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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte KAIWU DONG, XIANGJIE FANG,
HELFRIED NEUMANN, RALF JACKSTELL,
MATTHIAS BELLER, ROBERT FRANKE, DIETER HESS,
KATRIN MARIE DYBALLA, DIRK FRIDAG, and FRANK GEILEN

Appeal 2019-005531
Application 15/213,444
Technology Center 1600

Before ERIC B. GRIMES, RICHARD M. LEOVITZ, and
TAWEN CHANG, *Administrative Patent Judges*.

CHANG, *Administrative Patent Judge*.

DECISION ON APPEAL

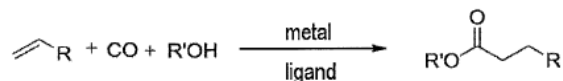
Pursuant to 35 U.S.C. § 134(a), Appellant¹ appeals from the
Examiner's decision to reject claims 1 and 7. We have jurisdiction under
35 U.S.C. § 6(b).

We AFFIRM.

¹ We use the word "Appellant" to refer to "applicant" as defined in 37
C.F.R. § 1.42. Appellant identifies the real party in interest as Evonik
Degussa GMBH. Appeal Br. 2.

STATEMENT OF THE CASE

“[A]lkoxy carbonylation is . . . the reaction of ethylenically unsaturated compounds (olefins) with carbon monoxide and alcohols in the presence of a metal-ligand complex to give the corresponding esters,” as illustrated below:



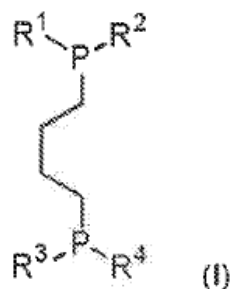
Spec. 1:7–14. The scheme reproduced above depicts “the general reaction equation of an alkoxy carbonylation.” *Id.* at 1:10–14. “Typically, the metal used is palladium” and “bidentate diphosphine compounds are used . . . as ligands.” *Id.* at 1:9–10, 22.

According to the Specification, the invention “provid[es] novel ligands for alkoxy carbonylation” that achieves good yields of esters and are “suitable for the alkoxy carbonylation of long-chain ethylenically unsaturated compounds, for example C₈ olefins, and of mixtures of ethylenically unsaturated compounds.” Spec. 2:7–11. In particular, the Specification teaches “butyl-bridged diphosphine compounds substituted by at least one heteroaryl radical on at least one phosphorus atom.” *Id.* at 2:13–14.

CLAIMED SUBJECT MATTER

Claims 1 and 7, the only claims on appeal, are reproduced below:

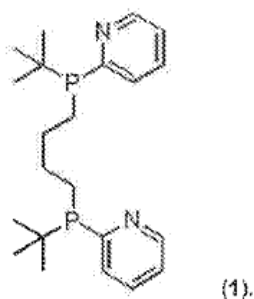
1. A compound capable of binding palladium having formula (I)



where

R^1 and R^3 are each a heteroaryl having 6-10 ring atoms;
and R^2 and R^4 are independently selected from -(C1-C4)-alkyl.

7. Compound according to claim 1, of the formula (1)



Appeal Br. 12 (Claims App.).²

² As listed in the Claims Appendix, claim 1 does not include the limitation “capable of binding palladium.” Appeal Br. 12 (Claims App.). However, the limitation was added in Appellant’s December 18, 2018 Response under 37 C.F.R. § 1.114, and the claims do not appear to have been amended subsequently to remove the limitation. Both Appellant and the Examiner also make arguments based on the limitation in the Appeal Brief and Answer, respectively. Accordingly, we understand that the limitation was inadvertently omitted in the Claims Appendix.

REJECTION(S)

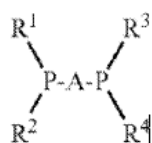
- A. Claims 1 and 7 are rejected under 35 U.S.C. § 103 as being unpatentable over Kodama,³ Wislicenus,⁴ and Hill.⁵ Ans. 3.
- B. Claim 1 is rejected on the judicially-created basis that it contains an improper Markush grouping of alternatives. Ans. 7.

OPINION

A. Obviousness rejection over Kodama, Wislicenus, and Hill (claims 1 and 7)

1. Issue

As an initial matter, the Examiner concludes that the preamble limitation, “capable of binding palladium,” is functional language that carries no patentable weight in claims for compositions of matter. Ans. 7. The Examiner next finds that Kodama teaches bisphosphines of formula (2), reproduced below, for making complexes of Au, Ag, Cu, or Pt for treating cancer:



(2)

Ans. 3–4. The Examiner finds that Kodama teaches that

R¹s and R³s each represent an alkyl group, a cycloalkyl group, an aryl group, an aralkyl group, a pyridyl group, or a pyrimidyl group; R²s and R⁴s each represent an alkyl group or a

³ Kodama et al., US 8,106,186 B2, issued Jan. 31, 2012.

⁴ Johannes Wislicenus, ADOLPH STRECKER’S SHORT TEXT-BOOK OF ORGANIC CHEMISTRY (W.R. Hodgkinson & A.J. Greenaway trans., 1881).

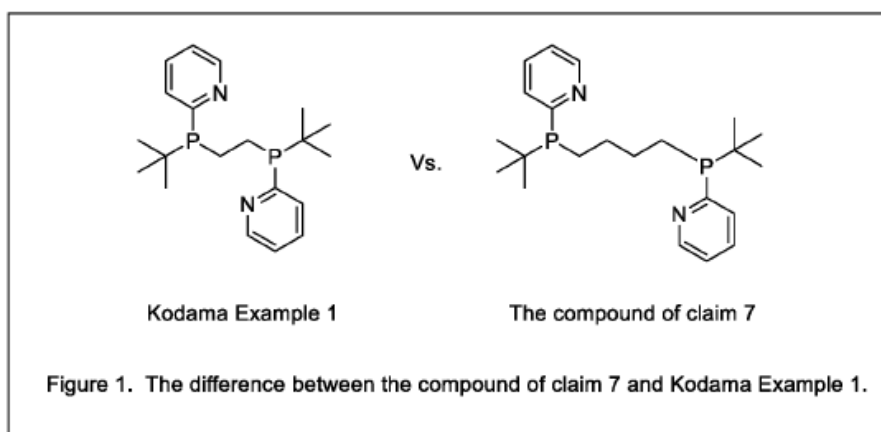
⁵ Hill et al., EP 0 198 696, published Oct. 22, 1986.

cycloalkyl group, provided that each R¹ and each R² are not the same group and that each R³ and each R⁴ are not the same group; As each represent a linear alkylene group....The present invention also provides the transition metal phosphine complex in [w]hich R¹s and R³s each represent a pyridyl group....

Id. at 4.

The Examiner finds that Hill also discloses various “butyl bridged bis-phosphine compounds” that are used as ligands to make various Au complexes useful for treating cancers. Ans. 4–5.

The Examiner finds that Kodama discloses a specific compound, 1,2-bis(tert-butyl(2-pyridyl)phosphino)ethane, that differs from the compound of claim 7, 2-bis(tert-butyl(2-pyridyl)phosphino)butane, by two methylene groups, as shown below:



Ans. 5, 10–11. The Examiner finds that, thus, Kodama discloses an alkyl homolog of the compound of claim 7.

The Examiner concludes that a skilled artisan would find the compound of claim 7 obvious because “[h]omologs have long been known to exhibit similar properties as evidenced by . . . Wislicenus,” and a skilled artisan “would expect the compounds to have similar properties.” Ans. 6.

The Examiner further cites to case law holding “[a]nalogous differing only in a

single methylene in an alkyl chain . . . to be prima facie obvious,” and to Kodama’s teaching that for purposes of its invention “As . . . represent a linear alkylene group,” which is described generically as “an ethylene group, a trimethylene group, a tetramethylene group.” *Id.* at 6–7. The Examiner explains that “[t]he tetramethylene group is butyl.” *Id.* at 7.

Finally, the Examiner finds that a skilled artisan would have a reasonable expectation of success at arriving at the claimed invention, because, “as can be seen by the Hill disclosure, preparing and making the complexes of all the alkyl congeners for these phosphine ligands is routine in the anti-cancer phosphine complex art” and “[a]ll of the alkyl homologs give the requisite complexes.” *Ans.* 7.

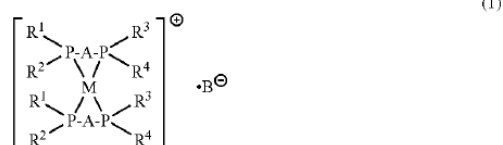
Appellant contends that the Examiner has not pointed to guidance that would have lead a skilled artisan to arrive at the claimed invention from the teachings of the prior art, with a reasonable expectation of success. *Appeal Br.* 4; *Reply Br.* 2–3. Appellant contends that the Examiner’s rejection is based on improper hindsight, improperly relied on inherency with respect to the limitation regarding palladium binding, and did not take due account of the unexpected results presented in the Specification. *Reply Br.* 3–4. Finally, Appellant contends that Kodama’s phosphine ligand is “solely useful as an intermediate” for preparing the final anti-cancer agent; thus, “no activity [is] expected to be ‘maintained’ for the . . . homologue[s].” *Id.* at 3.

The issue with respect to this rejection is whether a preponderance of evidence supports the Examiner’s conclusion that the compound disclosed in Example 1 of Kodama, in combination with the remaining teachings of Kodama, Hill, and Wislicenus, renders obvious the claims on appeal.

2. Findings of Fact

1. Kodama teaches

a novel transition metal phosphine complex having excellent anticancer activity. The transition metal phosphine complex is represented by general formula (1):

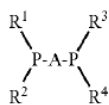


(wherein R¹s and R³s each represent an alkyl group, a cycloalkyl group, an aryl group, an aralkyl group, a pyridyl group, or a pyrimidyl group; R²s and R⁴s each represent an alkyl group or a cycloalkyl group, provided that each R¹ and each R² are not the same group and that each R³ and each R⁴ are not the same group; A each represent a linear alkylene group or a cis-vinylene group; M represents a gold atom, a silver atom, a copper atom, or a platinum atom; and B represents an anionic species).

Kodama Abstract; *see also id.* at 1:9–12, 2:1–6.

2. Kodama teaches that, with respect to its preferred embodiments, the A in general formula (1) represents “a linear alkylene group or a cis-vinylene group” and that, where A is a linear alkylene group, an alkylene group having 1 to 5 carbon atoms (e.g., a methylene group, an ethylene group, a trimethylene group, a tetramethylene group, and a pentamethylene group) is suitable, even though “[a]n ethylene group is preferred.” Kodama 4:30–35.

3. Kodama teaches “[a] method for producing the transition metal phosphine complex of [its] invention” by “allowing a bisphosphine derivative represented by general formula (2)



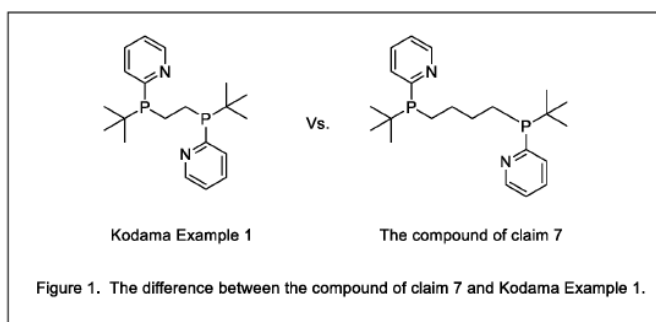
(2)

(wherein R¹ to R⁴ and A have the same meanings as defined above) to react with a transition metal salt of gold, copper, platinum, or silver.” *Id.* at 5:22–38. Kodama teaches that “[t]he bisphosphine derivative represented by general formula (2) is a starting material and may be produced by a known method.” *Id.* at 5:39–41.

4. Kodama teaches 4 example compounds and 1 comparative example compound. Examples 1–3 of Kodama teach the synthesis of racemic, meso, and R,R forms of bis(1,2-bis(tert-butyl(2-pyridyl)phosphino)ethane)gold(I) chloride (Compounds (1)–(3)) from stereoisomers of 1,2-bis(tert-butyl(2-pyridyl)phosphino)ethane. Kodama 11:15–12:26, 15:14–27 (Table 1). Example 4 teaches the synthesis of bis(R,R)-1,2-bis(tert-butyl(2-pyrimidyl)phosphino)ethane)gold(I) chloride. *Id.* at 12:60–13:26, 15:14–27 (Table 1). Comparative Example 1 teaches the synthesis of bis[1,2-bis(phenyl(2-pyridyl)phosphino)ethane]gold(I) chloride (Compound (5)) from 1,2-bis(phenyl(2-pyridyl)phosphino)ethane. *Id.* at 14:55–15:13, 15:14–27 (Table 1).

5. The Examiner finds, and Appellant does not dispute, that 1,2-bis(tert-butyl(2-pyridyl)phosphino)ethane differs from the compound of

claim 7 only by two methylene groups in the alkyl bridge between the phosphorous atoms, as shown below:

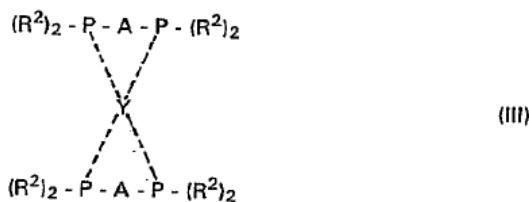


Ans. 5, 10–11.

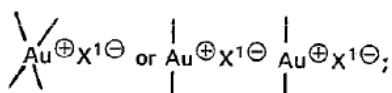
6. Kodama teaches that compounds (1)–(3), i.e., the transition metal-phosphine complex discussed above, have excellent water solubility; excellent anticancer properties compared with cisplatin, a known anticancer agent; and low toxicity. Kodama 15:28–16:67, 17:31–18:7.

7. Hill teaches

[p]harmaceutical compositions containing compounds of structure (III)



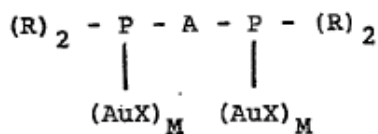
in which R^2 is the same and is phenyl, ethyl or 2-pyridyl, A is C_{1-6} alkanediyl chain, Y is a link of structure:



where X^1 is halo, and their use in therapy for inhibiting the growth of animal tumor cells. Intermediates used in the preparation of compounds (III), compositions containing them and their use in therapy for inhibiting the growth of animal tumor cells.

Hill Abstract (formatting added); *see also id.* at 10:32–11:25.

8. Hill also teaches
compounds of the formula:



FORMULA (I)

wherein:

- R is the same and is 2-pyridyl, 4-pyridyl, 2-thienyl or 2-furyl;
X is the same and is halo or thiosugar;
M is 0 or 1, provided that when M is 1, R is 2-pyridyl or 4-pyridyl; and
A is a straight or branched alkanediyl chain of from one to six carbon atoms.

When X is thiosugar, the attachment of X to the gold atom is through the sulfur atom of the thiosugar.

Hill 2:23–3:5. Hill teaches that compounds of formula (I) also inhibit tumor growth. *Id.* at 9:32–10:31.

9. Hill teaches that “[a]ll the compounds of Formulas (I) . . . and (III) can be prepared by methods available to one skilled in the art.” Hill 4:35–5:2.

10. Hill teaches example compounds of Formulas (I) and (III) wherein A is a butyl bridge, including some in which R or R² are 2-pyridyl groups. *See, e.g.* Hill 17:16 (1,2-Bis(di-2-pyridylphosphino)butane), 20:11 (dichlorobis[1,2-bis(diphenylphosphino)butane]digold), 24:8–9 (μ -[1,4-Bis(di-2-pyridylphosphino)butane]bis(chlorogold)), 25:8–9 (chlorobis-[1,4-bis(di-2-pyridylphosphino)butane]gold), 25:28–29 (μ -[1,4-bis(di-2-pyridylphosphino)butane]bis-(1-thio- β -D-glucofuranosato-S)gold).

11. Wislicenus teaches that “bodies of different molecular composition frequently exhibit great similarity in all their chemical and physical properties” and that “[t]he compounds in which these analogies are most marked are those whose formulae differ by CH_2 , or a whole multiple thereof, $n\text{CH}_2$.” Wislicenus 38.

12. Wislicenus teaches that “[t]he similarity of physical properties between the members of a homologous series is greater . . . the less they differ in chemical composition.” Wislicenus 38.

3. *Analysis*

Except as otherwise noted, we adopt the Examiner’s findings of fact and reasoning regarding the scope and content of the prior art (Final Act. 2–4, 6–10, FF1–FF12) and agree that claims 1 and 7 are obvious over Kodama, Wislicenus, and Hill. We address Appellant’s arguments below. Only those arguments made by Appellant in the briefs have been considered; arguments not presented in the briefs are waived. *See* 37 C.F.R. § 41.37(c)(1)(iv).

Appellant contends that the claims are “directed to butyl-bridged diphosphine ligands capable of complexing with palladium in a reaction mixture to form an active catalyst suitable for alkoxy carbonylation.” Appeal Br. 4. Appellant contends that the Examiner has not pointed to “[g]uidance that would have led one to the necessary substituents for alkoxy carbonylation activity” and that “[t]here is also no reasonable expectation of success of achieving alkoxy carbonylation catalytic activity.” *Id.* (emphasis omitted).

We are not persuaded. As an initial matter, the claims are directed to a compound and do not recite any limitations relating to alkoxy carbonylation. Thus, it is not necessary for a prior art reference to

suggest alkoxycarbonylation catalytic activity in order to render the claims obvious. Similarly, because the prior art combination renders obvious the compound recited in claim 7, the claim element “capable of binding palladium” is inherently met. *See, e.g., Abbott Labs. v. Baxter Pharm. Products, Inc.*, 471 F.3d 1363, 1368 (Fed. Cir. 2006) (“The general principle that a newly-discovered property of the prior art cannot support a patent on that same art is not avoided if the patentee explicitly claims that property.”).

Appellant contends that there is no guidance in the prior art for selecting the compound of Kodama’s Example 1 as a lead compound, no teaching in the art that “a ligand with a ‘butyl bridge’ . . . would have anticancer activity,” no discussion of how “the alkyl bridge length impacts transitional metal binding,” and no suggestion that “increasing the length of an ethyl bridge,” such as that found in the compound of Kodama’s Example 1, “would have a positive effect on anticancer activity.” Reply Br. 2–3.

We are not persuaded. Kodama teaches that the compound of its Example 1 (i.e., compound 1) has excellent water solubility; excellent anticancer properties compared with cisplatin, a known anticancer agent; and low toxicity. FF4, FF6. Thus, to the extent a lead compound analysis is applicable in this case, a skilled artisan would have had reason, based on the guidance provided in Kodama, to choose the compound of Kodama’s Example 1 as a lead compound.

Likewise, the teachings in the prior art provide a motivation for a skilled artisan to arrive at the claimed compound, with a reasonable expectation of success. Kodama’s Example 1 teaches a compound that differs from the compound recited in claim 7 only in two methylene groups in the alkyl bridges connecting the phosphorus atoms. FF5. That is, the

compound of Kodama's Example 1 contains an ethyl bridge, whereas the compound of claim 7 contains a butyl bridge, and the formulas of the two compounds thus differ by $-C_2H_4-$. *Id.*

It is known in the prior art that compounds whose formula differ by multiple of CH_2 "frequently exhibit great similarity in all their chemical and physical properties." FF11, FF12. More importantly, Kodama explicitly teaches that, with respect to preferred embodiments of its anticancer transition metal phosphine complex, the bridge between the phosphorus atoms may be a tetramethylene (i.e., butyl) group and further teaches that the bisphosphine derivative used as a starting material to produce the complex "may be produced by a known method." FF2, FF3. Similarly, Hill teaches antitumor bisphosphine derivatives, as well as transition metal phosphine complexes comprising such derivatives, that have an alkanediyl bridge connecting the two phosphorus atoms of the bisphosphine derivative, and provides examples of these compounds wherein the alkanediyl bridge is a butyl bridge. FF7, FF8, FF10. Hill further teaches that its compounds "can be prepared by methods available to one skilled in the art." FF9.

Appellant points to a statement in Kodama that "minute structural differences result in big differences in anticancer activity." Reply Br. 2. While we acknowledge Kodama's general teaching that "it is known that the anticancer activity and anticancer spectra of compounds depend significantly on chemical structures and that minute structural differences result in big differences in these properties" in its section entitled "Problems to be Solved by the Invention," we are not persuaded that this statement would have dissuaded a skilled artisan from producing the compound of claim 7, in light

of Kodama's specific teachings discussed above and its teaching that its invention is a means to solve the problem described. Kodama 1:56–62.

Appellant contends that the Examiner's rejection is based on improper hindsight, improperly relied on inherency with respect to the limitation regarding palladium binding, and did not take due account of the unexpected results presented in the Specification. Reply Br. 3–4.

We are not persuaded. While “[a]ny judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning,” such reconstruction is proper “so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made and does not include knowledge gleaned only from applicant's disclosure.” *In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971). In this case, as discussed above, the Examiner's rejection is properly based on the teachings of the prior art.

Neither are we persuaded that the Examiner's reliance on inherency is improperly speculative. Reply Br. 3–4. The Examiner has shown that the cited prior art renders obvious a compound identical to that recited in claim 7. The properties of identical compounds are inherently the same in the absence of proof to the contrary. *See, e.g., In re Donohue*, 766 F.2d 531, 534 (Fed. Cir. 1985) (explaining that, “where . . . the [compounds] of [the cited prior art] are identical to the claimed invention, the properties of [the prior art] compounds are inherently the same as those of the claimed invention in the absence of proof to the contrary”).

We are further unpersuaded by Appellant's conclusory argument that “[t]here is criticality shown for all the elements required by formula (1) appearing in the claims” and that a prima facie case of obviousness has not

been established, “especially when the unexpected results presented in the specification are considered.” Reply Br. 3. As an initial matter, Appellant did not raise arguments regarding unexpected results in the Appeal Brief. Neither has Appellant explained why these arguments could not have been raised earlier. Thus, arguments regarding unexpected results are waived. *See Ex parte Nakashima*, 93 USPQ2d 1834 (BPAI 2010) (informative).

Moreover, “it is well settled that unexpected results must be established by factual evidence. ‘Mere argument or conclusory statements in the specification does not suffice.’” *In re Geisler*, 116 F.3d 1465, 1470 (Fed. Cir. 1997) (quoting *In re De Blauwe*, 736 F.2d 699, 705 (Fed. Cir. 1984)). Appellant fails to point us to specific evidence in the Specification that demonstrates the alleged *unexpected* results exhibited by the claimed invention.⁶

Finally, citing Section VI of MPEP § 2144.09, Appellant contends that Kodama’s phosphine ligand is “solely useful as an intermediate” for

⁶ We note that, although not cited in the Reply Brief, the Specification does provide an experiment comparing “inventive ligand 1” (bis(2-pyridyl-tert-butylphosphine)butane) and “comparative ligand 2” (bis(diadamantylphosphino)butane), wherein the Specification concludes that “[the] experiment shows that the inventive ligand 1 forms a catalytically active palladium complex which catalyses the alkoxy carbonylation of di-n-butene” whereas “[t]he structurally similar ligand 2 . . . is unsuitable for catalysing alkoxy carbonylation.” Spec. 16:5–26:9. To the extent Appellant is referencing this comparison in its arguments regarding unexpected results, we note that “when unexpected results are used as evidence of nonobviousness, the results must be shown to be unexpected compared with the closest prior art.” *In re Baxter Travenol Labs.*, 952 F.2d 388, 392 (Fed. Cir. 1991). The experiment in the Specification does not compare the claimed compound to, for instance, the compound of Kodama’s Example 1.

preparing the final anti-cancer agent; thus, “no activity [is] expected to be ‘maintained’ for the . . . homologue[s].” Reply Br. 3.

We are not persuaded. Section VI of MPEP § 2144.09 cites *In re Lahu*, 747 F.2d 703 (Fed. Cir. 1984), for the proposition that “if the prior art merely discloses compounds as intermediates in the production of a final product,” a skilled artisan “would not ordinarily stop the reference synthesis and investigate the intermediate compounds with an expectation of arriving at claimed compounds which have different uses.”

In *In re Lahu*, the invention relates to certain perfluoroalkyl sulfonyl chlorides and bromides useful as “corrosion inhibiting agents, surface active agents, and leveling agents.” 747 F.2d at 703. The prior art teaches certain 1,1-dihydroperfluoroalkyl sulfonic acids containing from two to five carbon atoms, which are useful as high energy fuels and in reactions such as base neutralization, alkylation catalysis, and metal cleaning. *Id.* at 704. The prior art also teaches a method of preparing the 1,1-dihydroperfluoroalkyl sulfonic acids from the hydrolysis of 1,1-dihydroperfluoroalkyl sulfonyl chlorides, which are preferably isolated before hydrolysis in order to obtain a purer sulfonic acid product. *Id.* The rejection is based on the structural similarity between the reference sulfonyl chloride compounds used to make the sulfonic acids and the claimed compounds. *Id.*

The *Lahu* Court held that the prior art reference “does not teach the isolation and investigation of the intermediate sulfonyl chlorides, but rather discloses, as an optional step, the isolation and purification of the intermediate to obtain a purer sulfonic acid end product.” *In re Lahu*, 747 F.2d at 707. The court further held that this is “not motivation sufficient to support the structural obviousness rejection,” because

[t]he mere fact that [prior art] sulfonyl chlorides can be used as intermediates in the production of the corresponding sulfonic acids does not provide adequate motivation for one of ordinary skill in the art to stop the [prior art] synthesis and investigate the intermediate sulfonyl chlorides with an expectation of arriving at appellants' claimed sulfonyl halides for use as corrosion inhibiting agents, surface active agents, or leveling agents.

Id.

In this case, however, the bisphosphines of Kodama and Hill are not mere intermediates that no longer exist once the final prior art product is formed. Rather, the bisphosphines are ligands that complex with the metal ions and therefore remain part of the anticancer complex. In contrast, the intermediate in *Lalu* was chemically hydrolyzed to form a different compound. In Kodama and Hill, the bisphosphines are not structurally changed as in *Lalu*, but rather complex with the metal by electron donation (Ans. 10). The bisphosphines are not merely serving as chemical intermediates, but rather are the functional and active moiety complexed to the metal.

Thus, the bisphosphines in this case are known to have an anticancer utility apart from their usefulness as a starting material or an "intermediate" in a reaction. Moreover, unlike *Lalu* where the prior art reference provides no motivation to "investigate the intermediate sulfonyl chlorides with an expectation of arriving at appellants' claimed sulfonyl halides," in this case Kodama and Hill explicitly provide a reason why a skilled artisan would replace the ethyl bridge with a butyl bridge in the bisphosphines, with a reasonable expectation of success at arriving the claimed compound, because Kodama teaches that the alkyl bridge between the phosphorus atoms of its bisphosphines may be a butyl bridge, and Hill similarly provides

examples of transition metal phosphine complexes comprising bisphosphines having a butyl bridge between its phosphorus atoms. FF1, FF2, FF7–FF10.

B. Improper Markush grouping rejection (claim 1)

1. Issue

The Examiner finds that the members of the Markush group recited in claim 1 “do not share a substantial [structural] feature and/or a common use that flows from the substantial structural feature,” because “[t]he only non-variable atoms in Formula I are the butane chain and two phosphorus atoms,” and “[t]his structure is insubstantial to the disclosure of the compounds in the specification.” Ans. 7 (emphasis omitted).

More particularly, the Examiner finds that the Specification discloses only a single example compound (i.e., the compound of claim 7), whereas claim 1 is “so expansive that a common utility cannot be expected” of the encompassed compounds, particularly because it is known in the art that catalysis is an unpredictable, that heteroaryl groups have different properties depending on its heteroatom(s), and that “changing substituents on phosphorus ligands,” which may result for instance in changes in steric effects, “can cause marked changes in the behavior of the free ligands and of their transition metal complexes.” Ans. 8–10.

Appellant disputes that claim 1 is drafted in improper Markush group format.

The issue with respect to this rejection is whether a preponderance of the evidence of record supports the Examiner’s rejection of claim 1 as containing an improper Markush grouping of alternatives.

2. Analysis

“A ‘Markush’ claim recites a list of alternatively useable species” regardless of format. 76 Fed. Reg. 7162, 7166 (2011) (footnote omitted). “A Markush claim contains an ‘improper Markush grouping’ if: (1) The species of the Markush group do not share a ‘single structural similarity,’ or (2) the species do not share a common use.” *Id.* “Members of a Markush group share a ‘single structural similarity’ when they belong to the same recognized physical or chemical class or to the same art-recognized class.” *Id.* “Members of a Markush group share a common use when they are disclosed in the specification or known in the art to be functionally equivalent.” *Id.*

We are not persuaded that the Examiner has established a prima facie case that claim 1 contains an improper Markush grouping. The Examiner asserts that “[t]he only non-variable atoms in Formula I are the butane chain and two phosphorus atoms” and that “[t]his structure is insubstantial to the disclosure of the compounds in the specification.” Ans. 7.

However, the Specification states that the invention relates to butyl-bridged diphosphine compound and teaches that bidentate diphosphine compounds are typically used as ligands to modify a palladium catalyst for alkoxy carbonylation reactions. Spec. 1:10–22. The Specification further states that “butyl-bridged diphosphine compounds substituted by at least one heteroaryl radical on at least one phosphorus atom” are “particularly suitable as bidentate ligands for palladium complexes and lead to elevated yields in the alkoxy carbonylation of ethylenically unsaturated compounds, especially of C₈ olefins.” *Id.* at 2:13–16. Accordingly, we are not persuaded that the butyl-bridged diphosphine structure is “insubstantial” to the disclosure of the compounds in the Specification.

Furthermore, we note the structural similarity of the claimed compounds extends beyond the butane chain and phosphorus atoms, because claim 1 also limits the substituents R1–R4 that may be used in the claimed compounds.

The Examiner asserts that, although claim 1 defines “R1 and R3 . . . as heteroaryl having 6 to 10 ring atoms,” the claim nevertheless contains improper Markush grouping because (1) this definition of R1 and R3 encompasses a large number of species whereas the Specification provides only one example, pyridine; (2) “it is the heteroatom which imparts to a heterocyclic its distinctive and sometimes striking properties”; and (3) “[i]t is well known that molecular structure is correlated with physical properties and in particular in heterocyclic chemistry the change from one ring to another often results in dramatic changes in properties.” Ans. 8–9.

Although we acknowledge the Examiner’s point, we are not persuaded. As the predecessor to our reviewing court has explained, “[i]t is evident that in any Markush group, the compounds which are included will differ from each other in certain respects” and that “[i]n determining the propriety of the grouping, those differences must, to some extent, be weighed against the similarities.” *In re Jones*, 162 F.2d 479, 481 (CCPA 1947). Moreover, “[i]n determining the propriety of a Markush grouping . . . the compounds which are grouped must each be considered as a whole and should not be broken down into elements or other components,” in part because “[w]hether or not one portion of a compound is considered more important than another depends upon the purpose for which the compound is intended.” *Id.*

In this case, even though we take the Examiner's point that the identity of the heteroatom may provide the heteroaryl with distinctive properties, we are not persuaded that the Examiner has provided evidence sufficient to show that the claimed compounds, wherein R1 and R3 are heteroaryl having 6 to 10 ring atoms, do not have "a community of chemical or physical characteristics' which justify their inclusion in a common group," or that such inclusion is "repugnant to principles of scientific classification." *In re Jones*, 162 F.2d at 482.

The Examiner also asserts that "the alkyl group in the elected species is quite bulky and appears to be essential for the catalytic activity," whereas claim 1 allows R2 and R4 to be any C1 to C4 alkyl. Ans. 9.

We are not persuaded for reasons similar to those discussed above with respect to the Examiner's reasoning regarding R1 and R3. The Examiner cites evidence that "changing substituents on phosphorus ligands can cause marked changes in the behavior of the free ligands and of their transition metal complexes," including in their catalytic effect with regard to, e.g., reaction rate and product composition. Ans. 9-10. The Examiner has not cited persuasive evidence, however, that compounds of claim 1, wherein the R2 and R4 group are selected from -(C1-C4)-alkyl, would not function as catalysts, or that a skilled artisan would not consider such compounds to "belong to the same recognized physical or chemical class or to the same art-recognized class." *See* 76 Fed. Reg. at 7166.

The Examiner asserts that, despite the fact that "[c]atalysis is generally considered unpredictable merely from the chemical nature of the catalyst," only a single example compound is disclosed in the Specification. Ans. 7-8. The Examiner asserts that "[t]he claim[is] so expansive that a

common utility cannot be expected.” *Id.* at 8. The Examiner asserts that “[b]y appellant’s own admission other compounds do not work” to catalyze alkoxyacylation, including “catalysts of this formula.” *Id.* at 8, 9. The Examiner further cites to Appellant’s statements in the Appeal Brief that the prior art references do not suggest that their compounds are useful as active catalysts and that the Specification suggests that 2-pyridyl may play a role in the catalysis. *Id.* at 15.

We are not persuaded. To the extent the Examiner refers to Appellant’s statement that “ligand 2” is “unsuitable for catalysing alkoxyacylation,” we note that ligand 2 refers to bis(diadamantylphosphino)butane, which does not appear to fall within the scope of claim 1 because its R1–R4 are each adamantyl, which are neither heteroaryl nor a –(C1–C4)-alkyl. Similarly, Appellant’s statements that a particular R1/R3 group (2-pyridyl) may play a role in the catalysis, or that prior art fails to disclose the catalytic function of similar compounds, are not admissions that compounds of claim 1 do not share a single structural commonality or common use. Finally, the mere facts that only a single example is disclosed in the Specification or that the claim encompasses a large number of species do not, by themselves, suffice to show that members of the Markush group do not share a single structural similarity and/or common use, which is the standard for determining whether a Markush group is improper.

Accordingly, we reverse the Examiner’s rejection of claim 1 as containing an improper Markush group.

CONCLUSION

In summary:

Claims Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
1, 7	103	Kodama, Wislicenus, Hill	1, 7	
1		Improper Markush Group		1
Overall Outcome			1, 7	

TIME PERIOD FOR RESPONSE

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

AFFIRMED