 64 F.3d 1570, 1578 (Fed.Cir.1995) (citations omitted); *see also* 37 C.F.R. 1.56(b)(2) ("[I]nformation is material to patentability when it ... establishes ... a prima facie case of unpatentability of a claim; or ... refutes, or is inconsistent with, a position the applicant takes in [o]pposing an argument of unpatentability relied on by the [o]ffice, or [a]sserting an argument of patentability."). A reference, however, does not have to render the claimed invention unpatentable or invalid to be material. *See Merck v. Danbury Pharmacal*, 873 F.2d 1418 (Fed.Cir.1989).

61. After determining that the applicant withheld material information, the court must then decide whether the applicant acted with the requisite level of intent to mislead the PTO. *See Baxter Int'l, Inc. V. McGaw Inc.*, 149 F.3d 1321, 1327 (Fed.Cir.1998). "Intent to deceive cannot be inferred solely from the fact that information was not disclosed; there must be a factual basis for finding a deceptive intent." *Hebert v. Lisle Corp.*, 99 F.3d 1109, 1116 (Fed.Cir.1996). That is, "the involved conduct, viewed in light of all the evidence, including evidence indicative of good faith, must indicate sufficient culpability to require a finding of intent to deceive." *Kingsdown*, 863 F.2d at 876. A "smoking gun" is not required in order to establish an intent to deceive. *See Merck*, 873 F.2d at 1422. An inference of intent, nevertheless, is warranted where a patent applicant knew or should have known that the withheld information would be

material to the PTO's consideration of the patent application. *Critikon, Inc. v. Becton Dickinson Vascular Access, Inc.*, 120 F.3d 1253, 1256 (Fed.Cir.1997).

62. Once materiality and intent to deceive have been established, the trial court must weigh them to determine whether the balance tips in favor of a conclusion of inequitable conduct. *N.V. Akzo v. E.I. DuPont de Nemours*, 810 F.2d 1148, 1153 (Fed.Cir.1988). The showing of intent can be proportionally less when balanced against high materiality. *Id.* In contrast, the showing of intent must be proportionally greater when balanced against low materiality. *Id.*

63. Because a patent is presumed valid under 35 U.S.C. s. 282, inequitable conduct requires proof by clear and convincing evidence. *Manville Sales Corp. v. Paramount Sys., Inc.*, 917 F.2d 544, 551 (Fed.Cir.1990).

1. Materiality

64. The fully translated version of JP 51-82206 is highly material to the claims of the '514 patent because it discloses all the limitations of claims 1, 2, 6, 7, 9, and 10. Not only does JP 51-82206 disclose all of the above limitations, it discloses every claim limitation of the '514 patent except for the weight content limitation of claim 5. There is more than a substantial likelihood that a reasonable examiner would have considered this information important in deciding whether to allow the '514 application to issue as a patent.

2. Intent

65. Plaintiff had a full-length English translation of JP 51-82206 at least as early as June 16, 1988. (D.I. 103 at 147-48; DX 593) Drs. Requieme and Lacroix, two of the three named inventors of the '514 patent, testified that they read the full-length English translation of JP 51-82206 before coming up with the process patented by the '514 patent. (D.I. 103 at 147; D.I. 107 at 917) Furthermore, the '514 patent specification includes a description of JP 51-82206. ('514 patent, col. 1 at ll. 44-63) This description contains information not disclosed in the Derwent abstract submitted to the USPTO by the '514 applicants.

66. Plaintiff's in-house patent attorney at the time of its application for the '514 patent was Mr. Leboulanger. Partway through the prosecution of the '514 patent, in September of 1997, Pierre Granet took over responsibility for prosecution of the '514 patent. (D.I. 107 at 1051-52, 1058) Mr. Granet admitted that he had the full English translation of JP 51-82206 in his files, which were transferred to him from Mr. Leboulanger. (*Id.* at 1063, 1065) Frederick Calvetti, plaintiff's U.S. patent counsel, never received a copy of the full English translation of JP 51-82206, nor was the translation ever submitted to the USPTO by plaintiff. (D.I. 107 at 1027-28) Mr. Calvetti filed Information Disclosure Statements (IDS) with the USPTO which included a copy of JP 51-82206 in Japanese and a Derwent abstract of JP 51-82206. (*Id.* at 1031, 1042) The Derwent abstract of JP 51-82206 did not indicate that JP 51-82206 disclosed use of a pure chromium catalyst and had examples using contact times of 3.0 and 4.1 seconds.

66. Plaintiff also made several misrepresentations to the USPTO regarding JP 51-82206. The '514 applicants stated that JP 51-82206 discloses a catalyst containing "chiefly chromium oxide and optionally other metal oxides." (DX 579 at AT000175, AT000212) Characterizing JP 51-82206's catalyst as containing "chiefly" chromium oxide meant that JP 51-82206's catalyst contained other components. The applicants failed to mention that JP 51-82206 discloses a catalyst of pure chromium oxide. This misrepresentation is particularly important because the '514 applicants repeatedly represented to the USPTO that the key difference between the '514 patent and the prior art was the '514 patent process's use of a pure chromium catalyst. (DX 579 at AT000179, AT000180, AT000207, AT000216) Furthermore, the specification of the '514 patent repeatedly states that the claimed chromium catalyst is pure chromium. ('514 patent, col. 2 at ll. 54-59; col. 7 at ll. 7-12) Failure to identify JP 51-82206 as prior art disclosing use of a pure chromium catalyst allowed the '514 applicants to continue to make this argument.

67. The '514 applicants also mischaracterized JP 51-82206 with respect to the scope of the reference and the contact times used in the reference. According to the '514 applicants, "[a] person skilled in the art, who is looking for a means of fluorinating a specific H containing halocarbon (CH₂ Cl₂) with good selectivity, is therefore not prompted to consider the teachings of ... JP 51-82206." (DX 579 at AT000178, AT000215) (emphasis in original) However, in the full translation of JP 51-82206, methylene chloride, an H containing halocarbon, is listed as a preferred starting material. (DX 593 at 5) The applicants also stated that "[t]hese specific process conditions effect a contact time of 10 seconds or less.... The short contact time is not taught in the applied references. Contact time indicated in the references are substantially in excess of this." (DX 579 at AT000171) JP 51-82206 discloses contact times of 3.1 and 4.0 seconds, calculated from the reaction data provided in the experimental examples. (DX 593 at 6-8)

68. Based on plaintiff's possession and knowledge of the full translation of JP 51-82206, its failure to disclose this document to the USPTO and its repeated mischaracterization of this document, the court concludes that plaintiff had the intent to deceive the USPTO.

69. In *Semiconductor Energy Lab. Co. v. Samsung Elecs. Co.*, the Federal Circuit found inequitable conduct under conditions similar to those of the present case. 204 F.3d 1368 (Fed.Cir.2001). In that case, Semiconductor Energy Laboratory ("SEL") accused Samsung of infringing its U.S. Patent No. 5,543,636 ("the '636 patent"). Id. at 1371. The '636 patent's IDS included a Japanese Laid-Open Application No. 56-135968 assigned to Canon K.K. ("the Canon reference"). Id. In addition, "SEL submitted the entire 29-page Canon reference in its original Japanese, a concise explanation of its relevance, and an existing one-page partial English translation from a prior unrelated patent." Id. at 1371-72. Similarly, plaintiff at bar submitted JP 51-82206 in its original Japanese, an explanation of its relevance in the '514 patent specification, and the Derwent one-page partial English translation of JP 51-82206. In *Semiconductor Energy*, the district court found that the Canon reference was material since it established a prima facie case of unpatentability in combination with other information. Id. at 1374. In the present matter, the court has found that JP 51-82206 is material because it anticipates all the limitations of claims 1, 2, 6, 7, 9, and 10 of the '514 patent. The district court in *Semiconductor Energy* found an intent to deceive because the '636 patent inventor "knew that the Canon reference disclosed the important admonition to avoid impurities and that the preexisting, one-page partial translation did not discuss this teaching." Id. at 1376. Similarly, this court has found an intent to deceive because the '514 applicants knew or should have known that JP 51-82206 disclosed the important feature of a pure chromium catalyst and that the one-page partial translation did not discuss this teaching. In *Semiconductor Energy*, the Federal Circuit affirmed the district court's findings regarding materiality and intent and its ultimate conclusion that the '636 patent was unenforceable because the applicants for the '636 patent engaged in inequitable conduct. FN22 Id. at 1374, 1376, 1378.

FN22. In *Semiconductor Energy*, SEL also argued that "because it submitted the entire untranslated Canon reference to the PTO, it [could not] be deemed to have withheld the reference from the examiner." Id. at 1377. The Federal Circuit rejected this argument. According to the Court, "[t]he duty of candor does not require that the applicant translate every foreign reference, but only that the applicant refrain from submitting partial translations and concise explanations that it knows will misdirect the examiner's attention from the reference's relevant teaching. Here, the desirability of the examiner securing a full translation was masked by the affirmatively misleading concise statement and one-page translation." Id. at 1378. This court finds that, as in *Semiconductor Energy*, the '514 applicants' disclosure of the Derwent translation, together with its mischaracterization of JP 51-82206, masked the need for the USPTO to secure a full translation. Thus, disclosure of the full-length, untranslated JP 51-82206 was insufficient to refute defendant's claim of inequitable conduct.

3. Balancing Materiality and Intent

70. JP 51-82206 is highly material to the claims of the '514 patent. Based on plaintiff's knowledge of JP 51-

82206, its withholding of the full translation of this reference, and its misrepresentation of critical features of the full translation, the court concludes that the '514 applicants intended to deceive the USPTO. As a result, the '514 patent is unenforceable based upon JP 51-82206.

IV. CONCLUSION

For the reasons set forth above, the court finds the following: (1) the '514 patent is not literally infringed by defendant's accused process; (2) claims 1, 2, 6, 7, 9, and 10 '514 patent are invalid because they are anticipated by JP 51-82206; (3) claim 5 of the '514 patent is not obvious because there is no motivation to combine JP 51-82206 with *Galland*, *Tsuji*, or *Anello*; (4) the '514 patent is not invalid for lack of enablement or failure to disclose the best mode; (5) the '514 patent is invalid for inequitable conduct regarding the '514 applicants' disclosure and misrepresentation of JP 51-82206. An appropriate order shall issue.

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